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## PREFACE

Sustainable agriculture is "a way of practicing agriculture which seeks to optimize skills and technology to achieve long-term stability of the agricultural enterprise, environmental protection, and consumer safety. It is achieved through management strategies which help the producer select hybrids and varieties, soil conserving cultural practices, soil fertility programs, crop rotations, weed, pest and disease biological management programs, and strategic use of animal and green manures and use of natural or synthetic inputs in a way that poses no significant hazard to man, animals, or the environment. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, and to communities affected by this farming system both locally and globally. The goal of sustainable agriculture is to minimize adverse impacts to the immediate and off-farm environments while providing a sustained level of production and profit. Sound resource conservation is an integral part of the means to achieve sustainable agriculture.

Sustainable agriculture integrates three main goals--environmental health, economic profitability, and social and economic equity. A variety of philosophies, policies and practices have contributed to these goals. People in many different capacities, from farmers to consumers, have shared this vision and contributed to it. Despite the diversity of people and perspectives, the following themes commonly weave through definitions of sustainable agriculture.

Sustainable agriculture presents an opportunity to rethink the importance of family farms and rural communities. Economic development policies are needed that encourage more diversified agricultural production on family farms as a foundation for healthy economies in rural communities. In combination with other strategies, sustainable agriculture practices and policies can help foster community institutions that meet employment, educational, health, cultural and spiritual needs. By helping farmers to adopt practices that reduce chemical use and conserve scarce resources, sustainable agriculture research and education can play a key role in building public support for agricultural land preservation. Educating land use planners and decision-makers about sustainable agriculture is an important priority.

Consumers can play a critical role in creating a sustainable food system. Through their purchases, they send strong messages to producers, retailers and others in the system about what they think is important. Food cost and nutritional quality have always influenced consumer choices. The challenge now is to find strategies that broaden consumer perspectives, so that environmental quality, resource use, and social equity issues are also considered in shopping decisions. At the same time, new policies and institution must be created to enable producers using sustainable practices to market their goods to a wider public.

We are yet a long way from knowing just what methods and systems in diverse locations will really lead to sustainability. In many regions of the country, however, and for many crops, the particular mix of methods that will allow curtailing use of harmful farm chemicals or building crop diversity, while also providing economic success, are not yet clear. The stage is set for challenging not only farm practitioners, but also researchers, educators, and farm industry.

New policies are needed to simultaneously promote environmental health, economic profitability, and social and economic equity. For example, commodity and price support programs could be restructured to allow farmers to realize the full benefits of the productivity gains made possible through alternative practices. Government and land grant university research policies could be modified to emphasize the development of sustainable alternatives. Marketing orders and cosmetic standards could be amended to encourage reduced pesticide use. Coalitions must be created to address these policy concerns at the local, regional, and national level. In addition to strategies for preserving natural resources and changing production practices, sustainable agriculture requires a commitment to changing public policies, economic institutions, and social values. Strategies for change must take into account the complex, reciprocal and ever-changing relationship between agricultural production and the broader society.

Critical discussion of the sustainable agriculture concept will and should continue. Understanding will deepen; answers will continue to come. On-going dialog is important for another reason: with more parties, each with its own agenda, jumping into the sustainable agriculture "tent," only a continued focus on the real issues and goals will keep sustainable agriculture from becoming so all-encompassing as to become meaningless.

Finally, it is important to point out that reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, laborers, policymakers, researchers, retailers, and consumers. Each group has its own part to play, its own unique contribution to make to strengthen the sustainable agriculture community.

**Dr. Mithat DIREK**



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## THE CURRENT STRUCTURE OF WHEAT SUPPLY NETWORK AND STAKEHOLDERS' ACTIVITIES IN KONYA

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### ABSTRACT

Food industry has been importing agricultural raw material due to purchasing high quality in domestic. The objective of this study is to describe current structure of wheat supply and stakeholders' activities in order to increase quality of wheat. Konya where 10% of Turkey' wheat production occur has been chosen as survey area in 2014-2016. The current structure of wheat supply and the activities of stakeholders for high quality wheat were described as results of 103 questionnaires and analyses of 3200 samples. The database of wheat producers and amount of production areas as Ministry of Food, Agriculture, and Livestock (FAL) records were used for stratified sampling. Konya province was classified as seven homogeny wheat production areas with respect of PESTEL analysis and 103 questionnaires implemented to wheat producers. The results are important for reaching high quality wheat production, reducing wheat import, and domestic supply. The competitiveness of flour industry can be increased by the steps of establishing digital wheat supply database, supply chain network optimization, and integration of food and agriculture via e-governance. Integration of food, agriculture, and other stakeholder via e-governance will provide management opportunities of high yield, productivity, price, and quality for profit maximization.

**Keywords:** Wheat, Supply, Network, Stakeholders, Quality

### INTRODUCTION

Agribusiness is the main occupation for 65% of industry based open on agriculture in Turkey. The share of industry and services has been rising constantly. The climate and geographical indicators of Turkey are allows to produce any kind of crops, and different farming systems conducted in different regions. There were determined seven agro ecological regions such as Eastern Anatolian, Central Anatolia, Black sea, Mediterranean, Aegean, Marmara, and Southeastern Anatolia regions and 30 agro ecological zones. Tropics-warm, tropics-cool/cold/very cold, Subtropics-warm/mod cool, subtropics-cool, subtropics-cold, subtropics-very cold, temperate-cool, temperate-cold, temperate-very cold, boreal-cold, boreal-very cold, and artic regions of the world were identified by FAO. Conservation of natural resources, climate changes, energy saving, genetic resources and biodiversity, geo-information, global agro ecological zones, land resources, land tenure, research and extension, sustainability pathways, and water resources management are main concern for food, agriculture, and livestock in Turkey. Animal products (aquaculture, cattle and beef, dairy, poultry and eggs, sheep, and lamb) and crops (Corn, cotton and wool, beans, fruit and tree nuts, potatoes, and oil crops, sugar, vegetables and melons, and wheat) are main agricultural activities of farms as raw material of food industry. Also, hunting, forestry, and fishing are agricultural related activities. Both, agriculture and agricultural related activities are the way to produces raw material for food industry. Food industry mainly based on agricultural raw material for food and nutrition such as child nutrition, food and nutrition, food security, poverty and income volatility, supplemental nutrition, and food safety. Labeling and information policy, market incentives, government regulation, and response to incidents are some practices to reach food safety. Also, food quality is mainly based on agricultural raw materials where integration of agricultural production, raw material processing, agro-marketing, food consumption, recycling, and resource necessary agribusiness. In the agribusiness as system approach, food safety, international markets, global food security, macroeconomic indicators, and trade policy have been pushing people to increase quality of agricultural raw materials where the quality of agricultural raw materials related to natural resources and environment and climate change, conservation, environmental quality, invasive species and organic agriculture are important indicators of quality. As a result, comprehensive analysis of food industry get starts with the productivity growth of agricultural raw material, competitiveness, and general structural change.

The objective of this study is to describe current structure of wheat supply and stakeholders' activities as first step of increasing wheat quality for flour industry. Konya where 10% of Turkey wheat production occurs has been chosen as survey area. Selcuk University collaborated with Ova Un Company and Ministry of Science, Industry, and Technology in the study as SANTEZ program. The application of agribusiness management principles has been chosen as essential for productivity and quality assurance. Researchers collaborated on this study are from different sciences (natural sciences, social sciences, and engineering sciences) as essential components of agribusiness management for the objective that food safety and security through human sciences applications (believe, position, and behaviors) as individual, family, public, and communities development. This

paper attempt to analyze the current structure of wheat supply network and stakeholders' activities in Konya province.

The research looks toward an imagined future and make various assessments and judgments on the basis of possible future of wheat quality for flour industry in Turkey. As an important part of prospective, establishment of wheat quality via PF technology was chosen as goal. The goal is associated with collaboration within flour industry, wheat farmers, and the other stakeholders. Integration of agriculture and food industry is an important aspect of agribusiness as value chain. The integrated features of flour industry recognize as prospective of professional company, Ova Un Factory, support to the project as their real-life cases to explore the question on increasing wheat quality, the research contacted in Konya province for achieving wheat quality in the province.

## MATERIAL AND METHOD

On the basis of flour company assumption for bread wheat quality, this study was established 31 towns of Konya province as seven homogeny wheat production groups such as 1. Group Cihanbeyli, Kulu, 2. Group Hadim, Taşkent, Bozkır, 3. Group İlgin, Doğanhisar, Akşehir, Tuzlukçu, Yunak, Çeltik, 4. Group Karapınar, Emirgazi, Ereğli, Halkapınar, 5. Group Karatay, Çumra, Güneysinir, 6. Group Meram, Akören, Beyşehir, Seydişehir, Derebucak, Ahırlı, Hüyük, Derbent, Yalihüyük and 7. Group Selçuklu, Sarayıönü, Altınekin, Kadınhanı. In the PESTEL (Politic, Economic, Social, Technological, Ecological, and Legislation) framework, the model consists of supply chain networking and e-governance via ICT and PF application.

The current structure of wheat supply and the activities of stakeholders for high quality wheat supply were described as results of 103 questionnaires. The database of wheat producers and amount of production areas as farmer record system were used for stratified sampling. Konya province as 31 towns was described seven homogeny wheat production areas and the questionnaires implemented to wheat producers as well as the other stakeholders. The wheat quality data were collected from 3200 wheat farmers in 2014. Project supported by Ministry of Science, Industry, and Technology as well as Ova Un Company. The theoretical, experimental, and computational sciences were used to bring computing science where big data create significant agribusiness management. Scientists, strategists, researchers, and practitioners have been studying on wheat quality. The implementation of operations management in agribusiness such as design, operation, and improvement of the system were chosen as tool of study objectives for agricultural advisory services creation and deliver. Systematic approach of organization processes, career opportunities, cross functional applications, business education, agribusiness system (Farming System Research and Extension-FSRE), and operations as a service were define for profit maximization or cost minimization. Information and Communications Technologies (ICT) were accepted as tools of the objective. Imagine processing techniques were considered as operations management tool too. Operations were design as contribution of managers, operations managers, and directors. Also, operations management was accepted to cover the core services that the customers' wants from products such as color, size, and shape. The performances of core services for agribusiness management were determined product quality, service speed, cost reduction, and flexibility. New contributors of Operations Management and building new relationship with producers were accepted to be value added of services that covers information, field support, problem solving, and sales support. Agribusiness management decision were described by strategic (long range > 1 year), tactical (< 1 year horizon), and operational (frequently on hourly or daily basis) principles in value chain of wheat. With system approach, establishing e-governance is target of this study within wheat farmers, flour industry, and other stakeholder.

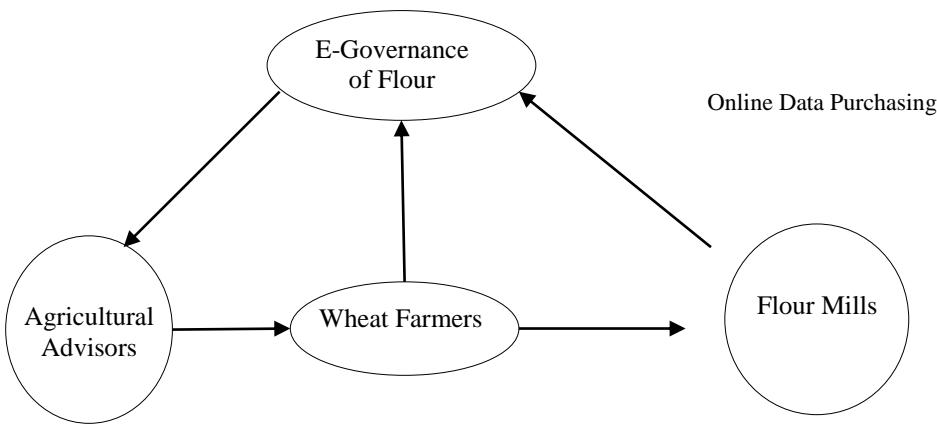
Information and Communication Technologies (ICT) and Precision Farming (PF) technologies were chosen the tools of agribusiness value chain management for the goal of high quality as well as productivity. E-governance agribusiness was formed through a variety of signs such as the supply chain features, marketing strategies, and operating style. The assumptions of this study can be made as the following; H1: E-governance of agribusiness has a positive impact on online quality management of raw material production. H2: E-governance of agribusiness has a positive impact on quality management of raw material production as satisfaction of wheat producers and flour industry. High quality wheat production expectation is the level of expectation between wheat producers and flour companies as important standards of wheat quality. E-governance offers farmers cost-effective production and services to guarantee quality and the other satisfaction.

## RESULTS AND DISCUSSION

The survey of 103 questioners and 3200 sample of wheat quality analyses were used as first source of the study. The literatures on wheat quality, data at wheat analyses laboratory, and experiences of Konya Commodity Exchange, and International Bahri Dagdas Research Institute were used as secondary source of the study. Many things were observed as sense to find out other objects, events, or living things for wheat supply networks and stakeholders' activities in Konya. Beside former literatures, some direct observation as survey and questionnaires results can be summarized as follows;

- Meram, Cumra, and Sarayonu towns are wheat producers but, they have been replacing wheat with corn, potato, sunflower for the purpose of high income and income diversity. Immigrant labor is low cost of labor which support for other crops production rather than wheat in the area. The revenue of wheat production was calculated 120 dollar, and the fertilizer cost was 25% of total production cost per dekar. The seed price is 42% higher than wheat price. The price of high quality wheat was 11% higher than the average price.
- There are old railroad which establish in the first years of Turkish Republic from Aksehir, Ilgin, Kadinhani, Sarayonu, Konya Selcuklu, Cumra, Karaman, and Eregli. Ten storages of Turkish Grain Board are in the railroad location that may give opportunities of wheat transportation via railroad and currently idle. The wheat producers prefer flour factories in the city center instead of towns' factories. Also, most of flour factories don't prefer buying wheat from farmers directly due to financial support and risk since wheat import release whenever the price increases. Wheat production cost is higher than many countries. The constrain of establishing new flour factory in Middle Anatolia Region, high transportation cost, low quality of wheat, lack of wheat quality classification, and lack of financial support are some risk elements for sustainability of wheat production in Konya province. Opposite of risk, there are some programs such as KOP new irrigation, railroad transportation, legislated storage support, PF technology application, agricultural advisory system, idle public land, basin based financial supports, and big bag storage may increase sustainability of wheat production in Konya.
- More than 35% of wheat producers have been producing more than 50 tons wheat a year. There are about 32 farmers who produce more than 400 dekar wheat a year in Konya. Most wheat producers (65% of bread wheat producer) have been producing less than 50 tons wheat a year.
- Guneysinir and Yunak towns are mainly big scale production area of wheat. The average wheat production area is about 200 dekar (1000 square meter) and e-governance can be applied on more than 50% of wheat land which in Konya province. The wheat production land is about 40% irrigated and 94% of farmer's growth bread wheat.
- High protein of wheat (>15) measured from samples that collected from Celik, Yunak, Aksehir, Doganhisar, and Ilgin. Low protein of wheat (< 15) measured from samples that collected from Huyuk, Derbent, Beysehir, Derebucak, Seydisehir, Ahirli, Yalihuyuk, Hadim, and Bozkir towns where production of wheat is less than other towns. The flour company prefers wheat protein between 11-13 since higher is hard for processing. Hectoliter is also important for flour companies since sometimes they did not prefer hectoliter less than 73 and less protein.
- Supply chain network; manufacturers, warehouses, factories, wholesalers, distributors, retailers and final consumers and the connection between the movement is a set of relationships that enable. Most of wheat producers (83,5%) supply wheat directly to the markets and just 16,5% of wheat producers store wheat for 4-9 months after harvesting since they have low cost storage advantages.
- The annual storing cost of wheat is less than 10% of the total production cost. The effect of storing on wheat price increasing is about 6-41% of average price based on import. Most of wheat producers (77%) believed that the competitiveness based upon wheat quality is very high for wheat market. High quality wheat mainly preferred by brokers (82%) and flour companies (16%), where 2% is Turkish Grain Board (TMO), and Konya Commodity Exchange.
- The most important problem is the complexity of supply chain management and complexity arises from the variability and uncertainty via external of Konya province. The complexity of supply chain in internal and external environment occurs based upon domestic price and quality. Wheat production is preference of farmers as least area or spatial uses.
- Maximum storage is not the case since quickly meet demands exist in national and international markets. There is minimal waste for wheat since wheat uses for different purposes such as feed, biofuels, etc.
- Supply chain network is effective way of active delivery and minimal none delivery.
- Establishing classic warehouse where production or sales points located in same province need collaboration within universities, farmers organization, and flour factories via ICT and PF technologies application as well as agricultural advisories in e-governance of agribusiness.
- There are two big companies for wheat delivery as distribution center where closer to small farmers and rapid product deliver to flour factories.
- Konya Commodity Exchange is suppliers point closer to wheat producers like consolidation center in terms of units sold over the internet.

- High quality wheat acceptances, managing wheat quality in the fields, and reservation or contract farming are variables of supply chain networks.
- Wheat area management is requiring security of high quality management as site specific management (PF). Konya Commodity Exchange and brokers are necessary for PF applications in order to create value added of supply networks.
- The costs of transportation, storage, and stock handling are lower. Increasing level of farmers' services such as agricultural advisory for high quality wheat growth will reduce wheat import from different region and nations.
- Wheat supply chain and the competitiveness of food industry were described via establishing digital supply database, supply network optimization, and integration of food and agriculture via e-governance as future steps of this study.
- E-governance of food industry, agriculture, and other stakeholder integration will provide opportunities of managing high yield, productivity, price, and quality for profit maximization (Figure 1).



- E-governance can cover stakeholder relations (processing and packaging company, universities, research centers, chambers), and advisors (contract farming with farmers, and marketing to agro industrial companies and trade companies) for quality ensuring in the field via Precision Agricultural (PF) technologies where traditional production, conventional production, organic production, biotechnologies, and precision farming technologies change the value chain of wheat.
- PF technologies create sustainability of agriculture and optimum uses of input in right place and right time are the first purposes for PF which moving to be uses for system management.

Wheat supply chain actors and roles played in Konya can be summarized as it in Figure 2.

Actors	The major roles of actors	The characteristics of actors
Wheat producers	Wheat production on average Transportation of wheat to the flour factories, brokers, Turkish Grain Board (TMO), and Konya Commodity Exchange. Engage in farm practices via PF technologies	Mainly middle and big holders Use technological farm implements Specialize in 5-6 varieties of wheat Mainly sells wheat to retailers and flour factories
Traders	Involved in collection of wheat from farms to collection points, Konya Commodity Exchange, and other markets	Operate on small scale transport and trade of wheat (about 20%)
Transporters	Offer transport services to traders	Operate in large scale
Bulk (lorry) traders	Involved in long distance transport of wheat from rural areas to major urban factories	Operate in large scale investments Act as a link between flour factories and wheat farmers
Retailers	Buy from farmers/traders and sell to processors in quality	Operate on big scale, major markets in the sectors
Importers	Overseas exporters are either involved in large scale production or buy from producers directly to ensure quality	Operate in large scale quality wheat Long term network with traders in other countries
Processors	Transformation of wheat to flour and flour products	Operate on big scale
Supply chain facilities	Storages, flour factories, commodity exchange Lack of Agricultural Advisory Services, value chain development, and funding of value chain activities	Activities along with others Research and development initiatives are separated
Consumers	Provide market for flour and flour' products	Households, bakers, restaurants

- Online supply chain management, online shopping, purchasing quality indicators in the fields, flour industry satisfaction for wheat quality, and farmers loyalty are endogenous variables where exogenous variables are data, data mining, and big data purpose of researchers and agricultural advisories. The influences of value chain as goods and money will be determined in further steps of the study.

## CONCLUSION

Improving farmers relations with flour factories, equitable sharing of wheat production risk, covering fixed costs variables as agricultural infrastructures, effectiveness of logistics activities and productivity, increasing flexibility of delivering, enhancement quick access rate of quality, time, and location are some indicators of e-governance of agribusiness. E-governance of agribusiness brings multidisciplinary studies within natural science, social science, and engineering science. Data mining uses for the management of resources, production, equilibrium, distribution, consumption, recycling, and again resources cycle where goods market, fiscal market, monetary market, stock market, and some related sectors occur. Both objectives require ICT and PF applications in agribusiness. Analyzing, visualizing, and disseminating require large data sets where computing is fourth paradigm in scientific discovery after theoretical, experimental, and computational science. The results of study are important sources of determination computing applications, characteristics, challenges, data grids, data centers, cost minimization design and management in agribusiness. Computational data, data mining, digital maps, and computing apps will be some outputs of this study in next year. Android Apps on Google Play for Decision Support System will be developed for agribusiness management. The results are important for the studies on reducing agricultural raw material import and supplying domestically. The competitiveness of food industry will be increased by establishing digital supply database, supply network optimization, and integration of food and agriculture via e-governance. E-governance of food and agricultural integration will provide opportunities of high yield, productivity, price, and quality for profit maximization. Operations strategy (introduction wheat location, monitoring growth, imagine processing), imagine design and wheat processing of flour company, supply chain design of core services, and control are the steps of reaching Electronic Operations Management for Agribusiness (E-Governance of Agribusiness). The study results as model of E-Governance of Agribusiness can be implemented for food industry in any country where internet technology and good service infrastructure existed. Economies of scale and scope, regional groups' demand, infrastructure factors, and competitive environment are different for each group of Konya towns. Expensive production technologies require large production area and more centralized production network. Lower fixed cost facilities of each regional group can be established easily. The infrastructure factors such as new manufacturing facilities and more transfer of raw material transportation facilities can be established based upon availability of necessary utilities such as power, water, and ICT. Selecting specific locations is determined by infrastructure and costs of labor, materials, facilities, transport, and inventory.

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## **FOOD INSECURITY IN AFRICA IN TERMS OF CAUSES, EFFECTS AND SOLUTIONS: A CASE STUDY OF NIGERIA**

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### **ABSTRACT**

The aim of this paper is to examine the increasing food insecurity in Nigeria and the implications on the stability of the country in particular and Africa in general. This study tries to x-ray the food insecurity in Nigeria and Africa in general. This is important in order to alert the stakeholders in the agricultural sector on the implications of the rising food insecurity in the country in recent years. In the course of the study, secondary data source from the Food and Agricultural Organization (FAO) of the United Nations were used by examining the trend of food insecurity from 1990 to 2014.

The findings of this study indicate that key food security indicators used for the study such as prevalence of undernourishment, food inadequacy and numbers of undernourished people are on the increase in Nigeria from the year 2009 to 2014 according to the latest survey. The implication of this is that if the trend is not halted as quickly as possible it is a time bomb that may pose great security risks and danger to the country and African sub-region as a whole being the most populous black nation. In order to prevent this, the immediate causes of the rising food insecurity as pointed out in the study must be identified while appropriate measures such as consistent policy framework for agriculture, provision of infrastructures, population control through birth control, provision of storage facilities and abolition of trade barriers among others are suggested to solve the food security challenges in Nigeria and by extension other African countries.

**Keywords:** Food insecurity, Prevalence of undernourishment, Africa, Nigeria

### **1. INTRODUCTION**

Food is one of the most important items in the world as it is critical to human survival together with clothing and shelter. These three items are usually classified as the man's basic needs. Food security in Africa has come under extremely threats due to some factors some of which are natural while some are artificial depending on the circumstances and the countries involved. A food-secure world is one where all people have access to safe, nutritious and affordable food that provides the foundation for active and healthy lives.

#### **1.1 Food Security**

The FAO defines food security as: "When all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." Nearly one billion people are undernourished, hungry and living without adequate daily calories (PAI, 2015).

Food security affects more than human health and welfare – it also contributes to economic and political stability as it is often noticed that most countries of the world where there is political instability are always associated with food insecure territories, the food insecurity in such countries might have been as a result of political instability or the political instability was as a result of food insecurity. One often led to the other but they go hand in hand in the affected areas. Food security has three aspects; food availability, food access and food adequacy.

#### **1.2 Food Insecurity**

Food insecurity exists when people lack sustainable physical or economic access to enough safe, nutritious, and socially acceptable food for a healthy and productive life. Food insecurity may be chronic, seasonal, or temporary. Food insecurity and malnutrition result in catastrophic amounts of human suffering. The World Health Organization estimates that approximately 60 percent of all childhood deaths in the developing world are associated with chronic hunger and malnutrition. In developing countries, persistent malnutrition leaves children weak, vulnerable, and less able to fight such common childhood illnesses as diarrhea, acute respiratory infections, malaria, and measles.

The United Nations estimates that about 805 million people – approximately one in eight – are undernourished as of 2014. The majority of these people live in developing countries, where more than 14 percent of the people are unable to meet their dietary energy requirements. Progress has been made in southern Asia, northern Africa

and most countries of eastern and southeastern Asia, as well as in Latin America. Feeding this growing global population in the years to come will require producing more food and distributing it in a manner that reaches more people (Cargill, 2014).

The root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty. While the rest of the world has made significant progress towards poverty alleviation, Africa, in particular Sub-Saharan Africa continues to lag behind. Projections show that there will be an increase in this tendency unless preventive measures are taken. Food security on the continent has worsened since 1970 and the proportion of the malnourished population has remained within the 33 to 35 percent range in Sub-Saharan Africa. The prevalence of malnutrition within the continent varies by region. It is lowest in Northern Africa with 4 percent and highest in Central Africa with 40 percent. (Angela, 2014).

### **1.3 Categories of Food Insecurity**

There are three main categories of food insecurity as classified by the Food and Agricultural Organization (FAO) of the United Nations.

- 1.3.1 Acute:** Sever hunger and malnutrition to the point that lives are threatened immediately (e.g. famine),
- 1.3.2 Occasional:** When food insecurity occurs due to a specific temporary circumstance,
- 1.3.3 Chronic:** Ability to meet food needs is consistently or permanently under threat.

## **2.0 MATERIAL AND METHOD**

This study was carried out using Nigeria as a case study being the most populous country in the African continent with estimated 172 million people and as such the country is more vulnerable to food insecurity considering the pressure on the available resources needed to ensure adequate and sustainable food supply to the populace. The study made use of mostly secondary data sourced from Food and Agricultural Organization (FAO) of the United Nations and other past survey works that have been carried out on similar topics. The key food security indicators such as prevalence of undernourishment, food inadequacy and numbers of undernourished people in Nigeria from the year 2009 to 2014 according to the latest FAO survey were used for the study and their respective trend were observed to give the appropriate judgment as to the food security status of Nigeria which is of great concern to the stakeholders in recent time.

## **3.0 RESULTS AND DISCUSSIONS**

### **3.1 State of Food Insecurity in Nigeria, Sub-Saharan Africa and the World At Large**

**Table 1** reveals that the latest estimates indicate that 805 million people – about one in nine of the world's population – were chronically undernourished in 2012–14, with insufficient food for an active and healthy life. This number represents a decline of more than 100 million people over the last decade and of 209 million since 1990–92. The vast majority of hungry people live in developing regions, which saw 42 percent reduction in the prevalence of undernourished people between 1990–92 and 2012–14, despite this progress, about one in eight people, or 13.5 percent of the overall population, remain chronically undernourished in these regions, down from 23.4 percent in 1990–92. The MDG 1c hunger target – of halving, by 2015, the proportion of undernourished people in the developing world – is within reach, but considerable efforts are immediately needed, particularly in countries where progress has stalled. Despite overall progress, large differences remain across developing regions. Eastern and South-Eastern Asia have already achieved the MDG hunger target. The same is true of Latin America and the Caribbean, while the Caucasus and Central Asia are on track to reach MDG 1c by 2015. Latin America and the Caribbean are also on track to reach the more ambitious WFS goal. By contrast, sub-Saharan Africa and Southern and Western Asia have registered insufficient progress to reach the MDG target. Sub-Saharan Africa has become home to more than a quarter of the world's undernourished people, owing to an increase of 38 million in the number of hungry people since 1990–92 (SOFI, 2014).

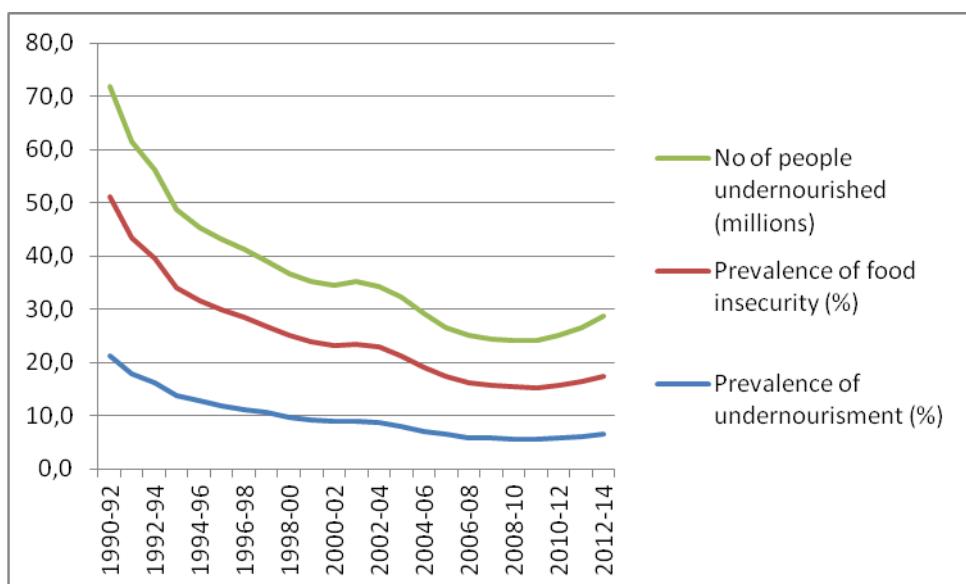
In the same vein, according to the Food and Agricultural Organization (FAO) as depicted in Table 2, the prevalence of undernourishment, food security and the number of undernourished people have been on increase in Nigeria since 2009 due to the enumerated causes as itemized below in Nigeria though with the current trend as depicted in this paper, Nigeria still remains one of the few countries with lowest value in terms of prevalence of undernourishment, food insecurity and the number of undernourished people in the sub-Saharan Africa thus one of the most food secured countries in the region. However, the current trend whereby these indicators of food insecurity keep on rising is worrisome and requires the immediate attention of the concerned authorities through the suggested solutions as listed subsequently in this paper.

**Table 1: Changing Distribution of hunger in the World: Number and Shares by Region (1990-92 & 2012-14)**

	Regions	Number (Millions)		Regional Share (%)	
		1990-92	2012-14	1990-92	2012-14
A	Developed Regions	20	15	2.0	1.8
B	Southern Asia	292	276	28.8	34.3
C	Sub-Saharan Africa	176	214	17.3	26.6
D	Eastern Asia	295	161	29.1	20.0
E	South Eastern Asia	138	64	13.6	7.9
F	Latin America &Caribbean	69	37	6.8	4.6
G	Western Asia	8	19	0.8	2.3
H	Northern Africa	6	13	0.6	1.6
I	Caucasus &Central Asia	10	6	0.9	0.7
J	Oceania	1	1	0.1	0.2
	<b>Total</b>	<b>1015</b>	<b>805</b>	<b>100</b>	<b>100</b>

Source: FAO, 2014.

**Figure 1: Prevalence of undernourishment and food security in Nigeria (1990–2014)**



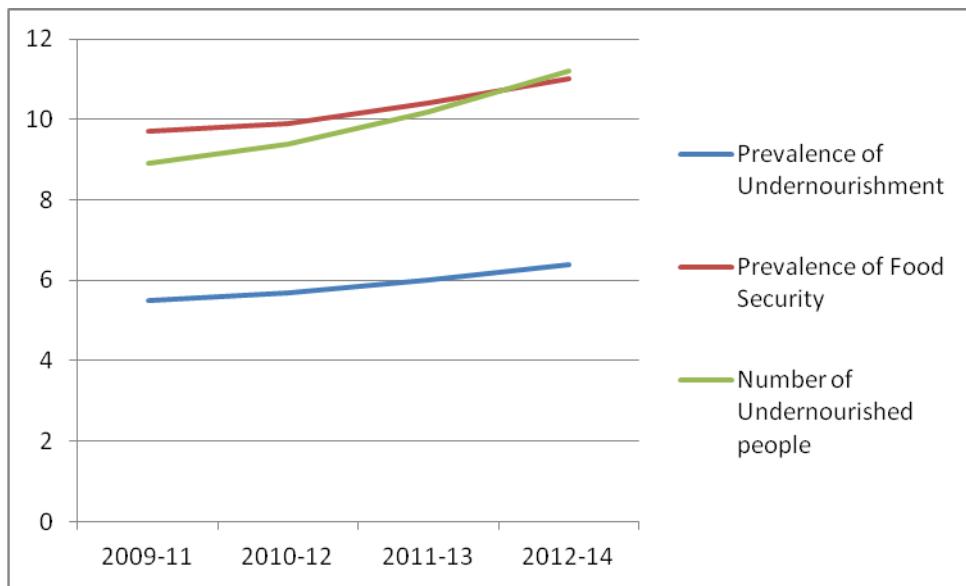
Source: FAOSTAT, 2014

**Table 2: Distribution of prevalence of undernourishment, food security and number of undernourished people in Nigeria between 2009 and 2014.**

Distribution	2009-11	2010-12	2011-13	2012-14
Prevalence of Undernourishment	5.5	5.7	6.0	6.4
Prevalence of Food Security	9.7	9.9	10.4	11.0
Number of Undernourished people	8.9	9.4	10.2	11.2

Source: FAOSTAT, 2014

**Figure 2: Graphical representation of prevalence of undernourishment, food security and number of undernourished people in Nigeria between 2009 and 2014.**



Source: FAOSTAT, 2014.

### 3.2 Causes of Food Insecurity

There are many causes of food insecurity in Africa. This presentation will limit the scope to that of Nigeria as presented in the above where it has been discovered that the food insecurity is on the rise since 2009 in the country which will give a template to the other African countries due to the fact that countries in Africa face similar challenges but only differ in magnitude. Some of the popular and common causes are itemized below:

#### 3.2.1 War and Political Instability

Of recent, the greatest threat to food security in Nigeria comes from the insurgency. As it is generally known that like other countries of the world, Nigeria is passing through one of her greatest challenges since independence from Britain in 1960. Of the six geo-political zones in Nigeria, the North East which is one of the critical zones that do not only provide the staple foods like grains, wheat and others but that is equally responsible for the provision of greater percentage of dairy products and animal protein in form of meat is currently under siege by insurgents. This has disrupted the agricultural activities in the areas while businesses worth millions of US Dollars have equally been halted. With this, the food security of the area is not only affected but almost every part of the country thus resulting to upward rising in the prices of food commodities in Nigeria. More than one million people have been displaced both internally and externally with more than ten thousand deaths. The remaining people in the affected areas are unable to continue their farming activities in the areas which had resulted in the alteration in the agricultural value chain in the country thereby resulting in reduction of food production. The problems started in 2009 and got escalated in the year 2014.

#### 3.2.2 Urbanization

Like other countries of the world, increasing rural-urban migration due to urbanization play key roles in the emerging food insecurity in Nigeria. According to Food and Agricultural Organization (FAO), by year 2050, 70 percent of the world population is expected to be living in cities. By this, the agricultural production will be disrupted thereby increasing the food insecurity.

#### 3.2.3 Population Growth

This is another factor responsible for food insecurity in Nigeria. Currently, Nigeria is the 6<sup>th</sup> populous country in the world with the estimated population of about 172 million people with annual growth rate of 2.8 percent. This has increased the demand for food products just like other countries of the world. With this glaring increase in the population, there is no commensurable increase in the agricultural production. According to the United Nations, Nigeria is expected to become third most populous country in the world by 2050 overtaking America (The Guardian, June 13, 2013).

### **3.2.4 Poor Agricultural Sector Development**

This is another problem that poses great threat to food security in Nigeria and Africa as whole. Most African countries including Nigeria do not have sustainable Agricultural policy that will enhance food security in the long run. This is so because in Nigeria and majority of African countries as a whole until recently do not have stable leadership thereby resulting to policy somersault. Nigeria for example has not been on stable political leadership until 1999 when the country returned to full democracy devoid of military intervention. This has led to inconsistencies in policies that could have placed the country on a stable track that could have ensured that there is uninterrupted food supply. However, the opposite is the case as successive governments have engaged in different agricultural policies that have led to cancellation of the existing ones even when the extant ones proved prosperous and sustainable. Some government policies interfere with markets, create standards that inhibit trade and remove price signals to farmers. Export restrictions and trading bans isolate local markets and give farmers little incentive to expand production for the next season, limiting the potential supply response to soaring prices.

### **3.2.5 Climate Change**

Climate Change is another reason why there is food shortage in Africa. It has changed the productivity pattern. The rain and water is less predictable now than before. The rain comes either too late or too early or for a shorter period. Farmers are confused and do not know when to cultivate their grains and other vegetables. Some years, the rain comes too early and when they plant the grains, the rain stops and the grains rot under the ground.

## **3.3 Effects of Food Insecurity**

In developing countries, persistent malnutrition leaves children weak, vulnerable, and less able to fight such common childhood illnesses as diarrhea, acute respiratory infections, malaria, and measles. Adolescents and adults also suffer adverse consequences of food insecurity and malnutrition. Malnutrition can lead to decreased energy levels, delayed maturation, growth failure, impaired cognitive ability, diminished capacity to learn, decreased ability to resist infections and illnesses, shortened life expectancy, increased maternal mortality, and low birth weight.

Food insecurity may also result to political instability just as food-insecure individuals may manifest feelings of alienation, powerlessness, stress, and anxiety, and they may experience reduced productivity, reduced work and school performance, and reduced income earnings. Household dynamics may become disrupted because of a preoccupation with obtaining food, which may lead to anger, pessimism, and irritability.

## **3.4 Suggested Solutions to the Problems of Food Insecurity**

Researchers and other stakeholders have consistently worked on the way forward for the lingering food crisis in Africa sub-region including Nigeria. In order to mitigate the effects of food insecurity on the people there should be proactive actions on the side of the leaders with a view to protecting their people from starving to death as we are currently witnessing in some African countries including Nigeria. To achieve this among other things, this paper will like to suggest these few things among other numerous ways of reducing the incidence food insecurity in Nigeria and other African countries;

### **3.4.1 Consistent Policy Framework**

First and foremost, the leaders must adhere strictly to unique agricultural policy that will be subjected to periodic review by experts concerned instead of the current policy somersault as we are currently witnessing. Once this is achieved, the successive governments will be able to pursue the food security with the desired vigour.

### **3.4.2 Provision of Infrastructures**

Provision of social amenities such as roads, portable water, electricity, etc. should be provided to the rural dwellers to prevent or reduce rural-urban migration as this will ensure there is adequate labour for agricultural activities in the rural areas thereby increasing food productivities that will not only guarantee food security but will equally provide employment opportunities to the growing population in a way that it will reduce the pressure in the urban centers. Under this, the government should also encourage mechanized farming as a way of reducing the incidence of food insecurity as all over the world now agriculture is a serious business enterprise and the world has moved beyond the era of subsistence farming whereby agriculture is seen as feeding the immediate family with little or nothing for income drive. Modern agriculture is not only feeding the family but the world and is generating millions of employment and veritable source of income to both the farmers and source of foreign exchange to many countries of the world.

### **3.4.3 Population Control**

Just like other African countries where poverty is rampant, population is majorly uncontrolled as the methods of achieving this menace such as contraceptives is still unpopular especially in the rural areas thereby resulting to population surge among the people thus encouraging undue competition for insufficient food. Government and other

development partners such as world bank, UNICEF, FAO, WFP and others should rise up to assist the government in educating people on birth control so that there can be food security guaranty.

### **3.4.4 Provision of Storage Facilities**

To avoid waste that usually accompany harvest season in Nigeria, government should do everything possible to ensure there is adequate provision of processing and storage facilities for Agricultural products so that there will be all year round food security and in turn boost the income level of farmers thereby reducing poverty which is the ultimate goal of the Nigerian government just like any other African government. The current situation in Nigerian has become so worrisome to the extent that vast majority of the harvested crops waste away during the farm season while huge amount of money is being used by the government to offset the import bills of the same commodities during the off season.

### **3.4.5 Abolition of Trade Barriers**

There should be free trade across the African borders to guarantee free flow of food commodities across borders. Though, there are various extant trade agreements with other African countries especially the western Africa but the enforcement across nations has been very weak. If these trade agreements are fully operational the food insecurity will not only be minimized in Nigeria but in other African countries.

## **4.0 CONCLUSION**

The problem of food insecurity must be seen as a security threats to not only to the country but also to the continent as a whole thereby prompting each country to device means aimed at reducing the menace headlong so as to prevent possible negative consequences that usually accompany food insecurity in countries that have suffered unrest before. If the problem is attacked with all seriousness by implementing the recommendations of various policy makers then the continent will be self sufficient in terms of food security.

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## **AN ANALYTICAL STUDY OF SOME DIMENSIONS FOR THE FUTURE VISION OF AGRICULTURAL DEVELOPMENT IN EGYPT**

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### **ABSTRACT**

The agriculture sector is the only source of food, and water is the major nerve of this sector and in light of the increasing pressures and emanating from the steady increase in population and the boat about 90 million people, which represents a severe pressing the need to get rid of these pressures, particularly in the long term, through a clear strategy of the Egyptian Agricultural Development.

### **INTRODUCTION**

And a closer look, we find that the water resources is the real nucleus of the events of the desired agricultural development, which is why this vision to focus on the development of water resources available currently and raise the efficiency of use through the achieved savings from re-crop Egyptian installation holly planning agricultural yield and achieved economic stability in the Under included tracts horizontal agricultural expansion and what it requires to make the necessary resettlement policies to ensure the exit of the narrow valley and stability in the new areas in addition to the environmental dimension and of intervention agencies concerned of the state of development of legislation and pass legislation for the protection of the environment from pollution and to follow preventive roads laws for the safety of public health and thus achieve balanced agricultural development.

### **RESULTS AND DISCUSSION**

And in the light of the above can be referred to four major axes depend on this vision to achieve agricultural development strategy in Egypt as follows:

1. The water used in agriculture and the provision of raising the efficiency of their use.
2. Propose some exploitation patterns and agricultural resettlement in Egypt.
3. Determine the compositions less risky crop.
4. Environmental dimension.

The following is a presentation of these themes in the light of the results of a concerted one of the previous studies on water resources and mainly the results of some other studies related to other axes of this vision.

#### **First, the provision of water used in agriculture and raise the efficiency of use.**

It is known that the concerned authorities of water resources and Kwazzrat bodies and research institutes are searching and prospecting for new sources of water Kthalih sea water and sewage treatment and agricultural drainage water, etc.. and that water and fill the deficit, which amounted to about 19 billion cubic meters in 2010, is that the concept of development of water resources in the light of the future vision is achieved through the provision of water resulting from the re-installation planning crop Egyptian particularly in light of the stability of water resources around 59 billion cubic meters (including the Nile River, the reservoir deep underground , rain and floods, and desalination), according to statistics of the Ministry of Water Resources and Irrigation in 2010.

As the following table indicates a summary of the most important results of the proposed alternatives for the installation of the crop Egyptian compared to alternative the actual average for the period (2009-2011), as the presence of six proposed alternatives notes was the best alternative the sixth, which saw a surplus in the amount of water to the area cultivated by about 3.16 billion cubic meters also achieved the highest net revenue from the unit to the water, which was about 1.2 pounds / m 3, compared to other alternatives, including actual alternative.

A summary table showing the results of the proposed alternatives compared to the actual alternative average period (2009-2011).

The sixth Alternative		V Alternative		IV Alternative		The third alternative		The second alternative		The first Alternative		Actual	Statement
The Surplus	The proposed	The Surplus	The proposed	The Surplus	The proposed	The Surplus	The proposed	The Surplus	The proposed	The Surplus	The proposed		
0	15.737	0	15.737	0	15.737	0	15.737	0	15.737	0	15.737	15.737	Crop area (million acres)
0.8	70.54	0	69.74	0	69.74	2.97	72.71	0	69.74	0	69.74	69.74	Net yield cultivated area (billion pounds)
-3.16	58.95	-2.17	59.94	-3.15	58.96	-1.91	60.2	-2.44	59.67	-3.13	58.98	62.11	Water for the amount of cultivated area (billion cubic meters)
45.9	4482.43	0	4436.35	0	4436.35	293.19	4729.72	0	4436.35	0	4436.35	4436.35	Net return per acre (pounds)
0.08	1.2	0.04	1.16	0.06	1.18	0.08	1.2	0.05	1.17	0.06	1.18	1.12	Net return water unit (pounds)

The Ministry of Water Resources and Irrigation, strategy development and management of water resources in Egypt until 2050, 2010 edition

Source: - Ministry of Agriculture and the Central Administration of the agricultural economy, the General Directorate of Agriculture Statistics.

- Computer results using LINDO program.

Which means the possibility of converting this surplus of water used in the Egyptian agriculture and Milirmtermkaab of about 3.16 to about (893) thousand acres planted area and about 1.5 million acre crop space in new areas outside the valley, which reflects the possibility of a Egyptian agriculture stakeholders to cause the expansion of Agricultural Landscape in depth new areas, what ease population pressure in this valley with the provision of the necessary atmosphere to achieve balanced agricultural development through the development of agricultural resettlement policies compatible structures and determine crop less risky and so as to achieve the agricultural stability.

### **Second: The proposal exploitation patterns and agricultural resettlement in Egypt.**

For agricultural resettlement policies in the light of lessons learned from previous studies and experiments can be referred to some of the following proposed exploitation and settlement patterns:

#### **A - Investment projects style:**

With relatively large amplitudes of agricultural investment projects represent top style efficiency in the exploitation of natural and agricultural resources, and this pattern is characterized by many of the characteristics that qualify it to be the main pattern among the various exploitation of new land patterns, and perhaps among those characteristics are as follows:

- moving towards the use of modern techniques and technologies in agriculture.
- Achieve an appropriate amount of production and marketing advantages of economies of capacity.
- leaning towards production specialization and focus on high-value products.
- has the capabilities and opportunities for better funding.
- rises by the intensity of use of capital for work.
- more self-reliant in access to inputs and services.

One of the things and the controls that are proposed to be taken into account in this pattern are as follows: include ownership contracts or use of the conditions and controls that prevent abuse or act which could lead to the fragmentation of the land or deviation activities for agricultural purposes or activities and target areas, and the state in those cases, the right to recover the land and compensation appropriate to the investor. Even new agricultural land will not be room for corruption or damage public interests of the community, and these controls but not limited to:

1. To withdraw land from companies that are not based agricultural exploitation within three to five years and be a condition binding irreversible, but it is possible to be accompanied by fines disable state resources, so as to

avoid a follow Tsquia land policy and to stop agricultural development movement and wasting huge investments in infrastructure without economic returns.

2. That is the allocation of not less than 50% of the land in favor of the production of domestic consumption in Egypt, and shall not exceed the proportion of exports for 50%.

#### **B - Pattern contribute to agricultural companies:**

In this mode it can accommodate many possessors and users groups of smallholder or medium who focus their attention primarily on investment in agricultural projects that generate them an appropriate return, along with the achievement of the desire to own part of the agricultural land without that being coupled necessarily full-time for the exercise of agricultural activity as a profession and field to work and live for the holder or members of his family.

According to this pattern is allocated spaces compound with a suitable capacity (thousand to five thousand acres, for example) are titled to individuals from groups wishing to own property without management. And each of them a number of shares that are commensurate with its own space.

Are exploiting every area of the combined space of the appropriate amplitude, which is investigating the technical and administrative efficiency considerations, in the form of agricultural joint-stock company, holders representing all members of the General Assembly of this company.

None of the shareholders may withdraw its own space outside the scope of the company, while the right to sell its shares traded and logically, and mortgage, as well as to bequeath to his family, of course.

Gets shareholder returns on its shares as decided by the Assembly of dividend ratios, and distribution of the proceeds of production between capital and labor. This along with the salary or remuneration in case of his participation in any of the jobs or work areas of the company.

According to this pattern realized societal goals for the expansion of wealth and land ownership base, with avoid the perennial problem of land fragmentation and associated reasons for the low efficiency in the exploitation of agricultural resources.

#### **C - Agricultural settlement pattern in the framework of cooperative societies sophisticated:**

Attention is focused on this type of exploitation patterns reclaimed land on the social and demographic considerations aimed at the establishment of new communities populated core business depends on agriculture. Usually it involves this style as appropriate to provide the facilities and the facilities and the provision of facilities and services that support the achievement of social and economic goals for agricultural resettlement. And should this pattern be the priority in the vicinity of the Valley and Delta areas, including easier for these social groups resettlement process in order to facilitate the transition and the production and marketing in accordance with the weak abilities, that leaves distant land available for investors and companies financially and technically the most capable to achieve development and reclamation in areas distant from the Delta and Valley.

#### **D - Integrated agricultural settlement pattern.**

Integrated pattern among young graduates and users on one hand and between small and medium-sized companies rely on the other hand in the medium dimension resettlement areas for the Delta and the valley so that it can achieve integration between investors and social groups, according to the diversity of capacities and capabilities between the above-mentioned categories, which serves each other to achieve development based on Features exchange between resettlement models subsidized social aspects and resettlement models supported economic aspects. So it is available for companies cheap and skilled labor nearby, which reduces the cost in the reclamation and cultivation process and provides economic aspects of graduates and users of machinery for the youth and jobs supported for their survival and keep their land in the reclamation process. The presence of small, medium and large companies with young graduates and users supported for both of them in the development process and a representative of need each other to achieve a balance between economic and social aspects in the development process.

#### **Third, determine the compositions less risky crop.**

With regard to mechanisms to identify structures cropping least risk in order to achieve economic stability due to the nature of the agriculture in general as biological industry is facing a lot of volatility and risk, are the use of roads and complex computational software to determine the best compositions crop in terms of minimizing the risk and maximizing the achieved yield in long-term, in the light of the estimate type and cost of risk in the Egyptian crop structure in light of the 2030 strategic objectives, where an estimate is the type and cost of risk for each agricultural crop in order to identify the most important agricultural crops, which will be marked by a high degree of risk if produced in the crop structure and, for example, You can view the most important results have been reached, according to the study models

## 1 - Risk assessment in crop structure in light of the 2030 strategic objectives:

### Based on the Quadratic Programming (QP)

Results solving quadratic programming model shown in order to minimize the risk, it was found that the total profit of the proposed model to maximize profit (which represents the case of complete uncertainty) in the case of not taking risk into account has reached 35.72281 billion pounds, while showing that the total proposed gross profit of solution model (QP) for the installation of the crop in the light of the strategic objectives in 2030 has reached about 41 336 million pounds, and by increasing the amount of about 5613 million pounds.

### 2. Type and the cost of risk according to the model (QP) in the light of the 2030 strategic objectives:

The results of the solution as quadratic programming model (QP) type and the cost of risk LE million compared to profit maximization model crop for installation in Egypt as follows:

**A - risk crops:** show that crops: alfalfa, winter onions, winter potato, rice summer, tomato summer, beans, sugar cane has a risk in crop composition, where the cost of risk was estimated to grow those crops around 238.24, 138.81, 458.25, 538.17, 117.67, 19.22 0.71820000 pounds each, respectively, in the case of crop risk here represent the cost to the farmer losses due to lower planted area of the crop.

**B- non-risk crops:** it shows that 28 crop of the study crops are wheat, barley, ring and faba bean, lentil, lupine and chickpeas, flax, sugar beet and alfalfa sustained, garlic and winter tomatoes and winter squash and winter cabbage and winter maize summer, sorghum summer, soybean, sesame, peanuts, cotton, potatoes and summer option Summer and zucchini and summer eggplant and summer corn Nile, tomatoes Nile and potatoes Nile cabbage Nile has no risk in crop composition, where the cost of risk was estimated for the cultivation of these crops ranged between a minimum 0.77 million pounds of lentils, and about 2216 million pounds of wheat, in the case of crops is risking the Here is a cost to the farmer profits obtained as a result of its expansion in the cultivation of such crops.

**C- neutral crops:** shows that there is no neutral crops has any neutral risk taking in the crop composition, in the sense that those crops are not farmers are turning to avoid the risk of or demand for them.

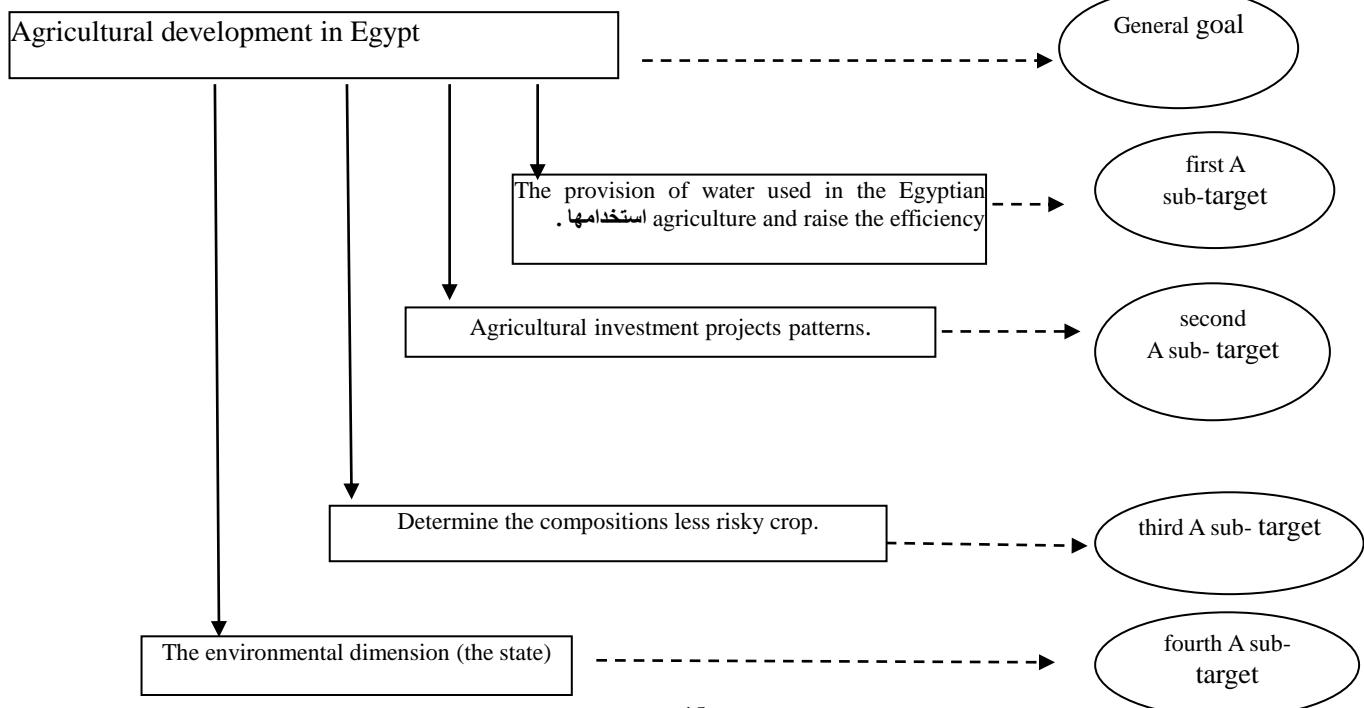
### Fourth: the environmental dimension

With regard to the dimension of the environmental and legal It is considered as the general framework provides the appropriate environment within which they operate agricultural development process in a balanced manner, where the concerned authorities to enact laws and necessary to criminalize the water wastage or misuse or events environmental pollution legislation, and Permanent urge protection of the environment and follow the preventive methods for the safety of public health.

### Summary

In the light of the above can be summarized vision of the future strategy for agricultural development in Egypt in the chart below:

A sub-goal of the fourth A sub-goal of the fourth



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## THE REFLECTIONS OF THE EGYPTIAN AGRICULTURAL AND ECONOMIC POLICIES ON PRODUCTION AND THE FEDDAN COSTS FOR THE WHEAT CROP

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### SUMMARY

Wheat crop is one of the most important crop in Egypt where the imported from it is used to meet the lack in its production to face the consumption needs from it. So this research aims to shed light on the effect of the agricultural policies on production or costs for the wheat crop through achieving the secondary objectives in:

- 1-Studying the effect of the agricultural policy on the total productive costs items of the wheat crop.
- 2- Studying the effects of the followed agricultural policies on the outcome of the feddan of the wheat crop.
- 3-Studying the resulted effects of the followed agricultural policies on producing wheat by using the policy analysis Matrix [ P.A.M] Through it we calculate the economic outcomes and costs of the feddan to calculate the deals of effective protection and its rates and the standard factor to produce wheat. To achieve this aim, the study depends on the published and unpublished secondary data through the period [1986-2012] declared from the Ministry of Agriculture and the Economic Sector and the Central System for Public Statistics, besides the various references and researches and the scientific papers related to the topic of the study. This study reached to what follows.

1- It becomes clear from the records of production costs that the increase in the total cost resulted basically on the value of both the human, robot work and the rent among the rest of the items of the total cost of the crop which is the topic of this study.

Whereas this rate advantage increased after the State had adopted the policy of the economic release [1986-1997] About 0,08 while the increase in the rate advantage reached during the complete release period [1998-2012] to 0,09 .The Study reached some recommendations by which we can activate the policy of the economic reform to raise the strategies of farming the cereal crops especially the wheat.

### INTRODUCTION

Heading for releasing the agricultural sector began since the early eighties has begun to crystallize its framework in the state adoption to the policy of the gradual release aiming at getting rid of the disorders which hinder its way for long years and weakened its abilities in achieving the hoped targets from it these policies include several modifications, the most important one is deleting the quantity and price restrictions applied on the Egyptian farmer's shoulder And Reducing the role of the state in possessing Agricultural lands.

And deleting the obligatory system of importing crops. And releasing the prices of the agricultural production needs releasing the relation between the owner and the tenant of farm lands. Allowing the agricultural sector to trade in the agricultural production supplies. Besides entering the private sector in the fields of marketing and local and abroad trade to the basic agricultural goods.

Wheat is one of the most important crop of the strategic cereal crops. It's even the most important of the basic food groups of food which we can't live without it in feeding the population in Egypt. It's considered an essential resource of energy. In regard with Egypt's suffering in the lack of producing wheat. It seeks to complete the food gap from it by import.

#### The problem of research:

The basic problem of the study crystallizes in working the volume of food gap from wheat in Egypt. Despite the multiplication of the political policies to reduce the food gap and increase the self-sufficiency through the economic reform programs generally in different sectors and especially in the agricultural sector ,but any modification or change in agricultural policies mechanism must be followed by several advantages and disadvantages on the efficiency of the agricultural and economic changeable items, Hence the problem of the study is related to the range of the efficiency of the adopted agricultural policies, whether the earlier periods in adopting the programs of the economic reform compared to the period adoption on the feddan production or costs of the wheat crop.

#### The aims of the research:

The research basically aims to study the agricultural policies and their effects on production and the feddan production of the wheat crop in Egypt through achieving the secondary aims as follows.

- 1-Studying the effects of the agricultural policies on the items of production and the outcome of the feddan.
- 2-Studying the resulted effects on the adopted agricultural policies of producing the wheat.

**The resources of the data:**

The study depends on the published and the unpublished secondary data announced from the Ministry of Agriculture, the economic sector and the central system of general packaging and statics in addition to several references and findings and the scientific messages related to the study topic.

**The research method:**

The style of the descriptive and quantitative analysis to appreciate and explain the phenomena related to

$$In_a = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**2 The index of production costs Alfdanah change in labor costs Animal (B):**

$$In_b = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**3 The index of production costs Alfdanah of change in the automotive labor costs (C):**

$$In_c = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**4 The index of production costs Alfdanah change in the value of the seeds used (D):**

$$In_d = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**5 The index of production costs Alfdanah change in the value of municipal fertilizer (E):**

$$In_e = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**6 The index of production costs Alfdanah change in the value of chemical fertilizer (F):**

$$In_f = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**7 The index of production costs Alfdanah of the change in the value of pesticides used (G):**

$$In_g = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**8 The index of production costs Alfdanah change in the value of petty cash (H):**

$$In_h = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**9 The index of production costs Alfdanah change in the value of the wage (I):**

$$In_i = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**(B) Indices net yield of the crop:** To measure the impact of each factor a component of the net yield per feddan Ali factors changes the incident which has been split record the simple to the following components:

1 simple record net earnings change as a result of the amount of output (productivity per acre):

$$I\pi Q = \frac{(Q_1 \cdot P_o) - C_o}{(Q_0 \cdot P_o) - C_o} \times 100$$

2 record simple to change as a result of the net return per acre production costs:

$$I\pi Q = \frac{(Q_1 \cdot P_o) - C_o}{(Q_0 \cdot P_o) - C_o} \times 100$$

Because crop under study is one of the crops resulting, one major and one minor secondary has been converted to the equivalent of the output of the main output. Using the following equation:

$$Q_{adjusted} = Q_1 + \frac{Q_0 \cdot P_0}{P_1}$$

Where it refers  $Q_1$  ,  $Q_0$  to the productivity per Feddan from the main output and secondary, respectively, and indicate  $(P_1$  ,  $P_0$ ) to an average price of the main product and secondary, respectively

Second: the style of the Mirrored policy analysis (PAM):

In terms of knowledge, which can calculate the following:

Protection measures (such as the nominal protection coefficient, and the coefficient of effective protection) or comparative advantage (DRC).

Research Results

#### **The impact of agricultural policies on productivity costs Per Feddan wheat crop:**

Table shows (1) the development of production cost of the wheat crop in terms of the Arab Republic of Egypt during the study periods (1986\_1997), (1998\_2012) of both current and real prices Based on this table data was calculated records of the costs of wheat production, which will be described in the following :

##### **1 index acre production costs as a result of change all cost items (In):**

Table indicators show (1) that the record for the average total production costs per acre average during the period (1986\_2012) has reached 350.4%, 142.1% of the wheat crop and current prices on the real arrangement.

##### **2 index acre production costs as a result of change in each of the various items of the wheat crop:**

To determine the responsibility of each of the various items of cost Alfdanah of wheat and of the value of each of: the wages of workers, seeds, fertilizers, municipal, chemical fertilizers, machinery and wages, rentals in addition to all other cost items. That using current prices that these items may have caused changes in the total cost of the wheat may increase amounted to about 141.7%, 106.5%, 102.4%, 112.5%, 121.9% 152.1% 99.9% 102.9% 105.8%, respectively. When using real prices shown in Table (1) that these items may have contributed to the arrangement in the changes in the total cost of wheat by about 97.4%, 100.8%, 99.6%, 102.1%, 102.2% 0.136%, 101.8% 99.2% 101.4 % Respectively. The results of the analysis, whether ongoing or in real terms to an increase in the total cost of wheat during the period (1986\_2012) as a result of the increase in the value of each of the workers' wages, seeds, fertilizers municipal, chemical fertilizers, machinery and wages.

**Table ( 1 ) : The development of production cost per Feddan wheat crop items at the level of the Arab Republic of Egypt during both periods study  
 (1986\_1997)·(1998\_2012)· Pound and current real prices .**

Statement year	Workers' wages		Animal labor costs		Agricultural machinery costs		Seeding costs		Municipal compost costs		Chemical fertilizer costs		Pesticide costs		General expenses		Rent farmland		Total	
	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms
1986	143.0	143.0	11.1	11.1	17.6	17.6	11.4	11.4	23.8	23.8	59.9	59.9	1.4	1.4	16.1	16.1	34.6	34.6	318.9	318.9
1987	134.5	120.8	3.4	3.1	81.0	72.8	19.7	17.7	14.9	13.4	26.1	23.5	1.1	1.0	22.2	20.0	50.3	45.2	353.2	217.5
1988	149.8	106.9	4.7	3.4	83.9	59.9	21.9	15.6	17.2	12.3	25.6	18.3	3.3	2.4	24.6	17.6	52.2	37.3	383.2	273.7
1989	148.6	84.7	4.6	2.6	90.9	51.8	26.5	15.1	17.4	9.9	42.5	24.2	1.7	1.0	23.3	13.3	52.1	28.7	407.6	232.3
1990	167.7	79.9	4.9	2.3	99.3	47.0	34.6	16.5	19.1	9.1	50.3	23.9	1.7	0.8	24.2	11.5	82.0	39.0	483.8	230.3
1991	170.0	69.8	5.2	2.1	114.4	47.1	44.4	18.2	20.5	8.4	73.1	30.0	2.3	0.9	36.6	15.0	95.6	39.3	562.1	230.7
1992	187.3	67.5	4.1	1.5	144.4	52.0	54.5	19.6	19.8	7.1	105.3	37.9	11.4	4.1	42.2	15.2	95.4	34.4	664.4	239.3
1993	200.3	68.6	6.5	2.2	160.8	55.1	57.8	19.8	27.9	9.6	116.9	40.1	7.7	2.6	62.9	21.6	300.0	102.8	940.7	322.4
1994	204.4	64.1	6.5	2.0	170.9	53.6	58.2	18.2	30.7	9.6	127.0	39.8	6.9	2.2	67.4	21.1	300.4	94.2	972.4	304.8
1995	216.6	63.9	8.2	2.4	202.4	59.7	61.1	18.0	31.2	9.2	133.5	39.4	9.3	2.7	72.8	21.5	300.6	88.7	1035.7	305.5
1996	228.8	62.7	7.6	2.1	212.3	58.4	64.3	17.7	40.4	11.1	136.0	37.4	15.3	4.2	77.5	21.3	305.3	83.9	1086.9	289.8
1997	239.2	65.8	7.1	2.0	218.6	60.1	71.8	19.7	42.1	11.6	136.9	37.6	21.4	5.9	80.9	22.2	308.6	84.9	1126.6	309.8
Average firstperiod	182.5	83.1	6.2	3.1	133.0	52.9	43.9	17.1	25.4	11.3	86.1	34.3	7.0	2.4	45.9	18.0	164.8	59.5	694.8	281.7
1998	244.2	65.7	3.1	0.7	241.2	64.9	32.2	8.7	78.9	21.2	152.5	41.0	13.2	3.6	84.2	22.7	703.4	189.3	1552.9	417.9
1999	256.1	66.8	2.7	0.7	264.5	69	68.0	17.7	35.5	9.3	145.4	37.9	18.5	4.8	87.0	22.7	655.0	170.8	1532.7	399.7
2000	265.0	69.1	2.4	0.6	253.4	66.1	67.8	17.7	45.1	11.8	134.5	35.1	19.4	5.1	86.6	22.6	636.2	165.8	1510.4	393.9
2001	283.9	71.7	2.8	0.7	234.2	59.1	57.6	14.5	41.3	10.4	131.8	33.3	20.3	5.1	86.9	21.9	645.8	163.1	1504.6	379.8
2002	292.6	70.6	2.7	0.7	233.2	56.5	79.8	19.3	50.5	12.2	138.6	33.4	24.0	5.8	90.4	21.8	646.6	156.0	1558.4	376.3
2003	332.0	76.7	3.0	0.7	254.0	58.7	89.0	20.6	55.0	12.7	150.0	34.7	28.0	6.5	100.0	23.1	704.0	162.7	1715.0	396.4

2<sup>nd</sup> International Conference on Sustainable Agriculture and Environment (2<sup>nd</sup> ICSAE)  
 September 30 – October 3, 2015, Konya, Turkey

<b>2004</b>	<b>359.0</b>	<b>79.5</b>	<b>4.0</b>	<b>0.9</b>	<b>282.0</b>	<b>62.5</b>	<b>97.0</b>	<b>21.5</b>	<b>55.0</b>	<b>12.2</b>	<b>177.0</b>	<b>39.2</b>	<b>31.0</b>	<b>6.9</b>	<b>100.0</b>	<b>22.2</b>	<b>799.0</b>	<b>177.0</b>	<b>1904.0</b>	<b>421.9</b>
<b>2005</b>	<b>376.0</b>	<b>80.1</b>	<b>4.0</b>	<b>0.9</b>	<b>292.0</b>	<b>32.2</b>	<b>115.0</b>	<b>24.5</b>	<b>37.0</b>	<b>7.9</b>	<b>188.0</b>	<b>40.0</b>	<b>36.0</b>	<b>7.7</b>	<b>105.0</b>	<b>22.4</b>	<b>828.0</b>	<b>176.2</b>	<b>1971.0</b>	<b>421.9</b>
<b>2006</b>	<b>411.0</b>	<b>84.2</b>	<b>5.0</b>	<b>1.0</b>	<b>322.0</b>	<b>66.0</b>	<b>123.0</b>	<b>25.2</b>	<b>49.0</b>	<b>10.0</b>	<b>200.0</b>	<b>41.0</b>	<b>46.0</b>	<b>9.4</b>	<b>115.0</b>	<b>23.6</b>	<b>872.0</b>	<b>178.7</b>	<b>2143.0</b>	<b>438.2</b>
<b>2007</b>	<b>476.0</b>	<b>67.6</b>	<b>6.0</b>	<b>0.9</b>	<b>345.0</b>	<b>49.0</b>	<b>126.0</b>	<b>17.9</b>	<b>69.0</b>	<b>9.8</b>	<b>255.0</b>	<b>63.2</b>	<b>58.0</b>	<b>8.2</b>	<b>134.0</b>	<b>19.0</b>	<b>975.0</b>	<b>138.6</b>	<b>2444.0</b>	<b>347.2</b>
<b>2008</b>	<b>593.0</b>	<b>69.6</b>	<b>7.0</b>	<b>0.8</b>	<b>428.0</b>	<b>50.2</b>	<b>166.0</b>	<b>19.5</b>	<b>39.0</b>	<b>4.6</b>	<b>378.0</b>	<b>44.4</b>	<b>103.0</b>	<b>12.1</b>	<b>171.0</b>	<b>20.1</b>	<b>1260.0</b>	<b>147.9</b>	<b>3145.0</b>	<b>366.2</b>
<b>2009</b>	<b>648.0</b>	<b>80.6</b>	<b>7.0</b>	<b>0.9</b>	<b>456.0</b>	<b>56.7</b>	<b>177.0</b>	<b>22.0</b>	<b>54.0</b>	<b>6.7</b>	<b>404.0</b>	<b>50.3</b>	<b>57.0</b>	<b>7.1</b>	<b>182.0</b>	<b>22.6</b>	<b>1456.0</b>	<b>181.1</b>	<b>3441.0</b>	<b>428.0</b>
<b>2010</b>	<b>698.0</b>	<b>77.1</b>	<b>8.0</b>	<b>0.9</b>	<b>483.0</b>	<b>53.3</b>	<b>188.0</b>	<b>20.8</b>	<b>49.0</b>	<b>5.4</b>	<b>426.0</b>	<b>47.0</b>	<b>90.0</b>	<b>9.9</b>	<b>188.0</b>	<b>20.8</b>	<b>1550.0</b>	<b>171.1</b>	<b>3680.0</b>	<b>406.3</b>
<b>2011</b>	<b>845.0</b>	<b>81.4</b>	<b>7.0</b>	<b>0.8</b>	<b>557.0</b>	<b>53.6</b>	<b>206.0</b>	<b>19.8</b>	<b>78.0</b>	<b>7.5</b>	<b>435.0</b>	<b>41.9</b>	<b>93.0</b>	<b>9.0</b>	<b>222.0</b>	<b>21.4</b>	<b>1626.0</b>	<b>156.5</b>	<b>3869.0</b>	<b>391.9</b>
<b>2012</b>	<b>1006.0</b>	<b>94.5</b>	<b>8.0</b>	<b>0.8</b>	<b>580.0</b>	<b>54.5</b>	<b>230.0</b>	<b>21.6</b>	<b>106.0</b>	<b>10.0</b>	<b>433.0</b>	<b>40.9</b>	<b>100.0</b>	<b>9.4</b>	<b>247.0</b>	<b>23.2</b>	<b>1713.0</b>	<b>161.0</b>	<b>4423.0</b>	<b>415.9</b>
<b>Average secondperiod</b>	<b>472.4</b>	<b>75.7</b>	<b>4.8</b>	<b>0.8</b>	<b>348.4</b>	<b>58.8</b>	<b>121.5</b>	<b>19.4</b>	<b>56.2</b>	<b>10.1</b>	<b>249.9</b>	<b>39.8</b>	<b>49.2</b>	<b>6.8</b>	<b>133.3</b>	<b>22.0</b>	<b>1004.7</b>	<b>166.3</b>	<b>2434.4</b>	<b>400.3</b>

Source : Collected and calculated by the Ministry of Agriculture and agricultural land reclamation \_ Economic Affairs Sector \_ Agricultural Statistics Bulletin • Sporadic numbers \*The referee based on the index of wholesale prices , considering that a year

**Table (2): the effect of changes in the various items of the average cost Alfdanah on changes in total costs for wheat during the study periods (1986\_1997), (1998\_2012)**

Cost items	At current prices%	At Real prices%
All cost items	350.4	142.1
Workers' wages	141.7	97.4
Wages animals	99.9	99.2
Wage machinery	121.9	102.2
Seeds	106.5	100.8
Municipal fertilizer	102.4	99.6
Chemical fertilizers	112.5	102.1
Pesticides	102.9	101.8
Expenses	105.8	101.4
Rent	152.1	136.0

Source: collected and calculated data from Table (1).

#### **Second, the impact of agricultural policies on the net yield per feddan of wheat: -**

##### **1\_ record for net yield change as a result of all the factors (In<sub>π</sub>) :-**

Analysis shows the table number indicators (3) that the record for the net yield of wheat crop reached 340.7%, during the study period (1986\_2012).

##### **2\_ indexes to the net yield of wheat crop: -**

##### **A\_ record simple net yield as a result of productivity change Per Feddan (In<sub>q</sub>) :-**

The results of the analysis in Table (3) that the record for the net yield due to changes in the quantity produced amounted to about 127.6% during the study period(1986\_2012), which shows that the positive effect of agricultural policies on the productivity per acre of wheat crop.

##### **B \_ To record the simple net yield farm price change as a result of: -**

Noted the table number data (3) indicates that the record for the net yield as a result of change farm price reached 442.2% during the study period (1986\_2012) which Abeben the positive effect of agricultural policies along the study period, the wheat crop.

##### **C\_ Simple to record net return per Feddan as a result of changing production costs per Feddan:**

Study table No. (3) showed that the index of net feddan of wheat crop yield as a result of change of production costs per acre was about 50.8% during the study period(1986\_2012) where we note the low record for net yield along the study period . Which illustrates the negative impact of agricultural policies including the abolition of labor on agricultural production requirements and raise the rental value of acres and pricing that Almseitlizimat by a strong market and the entry of the private sector in the field of production inputs trade.

**Table (3): indexes to the net yield of wheat crop and the changes during the period (1986\_2012)**

<b>Statement</b>	<b>The first period (1986_1997)</b> <b><math>\pi_0</math></b>	<b>The second period (1988_2012)</b> <b><math>\pi_1</math></b>
<b>Net return per feddan by pound</b>	<b>660.7</b>	<b>2013.1</b>
<b>Indexes to the net yield in pounds as a result of change of each</b>		<b>304.7%</b>
<b>1_All the factors influencing</b>		
<b>2_Productivity per feddan</b>		<b>127.6%</b>
<b>3_Price farm</b>		<b>442.2%</b>
<b>Production per Faddan costs</b>		<b>50.8%</b>

Source: collected and calculated from the Ministry of Agriculture, bulletins Agriculture statistics, various issues.

### **Third, the results of agricultural policy analysis matrix:**

#### **1\_Nominal Protection Coefficient Devices:**

coefficient and the rate of nominal protection for wheat: The study showed that the value of the nominal protection coefficient of productivity requirements for wheat (during the study) less than the correct one, reflecting lower production requirements Introduction to producers of wheat prices on the global value . The study also showed that the protection rate of wheat crop value during that periodic less than zero, which indicates that the implicit tax on the product internally. If it reaches the value of the nominal protection coefficient of the kits in the two periods before full liberalization towards 0.70, 0.90, in accordance with Table (4) This means decreasing directed to producers of 30% support rate, in the first period (1986\_1997) to about 10% in the period (1998\_2012) .

#### **2\_estimate coefficient and the nominal protection rate of return per feddan of wheat: -**

As laboratories during the period (1986\_ 1977) according to Table (4) at about 0.70and this indicates the presence of an implicit tax on the product and consumer support, The product gets the equivalent of 70% of the value of its products at world prices. And it carries an estimated 30% of the revenues of these products at world price simplicit taxes. During the second period (1998\_2012) after full economic liberalization has been estimated at 0.80, which indicates the existence of support for wheat. This suggests the existence of an implicit tax on the product g is estimated at about20% of the revenues of these products is a resident at world prices.

#### **3\_Estimate coefficient and the effective rate of protection (EPC) for wheat: -**

Table shows indicators (4) The effective protection of wheat plants during periods ofthe study was about 0.70, 0.80, which indicates that the farmer only gets about 70%.80% of the added value of the global crop prices And bear implicit taxes and support for the consumer accounts for about 305.20% over the study periods despite the decline in the value of local production requirements for its economic value. In other words, the full economic liberalization to rent farmland policy led to higher value-added wheat crop.

#### 4\_ comparative advantage coefficient (DRC) for wheat:

Results of measuring the comparative advantage of wheat transactions schedule No (4 ) During the lead up to full economic liberalization ( 1986 \_ 1997 ) It shows that it's about 0.08 . While this factor indicates 0.09 after full economic liberalization has shown that the Arab Republic of Egypt has a comparative advantage in the cultivation of wheat, because the results of laboratory fall from the correct one by a large margin and that throughout the study period

**Table.No (4) : Measure the results of the agricultural policies of the wheat crop in Egypt analysis matrix during both periods (1986 \_ 1997 ) ‘ (1998 \_ 2012 )**

Items	The first period	The second period
Nominal Protection Coefficient Devices	0.7	0.90
The rate of Nominal Protection Devices	30 %	10 %
Nominal Protection Coefficient products	0.70	0.80
The rate of nominal protection products	30 %	20 %
Effective Protection Coefficient	70.0	0.80
The effective rate of protection	30 %	20 %
The cost of local resources coefficient	0.08	0.09

Source: Collected and calculated by the Ministry of Agriculture ‘ \_ Agricultural Statistics Bulletin ‘ Sporadic numbers .

#### RECOMMENDATIONS

In light of the outcome of the results of the study were reached following recommendations: \_

- (1) Work to increase the output of wheat crop by providing this high productivity varieties in addition to encouraging and supporting the expansion of cultivation in the reclaimed land .
- (2) Rationalizing the consumption of wheat crop and work to reduce the proportion of quantitative and qualitative losses.
- (3) Studies need to work the crisis to assess the impact of liberalization policy on the production of the wheat crop in order to avoid the negative effects of this policy and that by modifying programs and procedures for economic freedom.

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## SERICULTURE IN ORGANIC AGRICULTURE AREAS IN TURKEY AND ITS CONTRIBUTION TO SUSTAINABILITY OF SECTOR

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### ABSTRACT

Sericulture in Turkey, far from industrial areas, mostly done on small scale in mountainous areas inconvenient for agriculture is a value added agricultural activity that contributes national economy. At the end of such as a short production period of 35-40 days, providing additional income to farmers in places where there are no alternative sources of income is a very important economic activity for low level income farmers. On the other hand; sericulture has significant role on conservation of cultural heritage and genetic resources in Turkey. In addition to this, depending on it is labor intensive production, sericulture sector is very important in terms of rural development with creating new job opportunities and preventing immigration. But over the last 20 years wet cocoon production volume in Turkey has decreased by 90%. Thus, it is of importance that sustainability should be provided and production should be encouraged.

Sericulture having organic production structure that forms a chain which conserves Turkey's natural resources and nature. As a matter of fact, at low land villages where intensively agricultural spraying are done, due to pesticide contamination of mulberry trees used for breeding finalized in serious loss of silkworms and sericulture had to be banned.

The leaves of mulberry trees used in breeding should be obtained in natural conditions and should be far away from chemical fertilizers and agricultural spraying. Hence sericulture is partially or fully organic agricultural activity. In this context; it is significantly important to provide sustainability to the sericulture sector and encourage production and dissemination of production as a auxiliary activity in the areas where agricultural chemicals and fertilizers are not used. As a result of providing an increase of production in the sector both large number of new jobs opportunities created and both as a result of the reduction of import will be made in silk significant foreign exchange savings.

The purpose of this study is to evaluate current status of mulberry trees used in breeding silkworm in Turkey and to determine possibility and potential production in present organic agriculture areas. In this study, KOZABİRLİK and Ministry of Food, Agriculture and Livestock records were used with the findings of previous research conducted on the subject.

**Keywords:** Sericulture, wet cocoon production, organic agriculture, organic sericulture

### INTRODUCTION

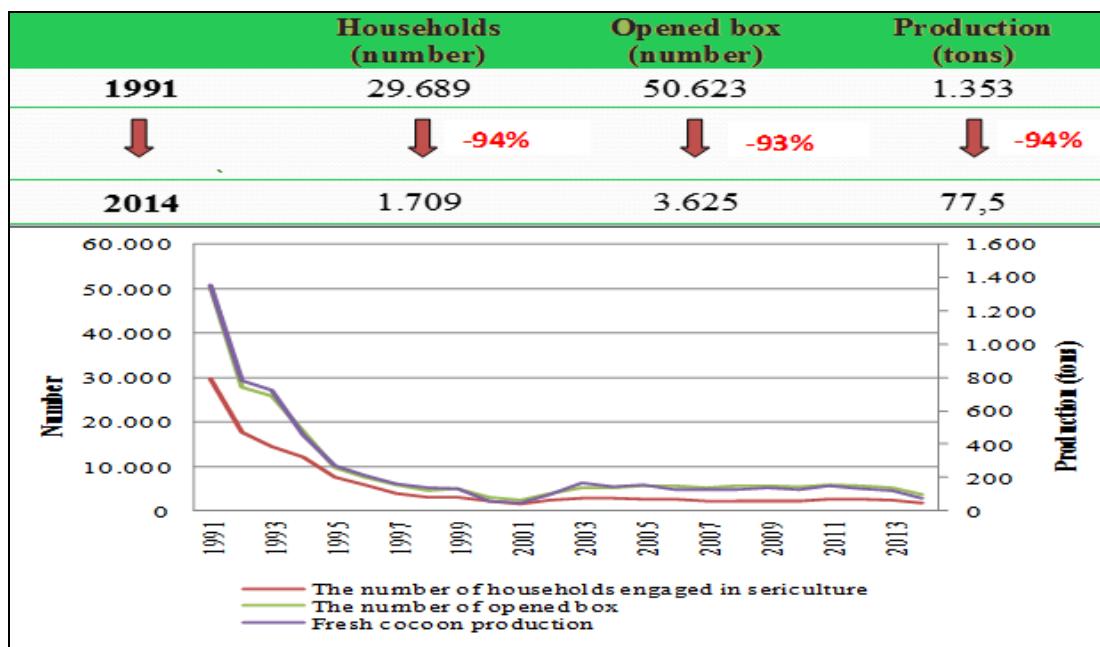
Sericulture is an agricultural activity carried out in mountainous areas far away from industrial areas, where conditions for agriculture are unfavorable. Sericulture in Turkey is mostly carried out by small sized family farms in small scale and is a significant economic activity for the producers with low income and where there is no alternative source of income (Taşkaya Top vd 2015/a). Due to its organic production it is a chain of economic activities that conserves natural resources and nature of the country. On the other hand, sericulture has an important role in conservation of cultural heritage and gene resources in Turkey.

In terms of climate, Turkey is one of the most suitable countries for growing mulberry trees and sericulture.

Nevertheless in last two decades the number of farms involved in sericulture and quantity of fresh cocoon produced decreased by 94% in addition to this Turkey depend on raw silk as importer (Figure 1). Immigration, industrialization, intensive and unconscious pesticide use has a significant role in decline of production.

As of 2014, in Turkey, sericulture activities were held in 338 villages and carried out by 1.709 households and fresh cocoon production realized as 77,5 tons (Figure 1).

**Figure 1.** The number of households engaged in sericulture, number of opened boxes and fresh cocoon production in Turkey



Source: KOZABİRLİK, 2014

Because of youngsters living in mountainous areas and forest villages are quitting agricultural activities due to low level income, it is estimated that the generation maturity will increase in future and in connection to this the number of households engaged in sericulture will decrease significantly due to mature generation (Taşkaya Top vd 2015/b).

Despite being an eligible country to silkworm breeding, production was made in 37 provinces out of current 81 in Turkey by 2014. 80% of the freshcocoon production was carried out in Antalya, Diyarbakir, Istanbul, Ankara, Izmir and Sakarya (Figure 2).

**Figure 2.** Distribution by province of fresh cocoon production in Turkey (2014)

p.s.: Blue: 97 percent of fresh cocoon production, Yellow: 3 percent of fresh cocoon production, Dark Grey: the provinces that are unproductive, Red points: the provinces that make 100 percent of the breeding production



Source: KOZABİRLİK, 2014

### SERICULTURE IN ORGANIC AGRICULTURE AREAS

One of the most important factors affecting the sustainability and the quantity of production in sericulture production in Turkey is - labor force insufficiency as well as the lack of breeding house- lack of mulberry trees. Mulberry leaves are the only food source for silkworm and sustainability of production depends on availability and quality of mulberry leaves.

Depending on the amount and existence of mulberry leaves and whether to carry out silkworm breeding and capacity is determined (Gürbüz ve Karahan, 2014). In Turkish case, to feed a box of silkworm seed an average of 500-600 kg of mulberry leaves are required (GTHB, 2014).

47,3 % of the farms in Turkey own less than 51 mulberry trees and box per farms is 2,17 in average (Taşkaya Top vd, 2015/a). This situation indicates that farms have limited opportunities to increase the number of boxes opened (hence production).

In this regard, in terms of ensuring the sustainability of sericulture, increasing the presence of mulberry trees has a great importance. With the "Mulberry Sapling Action Plan" implemented by Ministry of Forest and Water Affairs (2014/2016) it is aimed to utilize low yield lands and increase the number of mulberry trees Turkey wide which are non-selective with respect to climate and soil requirements. In the scope of Mulberry Sapling Action Plan it is planned to distribute 3 millions of sapling free of charge to the producers. It is aimed to increase employment and income level in the rural areas by utilization of mulberry trees used in sericulture (OSB, 2015). While distribution of mulberry trees under Mulberry Action Plan, with the purpose of encouraging sericulture priority should be given to fruitless mulberry, white mulberry and Japan ichinoese types and organic agricultural areas should be considered for plantation.

On the other hand, in the scope of promotion work of sericulture, KOZABİRLİK delivers free mulberry sapling to producers in order to increase mulberry tree capacity. Between years 2009-2013 KOZABİRLİK delivered 350.000 saplings (KOZABİRLİK, 2014).

In silkworm breeding, the quality of the mulberry leaves is very important as much as quantity. It is not possible to treat silkworm disease so disease prevention is of greater importance than treatment. Disease encountered in silkworm breeding leads to significant yield loss due to decline in production. Thus, during the research conducted by (Taşkaya Top vd, 2015) it is determined that yield per box decreased 19% in the farms which encountered disease.

One of the most important diseases encountered in silkworms is poisoning. Mulberry leaves is the only food source of silkworms so in order to prevent poisoning spraying should be cautiously done in where mulberry trees are planted (Başkaya, 2013). Mulberry leaves should be collected from natural and organic areas where there are no chemicals applications and spraying done. Therefore, silkworm breeding is partially or completely in the event of an organic agriculture.

Because of pesticide contamination in the mulberry gardens due to intensive usage of pesticide during other agricultural activities carried out in low land villages, silkworms feed on these leaves are poisoned and product losses are experienced. So sericulture cannot be carried out in lowland villages. For this reason in Turkey, the mulberry trees utilized in silkworm breeding are usually found in mountain villages and by the roadside or planted as border tree with other agricultural products (Taşkaya Top vd 2015/a). The plantation of mulberry trees brings risk if they are planted by the roadside because leaves could be covered with dust and if they are planted as bordering trees they could be contaminated by pesticides. This situation indicates that organic agriculture areas where chemicals are abandoned are alternative and appropriate areas for sericulture.

Due to increase in consumers rising awareness on organic food consumption or food coming from good agricultural practices, organic agriculture has been extended so that farms located in this areas should be encouraged to get involved in sericulture and subsidized.

In order to increase production and ensure sustainability of sericulture; new areas should be determined and current production areas should be rehabilitated allowing to enlarge production areas. Organic farming areas are the most favorable areas in order to achieve this goal. While Mulberry saplings are distributed within the scope of the Action Plan in order to encourage sericulture it is considered important that provinces which intensive organic farming carried out are taken into account.

In Table 1; below, as of 2014, provinces involved in organic production, number of producers and production areas are indicated and as of the same year it is compared to both provinces involved in sericulture and number of producers. Following from the table 1, in the provinces where intensive organic agriculture is carried out it is determined that either sericulture is not carried out or a few farms are engaged. However, a large portion of provinces listed in the table are suitable for sericulture.

During silkworm breeding period, it is very important to keep breeding rooms under optimum temperature and humidity. Silkworms are growing normally at temperatures between 20-30°C. However, temperature requirement vary for all ages. Optimum temperature requirement at age 4 is 24°C and 25°C for age 5. In breeding environmental temperature is important as well as humidity. The high rate of humidity prepare a suitable environment various fungal diseases (Şahinler ve Şahinler 2002). At first ages humidity requirement is 80-85% and in maturity decreases to 70-75%, in the sleep stage humidity should be kept under 70% (GTHB, 2014).

In this regard, during feeding stage excluding high humidity provinces (Rize, Trabzon, Giresun etc.) especially in the summer season sericulture could be carried out in all provinces which have humidity under 80%. Thus, many of the provinces indicated in table above considered to be taken into production (Sivas, Erzincan etc.) by KOZABİRLİK. On the other hand, raise in temperature during maturity phase causes an increase in diseases.

However, it is possible to eliminate the temperature differences in the provinces by starting feeding earlier or afterwards. Already, feeding start dates vary by considering the amount of temperature and humidity in the provinces where production is carried out.

**Table 1. Number of producers engaged in Organic Agriculture and Sericulture in Turkey (2014)**

Provinces	N. of producers engaged in Organic Agriculture	Production Area	Provinces	Number of producers engaged in sericulture
Van	6.339	75.677	-	-
Aydin	4.231	20.953	Aydin	34
Kars	3.345	38.153	-	-
Erzurum	2.929	31.452	-	-
Muş	2.626	28.298	-	-
Ağrı	1.473	28.986	-	-
Rize	1.409	1.282	-	-
Manisa	1.178	6.894	Manisa	10
İzmir	1.161	6.822	İzmir	115
Zonguldak	878	1.779	-	-
Samsun	622	2.265	Samsun	1
Artvin	548	1.186	-	-
Malatya	530	4.010	Malatya	3
Sivas	513	7.834	-	-
Konya	449	755	Konya	2
Ordu	429	1.688	Ordu	1
Bitlis	371	4.721	-	-
Çanakkale	334	1.957	Çanakkale	5
Niğde	277	837	-	-
Ardahan	275	1.496	-	-
Trabzon	257	362	-	-
Afyonkarahisar	248	1.059	-	-
Kastamonu	240	355	-	-
Şanlıurfa	231	10.648	Şanlıurfa	2
Diyarbakır	224	789	Diyarbakır	480
Erzincan	223	2.628	-	-
Mersin	211	1.532	Mersin	3
Adana	170	779	Adana	19
Tokat	153	363	-	-
Muğla	141	1.104	Muğla	103
Kilis	129	1.359	-	-
Denizli	119	551	Denizli	9
Isparta	117	514	-	-
Bayburt	113	1.102	-	-
Bursa	108	883	Bursa	43
Adıyaman	94	447	Adıyaman	1
Düzce	91	382	-	-
Tunceli	88	477	-	-

Çankırı	80	89	-	-
Karaman	72	136	-	-
Balıkesir	71	813	Balıkesir	8
Gaziantep	69	1.996	-	-
Bilecik	60	92	Bilecik	103
Burdur	60	159	Burdur	5
Uşak	47	145	-	-
Antalya	39	111	Antalya	395
Ankara	34	2.117	Ankara	99
Kütahya	34	72	Kütahya	1
Mardin	34	1.081	-	-
Gümüşhane	33	364	-	-
Sakarya	29	148	Sakarya	88
Hatay	25	928	Hatay	17
Çorum	20	8	-	-
İstanbul	19	111	İstanbul	6
Giresun	16	77	-	-
Hakkari	14	32	-	-
Batman	13	663	Batman	24
Bartın	11	1	Bartın	1
Kahramanmaraş	10	78	-	-
Amasya	8	7	Amasya	1
Bolu	8	20	Bolu	67
Eskişehir	8	81	Eskişehir	55
Kayseri	6	78	-	-
Elazığ	5	47	Elazığ	1
Kırıkkale	5	4	-	-
Kırklareli	5	121	Kırklareli	1
Kocaeli	5	36	Kocaeli	2
İğdır	4	47	-	-
Tekirdağ	4	80	Tekirdağ	1
Yalova	4	13	Yalova	1
Kırşehir	2	23	Kırşehir	1
Yozgat	2	103	-	-
Osmaniye	1	0	Osmaniye	1
Diger	7	54	-	-
<b>TOTAL</b>	<b>33.738</b>	<b>302.316</b>	<b>TOTAL</b>	<b>1.709</b>

Source: GTHB, 2015; KOZABİRLİK, 2014

KOZABİRLİK is the only producer organization engaged in marketing channel of sericulture sector in Turkey and purchases are guaranteed for fresh cocoon produced in all regions of Turkey. Therefore, there is no problem in marketing of sericulture products in Turkey.

Taking into account the existing potential mulberry, KOZABİRLİK, determines the seeds requirements of producers. Considering climatic variations among regions and taking into account the optimum time and quantity of silkworm seeds are distributed free of charge by KOZABİRLİK (Taşkaya Top vd, 2015/b).

Besides, some of the input costs like seed and medicine etc. are covered by KOZABİRLİK so fresh cocoon production cost is relatively low in Turkey (Anonim, 2015). Indeed, (Taşkaya Top vd, 2015/a) in the study, fresh cocoon costs were calculated 2,72 Euro / kg. This situation shows us that if organic agricultural producers engage in sericulture as an additional economic activity then they will not encounter with high input costs. In case a producer takes 2 boxes of hybrid silkworm into breeding with a yield of 40-45 box/kg, in 35 to 40 days, farms are expected to have additional income of 1000 Euro (2015 prices) in the average. Nevertheless, it has significant importance to give support these producers in order to install a breeding house and to form a mulberry tree yard.

In addition to this, as sericulture is an organic form of production it could be considered as a method for environmental inspection of fields in terms of pesticide usage. This situation will facilitate the enlargement of new production areas.

## **CONCLUSIONS AND RECOMMENDATIONS**

In Turkey, considering its importance on rural development in terms of employment and livelihood income and with its created value added contribution to national income and economy, on the other hand protecting and conservation of cultural heritage and gene resources sustainability of sericulture should be provided.

Basic vision of sericulture in Turkey is not only to protect and conserve cultural heritage and traditional methods but also to provide livelihood income and employment in the scope of rural development studies.

In this scope; in order to encourage sericulture activities, production sustainability and to provide livelihood income and employment opportunities who are living in rural areas, considering to conserve traditional production and rural development efforts, Ministry of Agriculture Food and Livestock supports sericulture in Turkey (GTHB, 2014). Barely to achieve this purpose; primarily current production areas should be rehabilitated and to enlarge production areas new areas should be determined.

In order to achieve this goal for sericulture, organic agriculture areas are the most convenient places. In Turkey, in the areas where organic agricultural production is carried out and pesticide is not used, as auxiliary economic activity sericulture should be carried out and production must be encouraged in order to spread the production and sustainability of sector. As a result of increase in production in the sector both new job opportunities will be created and significant amount of currency will be saved due to decline in raw silk import. This potential should not be lost while such current sericulture is going on.

But inadequate number of breeding house and supply problems of mulberry leaves have a great role in quitting sericulture. In terms of sustainability and to increase the production; building closed mulberry yards and breeding house should be subsidized.

While distribution of mulberry trees under Mulberry Action Plan, with the purpose of encouraging sericulture priority should be given to fruitless mulberry, white mulberry and Japan ichinoese types and organic agricultural areas should be considered for plantation.

On the other hand, recently increasing awareness of consumers lead to a raise for demand on organic textile products. In this context, worldwide studies on organic silk thread and organic silk products has speeded up. In this context, the raw material for organic silk products will be collected from organic cocoons feed from organic mulberry leaves which are grown in organic agricultural areas. All the process carried out in organic agriculture so the final product will be also organic.

Due to increase in added value generated by the organic sericulture, contribution of sector to national economy will rise. In line with this, increased support granted for organic mulberry plantation per hectare and organic cocoon will be able to promote yield and quality which will increase generation of added value.

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## RENEWABLE ENERGY AND RURAL WOMAN

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### ABSTRACT

Energy is an important component of almost any activity in our life. Turkey has substantial renewable energy resource potentials and they are the second largest domestic energy source after coal. Main renewable energy resources in Turkey are hydro, biomass, wind, geothermal and solar. Rural areas in developing countries suffer significantly from energy scarcity. The income of a rural population depends largely on farming. Energy is used primarily for households (mainly cooking) and other domestic uses plus pumping water for agriculture. Most of the energy needs in rural areas are met with traditional biomass for household uses, and human and animal power for agriculture. Rural people use biomass such as wood or dung as their primary source of cooking and heating. Usually young girls and women carry cow dung and collect wood in the bushes and carry them back to home. This is a hard work and they spend too many hours in the bushes to collect wood. Women of developing countries can spend anywhere between two and nine hours each day in fuel collection and cooking chores. Instead of collecting wood, women can do other things and children can go to school to improve their quality of life. Biomass use not only takes too much of their time but also cause health problems for them. Burning biomass for fuel can also cause significant health risks for women and children. This paper discusses the role of rural women in the use of renewable energy in Turkey.

**Keywords:** Renewable energy, rural woman, sustainability, Turkey

### 1. INTRODUCTION

Energy is an important component of almost any activity in our life. The IEA presented a three-step definition that helps to clarify an evolution in access to energy services, starting from the case of full deprivation. At the first level, energy is needed for basic human needs: lighting, health, education, communication and community services. Then, energy is needed for productive uses that include modern fuels and other energy services to improve productivity, such as in agriculture, water pumping for irrigation, fertilizer, mechanized tilling and in commercial uses of agricultural processing, cottage industry and transport, and fuel. At a third level, energy is needed for modern society needs of domestic appliances, increased requirements for cooling and heating, and private transportation (IEA, 2002). But, World Energy Outlook 2014 pointed out that nearly 1.3 billion people are without access to electricity and 2.7 billion people rely on the traditional use of biomass for cooking, which causes harmful indoor air pollution. These people are mainly lives in rural areas or developing countries (<http://www.worldenergyoutlook.org/resources/energydevelopment>).

Fossil fuels provide a remarkable service in our life. Unfortunately, they become heavily depleted over time and expensive to use. There is an ongoing debate that fossil fuel reserves will be depleted within 50 or 100 years. Also, they are not so environment friendly. On the other hand, many countries have substantial renewable energy resource potential. Turkey is one of them. Last decade advantages of renewable energy resources are utilized and countries are started to get benefit from these sources.

The income of a rural population depends largely on farming. Energy is used primarily for households (cooking and heating) and other domestic uses plus pumping water for agriculture. Most of the energy needs in rural areas are met with traditional biomass for household uses, and human and animal power for agriculture.

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Eventhough women play an important role in agriculture and in energy use and saving, they are not involved the projects and/or programs that deals with energy. In this paper, first the potential of renewable sources in Turkey is discussed and the second part the role of rural women in renewable energy was analyzed.

## 2. RENEWABLE ENERGY SOURCES IN TURKEY

Turkey has a favorable climate and environment, with substantial reserves of renewable energy sources to meet increasing energy demands. These energy sources are the second largest domestic energy source after petroleum. Main renewable energy resources in Turkey are hydro, biomass, wind, geothermal and solar.

Historically, hydropower is considered as the most important renewable energy source in Turkey. and currently it is the second largest domestic energy source after coal. The economically feasible hydropower potential of Turkey has shown an upward trend in the last decades. In 2013, the renewable energy share in electricity production was 29% of the total production and 40% of the installed capacity. Hydropower, which supplies nearly 25.0% of Turkey's electricity requirement, is the primary renewable energy source in the country (Melikoglu, 2013)

Agricultural and forest residues, as well as purpose-grown energy crops, are potential energy resources. Homegrown energy sources will reduce dependence on oil to a considerable extent and thus oil imports will be decreased (Bascetincelik et al, ). Fuel wood and animal waste are the main biomass fuels used for heating and cooking in many urban and rural areas. Total biomass production is expected to be 52.5 Mtoe in 2030. This estimate is based on the recoverable energy potential from agricultural residues, livestock farming wastes, forestry and wood processing residues and municipal wastes.

Turkey's technical wind energy potential is 88,000 MW but the current wind energy potential that is economically viable is 10,000 MW. The country been classified into six different wind regions with a low of about 3.5 m/s and a high of 5 m/s at 10m altitude, which corresponds to a theoretical power production of between 1,000 and 3,000 kWh/(m<sup>2</sup>yr). The most attractive wind energy sites are the Marmara Sea region, the Mediterranean Coast, the Aegean Sea Coast.

Turkey is ranked as the seventh richest country in the world in terms of its geothermal potential for electricity generation and direct use of this energy . After China, Japan, USA and Iceland, it is the fifth biggest country using geothermal energy for hot spring and heating purposes (Demir et al, 2013). Unlike the rest of the world, the utilization of heat pumps and development of enhanced geothermal systems has not gained any footage in Turkey. Heat pump utilization is very limited due to its high capital costs. But greenhouse heating looks very profitable. The cost of constructing a 10 ha greenhouse which will pay for itself in two years is estimated to be 5 million dollars (ISI, 2005). 55% of the geothermal areas in Turkey are suitable for heating practices. In Turkey, a total of 120 ha greenhouses and 100,000 houses in 15 different settlements are heated with geothermal energy ([www.enerji.gov.tr](http://www.enerji.gov.tr)).

Turkey has huge potential, flat-plate solar collectors for domestic hot water production in coastal regions. Use of solar thermal is already widespread. Turkey's total solar energy potential is 35 Mtoe per year and the share of in renewable energy 5.8%. is expected to reach 1,119 kilo tonnes of oil equivalent (Ktoe) in 2020 (Eurostat, 2014).

The share of renewable energy supply by biomass and wastes, hydro energy, geothermal energy, solar and wind energy are 33.0%, 37.2%, 19.2%, 5.8% and 4.7% respectively with a total (Eurostat, 2014). The effective use of renewable energy is important in Turkey. Like other developing countries, rural people use biomass such as wood or dung as their primary source of cooking and heating.

### **3. RENEWABLE ENERGY AND RURAL WOMEN**

Renewable energy technologies not only create new jobs for male farmers but also provide welfare for women's life. Women need renewable energy for cooking and heating. They collect wood and cow dung and carry them to home. It is not an easy job and they have to spend too much time. Women spend extremely important time at home and in agricultural activities. Cleaning, cooking, heating, grain grinding and water pumping are some of the activities which rural women mainly responsible. Women of developing countries can spend anywhere between two and nine hours each day in fuel collection and cooking chores. Instead of collecting wood, women can do other things and children can go to school to improve their quality of life.

Also, rural women are trying to earn extra income for their family with using micro credits. With the help of micro-credits, they have small enterprises, such as sewing, they also need energy for their new job. Cecelski (2000) addressed women's needs in renewable energy in four areas; a) the biomass cooking crisis: fuel scarcity; health and safety; b) the human energy crisis: women's invisible time and effort; c) energy for microenterprises: livelihoods and income and d) energy for the modern sector: fuel substitution, efficiency and transport.

Women use energy more effectively than men because their life becomes very tough without energy. They need energy but clean and affordable energy. Because IEA estimates that 1.3 million people, mostly women and children- die every year because of exposure to indoor air pollution from biomass (IEA, 2006). Use of renewable energy also provides clean environment. Women also negatively affected by deforestation because they use forest products to improve their quality of life.

Lack of energy can also cause less use of Information Communication Technology (ICT). The ICT, such as TV, internet and phone, can improve the knowledge of rural women. Women farmers can use solar space heating systems in livestock, dairy and also other agricultural activities. They have been using sun to dry their crops for decades. With solar dryers, they dry their crops without insects. Also greenhouses can be built with using solar energy.

### **4. CONCLUSION AND DISCUSSION**

Adoption of new technology has never been easy. Women farmer's social and economic factors have an influence on adoption of new technology. Unfortunately not only income levels but also educational levels of rural women are low in Turkey. Also government policies has been affecting adoption rate of technologies. Extension can help with providing technical assistance at farm level. The assistance may include providing information about government priorities and policies and training to farmers leading to improve energy efficiency on farms and houses related to cooking, cleaning, heating, tillage, irrigation and grazing. As rural energy used in farms and households that can add value to agricultural products which helps improve the farmers' incomes and sustainability.

Eventhough women play an important role in agriculture and in energy use and saving, they are not involved the projects and/or programs that deals with energy. Women can have a significant role in developing and engaging programs related to energy production and use. They also educate their children about energy use and saving because as Nishimizu (2001) pointed out that usually young girls help their mother to carry cow dung and collect wood in the bushes and carry them back to home. They spend too many hours in the bushes to collect wood.

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## THE COMPARISON OF PEST MANAGEMENT INFORMATION SYSTEMS AND COMMUNICATION NETWORKS FOR ORGANIC AND CONVENTIONAL HAZELNUT PRODUCERS IN SAMSUN PROVINCE OF TURKEY

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### ABSTRACT

The main aim of this study is to compare the pest management related information sources used by organic and conventional hazelnut producers in Terme and Çarşamba district of Samsun province, Turkey. This study also presents the communication networks for both groups of producers. The main data were collected with surveys from organic and conventional hazelnut growers in Çamlıca, Yüksekyayla and Ağcagüney villages and the interviews were also conducted with key informants in the network. The socio-economic characteristics of organic and conventional hazelnut growers were analyzed with descriptive statistics; the use of different pest management strategies (i.e. pesticide and plant protection methods) and attitudes towards pesticide use were analyzed with Knowledge, Attitudes and Practice (KAP) approach; their current communication networks were analyzed and compared with Social Network Analysis (SNA). According to the results of the study, the organic hazelnut growers' the social security status, the land size; hazelnut sale price, agricultural organization membership, labor needs, status of agricultural insurance and utilization of agricultural supports were higher than that of conventional hazelnut producers. The organic hazelnut producers cannot used chemical pesticides instead they used different organic pest management strategies such as collecting and burning pests, pest traps, organic materials, cultural treatments and mechanical weed control. On the other hand, the conventional hazelnut growers mainly used chemical pesticides bought from local dealers and chambers of agriculture. The attitudes and behavior of organic hazelnut growers towards using all kinds of organic pest control methods were more positive than that of conventional hazelnut growers who generally prefer to use chemicals. The informal information sources for both organic and conventional hazelnut growers were mainly used and that were leader farmer who were also organic growers. It was identified that the institutional or formal information sources supporting both groups of hazelnut growers were limited and seldom used. They were public institutions' staff such as MFAL extension workers and university researchers and local private agricultural advisors. The organic producers shared their experiences and local knowledge with themselves. However, their local knowledge should have been supported with scientific information.

**Keywords:** information systems, communication networks, Social Network Analysis, organic hazelnut, pesticides

### 1. INTRODUCTION

Agricultural struggle can be stated as protection the plants from the harmful effects of plant diseases, pests and weeds within the economic base and increasing the amount and quality of production. Plant protection is defined as a process of all technical, economic and legal precautions to minimize the harmful effects or treatments (Döken et al., 2011). When examined both definitions, it seems to emphasize two issues: economic framework and health of human and the environment.

In the world, many agricultural control and plant protection methods are applied against disease occurring in the agricultural production and harmful pests. Although it is known environmental problems caused by modern agricultural system and increasing social awareness, even in developed countries chemical pesticides are used extensively in protection methods (Dağ et al., 2000).

The intensive use of chemical pesticides leads to some drawbacks. Some of them are economic losses, adverse effects on human health, disruption of the natural balance, the emergence of drug resistant species and the second-degree harmful pests species come to first-degree position.

As it emerges harmful effects of the chemicals began to be given to alternative methods of struggle. In these control methods that seek intensive knowledge and labor, it is taking advantage of the natural enemies. Also they are evaluated together with the ecology of harmful and useful and provides direction to combat cultural measures. In order to achieve the intended application of plant protection methods, agricultural struggle should be carried out in accordance with the framework of integrated pest management (IPM). The concept of integrated pest management expresses all the studies that taking advantage of all the known methods of struggle in agricultural and the least negative impacts on the environment and human health (Delen et al., 2005).

Integrated Pest Management (IPM) is one of the alternative methods and it has been raised for the first time in 1959 by Stern. It is defined as the use of biological and chemical control methods in accordance. The concepts get on the agenda by the FAO in Rome in 1965 and supported by international organizations such as FAO, World Bank, GATT, UNCED, UNEP and WHO. In particular, the role of the financial support of the World Bank is great in the expansion of this method (Abdpourdalal, 2002). The system is intended to be kept below the economic damage level of the harmful effects populations, not completely eliminate. The conservation and maintain of natural enemies in the environment are most important (TKB, 2002).

These developments in agricultural struggle have prompted the researchers in the development of sustainable agricultural technologies related to combat. In addition to these changes in crop production systems, the development of plant protection methods are experienced. The good agricultural practices (GAP) and organic farming aiming at protecting the environment and human health are the good examples of this system.

Organic farming, contrary to conventional agriculture based on high input use, has emerged as a closed system of agricultural production based on principles of self-sufficiency. Organic farming is a sustainable agricultural system that has specific principles and practice of farming management to marketing of the products (Demiryürek, 2000). The countries in all over the world in transition to organic farming have chosen to start from the traditional products of the country. In Turkey, dried fruits and nuts, are the first products produced as organically. Today, over 42 thousand producers producing approximately 216 different products in 380 thousand hectares of land as organically (Demiryürek, 2011). Organic products are exported to more than thirty countries from Turkey and made more than 40% in value of exports to Germany (Demiryürek and Aydoğan, 2010).

Organic hazelnut cultivation in Turkey began with a German company's demands for organic hazelnut in Çamlıca village in Terme district of Samsun. Organic hazelnut production is the most-produced product in 20,145 decar production area in the province of Samsun. Organic hazelnut production is intensively produced in Çamlıca and Yüksekyayla village in Terme district and in Ağcagüney town in Çarşamba district of Samsun province (Yetgin, 2010). The amount of organic hazelnut production in Samsun province is approximately 10% of the Turkey's organic hazelnut production (Aydoğan, 2012). Samsun province has an important place in terms of the organization of organic hazelnut growers and the creation of marketing channels as well as organic hazelnut growing. The first agricultural and indeed organic producers association was established in Terme district of Samsun province in Turkey. In context of organic farming in the Samsun province, Terme Organic

Agriculture and Hazelnut Growers Association, Yüksekyayla Village Cultural and Solidarity Association, Çarşamba Organic Hazelnut Growers Association and Yukarı Aksu Organic Village Farm Project have been completed their organization process. Local governments and public institutions by providing the necessary support provided opportunities to reach consumers in organically produced products (Demiryürek, 2010; Aydoğan, 2012).

In this study, the information sources of organic and conventional hazelnut growers related pest control, the structure of the communication networks among growers and the structure of the relationship between producers were examined by social network analysis.

## **2. MATERIALS AND METHODS**

### **2.1. Study area**

This study was carried out in three different namely Ağcagüney town in Çarşamba district of Samsun, Çamlıca village and Yüksekyayla village in Terme district of Samsun province. Çamlıca village is one of the first areas began to be produced organic hazelnut production in Turkey. Organic hazelnut production in Çamlıca village was begun with organic hazelnut demand from a German organic marketing company in 1993. The first organic hazelnut growers association in Turkey was established in Çamlıca village by organic hazelnut growers. Conversion to organic farming in Yüksekyayla village was started with the project of EU Capacity Development for Transition to Organic Agriculture. In Yüksekyayla village the hazelnut growers were trained and adopted organic farming. Conversion to organic farming in Ağcagüney town was also started with the project of Conservation of Land for Environmental Purposes (CLEP). Transition to organic farming has been mandated in this town located in the basin of the drinking water dam Gökçeçakmak. Conventional agriculture has not been allowed in the basin of dams that provide drinking water. These study areas was selected purposefully due to their different ways of conversion to organic farming.

### **2.2. Interviews and Sampling**

The sample frame in the research area composed of organic and conventional hazelnut producers in the Ağcagüney town, Yüksekyayla and Çamlıca villages in Samsun province. The conventional producers were selected from same location with organic growers in order to eliminate differences about agriculture and ecology and to compare organic and conventional growers in terms of their socio-economic characteristics, input use and pest management methods, information sources, and networks. Data were collected using structured interviews of 57 randomly selected conventional hazelnut producers and all 55 organic hazelnut producers in the study area. To ensure reliability and validity, a pilot survey was tested on a small group (10 organic and 10 conventional producers) to test and modify the interviews before conducting the main fieldwork. Cronbach alpha was used as an index of internal reliability or consistency for a set of questions, and an alpha of 0.71 or higher was considered to indicate an acceptable level of internal reliability.

### **2.3. Statistical methods**

The data obtained by questionnaire coded in a SPSS file. To compare organic and conventional hazelnut producers in terms of socio-economic characteristics, the variables grouped in to parametric and nonparametric variables. The Student's t-test was initially used to test parametric variables and chi-square test was used to test nonparametric variables in this research.

Social network analysis (SNA) test methods also used to compare the structures of their networks, to determine who the leader farmers are in the network and to interpret other implications related with network theory. SPSS software was used to execute Student's t-test, chi-square test, and NodeXL software was used to execute SNA statistics and to visualize the networks.

### 3. RESULTS AND DISCUSSION

#### 3.1. Socio-economic characteristics

As can be seen in Table 1, both organic and conventional hazelnut producers were over 50 years of age, and there was no statistical difference between their ages ( $p > 0.05$ ). In other words, it can be said that age is not effective on the identifying production system. Age variable was similar with results of previous studies in the same area (Demiryürek, 2000 and 2010) and studies in other regions (Olhan, 1997; Rahman and Yamao, 2007).

**Table 1: Comparison of socio-economic characteristics**

Variables	Organic producers		Conventional producers		t test p
	Mean	Std dev.	Mean	Std dev.	
Age (years)	56	13.3	53	11.5	-
Formal education duration (years)	6.7	2.9	6.3	2.5	-
The current cultivated land (da)	49.1	44.5	33	23.5	*
The current leased land (da)	3.3	12.3	0.4	3.3	*
Hazelnut production area (da)	47.5	44.3	30.9	19.7	*
Need for foreign labor force (people)	79.3	77.5	52.1	46.2	*
Hazelnut selling price (TL/kg)	4	0.3	3.8	0.2	*
The share of agricultural income in total income (%)	53.9	-	42.4	-	*
Agricultural insurance coverage status (%)	9.1	-	1.8	-	*

Although the education level of organic hazelnut producers is expected higher than education level of conventional hazelnut producers (Demiryürek, 2000 and 2010; Padel, 2001; Jacobson et al., 2003), there was no statistical difference between their education levels ( $p > 0.05$ ). Due to the homogeneous demographic structure of the region, relatively aged people are living in the villages and young people generally prefer to live in city centers and are not interested in agriculture. Therefore, education levels of both organic and conventional hazelnut producers were similar and low.

When organic and conventional hazelnut producers compared in terms of land size, leased land size, and hazelnut production land size, organic hazelnut producers had more farm land ( $p < 0.05$ ). Organic hazelnut producers increased their current land size with leasing. The organic hazelnut producers allocated most of their land size for organic hazelnut production compared to the conventional hazelnut producers ( $p < 0.05$ ). Organic hazelnut producers had bigger land size than conventional hazelnut producers ( $p < 0.05$ ). It could be explained that the organic marketing company wanted to be the object of less organic hazelnut producers. Therefore, the organic marketing companies contract with the organic hazelnut producers who have bigger hazelnut production area (Demiryürek, 2010).

Organically produced hazelnut sale price was higher than conventionally produced hazelnut sale price ( $p < 0.05$ ). Due to the marketing problems and insufficient demand, few organic hazelnut producers could sell only 18.2% of their organic hazelnut products as organically. Nevertheless, differences between organic and conventional hazelnut sales prices were based on contracting farming model in organic agriculture. Even if organically produced hazelnuts were sold as conventionally in the local market, the sale price may be higher due to its better quality. Farm enterprises that produce organic hazelnut needed 65% more foreign labor forces than conventional

hazelnut producing enterprises ( $p<0.05$ ). Higher demand for labor from out the farm could be explained by using lime, manure and organic fertilizers in organic hazelnut farming. These plant maintenance activities required the use of intensive labor. Organic hazelnut producers' share of agricultural income in their total enterprise income was statistically different from that of conventional hazelnut producers ( $p<0.05$ ). Due to additional premium price for organic agriculture, purchase and price match guarantee in contract farming in organic hazelnut production, obtaining certification premium as a grant, and not using chemical inputs in organic farming, the economic performance of organic hazelnut producing were better than conventional one. In both organic and conventional production systems, willingness to take insurance was low but the number of organic producers who taking insurance was more than the conventional producers ( $p<0.05$ ). The reasons for taking out insurance were statistically different for organic hazelnut production and conventional production systems. According to organic hazelnut producers, they did not have enough information about agricultural insurance and the insurance premiums were found to be expensive. According to conventional hazelnut producers, they did not need the taking insurance and they had land ownership problem due to lack of land registration. In other words, in conventional production system the ratio of joint land using was more than organic production system. 16% of organic producers stated that they would take insurance in the next production period. Organic hazelnut producers' willingness to joint agricultural organizations differed statistically from conventional hazelnut producers' willingness. While organic producers set up their own agricultural organizations (union, association, cooperative and so on), the conventional producers were not organized themselves and willingness ratio of joining the existed agricultural organizations was low.

### **3.2. Pest Management Information Systems and KAP (Knowledge, Attitude, Practice)**

KAP approach is an analysis method to measure a communities have information about a case, attitudes and practices. In other words, KAP shows the tendency of the community on the issue. The main objective of the KAP analysis is to investigate changes in behavior, attitudes and practices of the communities or individuals on the issues (Goutille, 2009). In the classical research design, only information scores (or current state) can be measured, cannot be determined what the attitudes of the test subjects. To do forward planning and to fully define the research area require not only individuals' information on the subject, at the same time what they think about the subject. KAP approach provides the opportunity to researchers questioning the forward-thinking information of the individuals on relevant issue besides whether the individuals have any information on the subject.

In this research project, the questionnaire prepared to measure awareness of the some inputs and the input use of the organic and conventional hazelnut growers is designed according to the KAP approach methods. Since the main purpose of the study is to examine the communication sources of the hazelnut growers on crop protection methods; the names of the plant protection methods used in organic and conventional hazelnut farming were asked open-ended questions and the information, attitudes and practices on crop protection methods of the individuals was investigated. In the study, the hazelnut growers were asked to specify their information status for each plant protection methods separately, from which sources they gain this information and input purchasing resources.

The earlier studies conducted in the Black Sea region was examined, it is seen that the *Xyleborus dispar*, *Aphids*, *Curculio nucum*, *Gypsonoma dealbana*, *Phytoptus avellanae* and *Hyphantria cunea* hazelnut pests cause economically damage (Işık et al., 1987; Ecevit et al., 1995; Saruhan and Tuncer 2001; Tuncer et al., 2002; Ak et al., 2005). Generally, collection, burning and chemical applications methods are applied in the fight against these harmful pests.

In this part of the study, awareness and tendencies of hazelnut producers for these harmful pests and pest management methods analyzed. As it is known, it is not allowed to use chemical pesticides in organic farming system. However, there is no restriction in the conventional production system. However, hazelnut pests mentioned above serve the same damage in both organic and conventional production systems. Thus, if the

methods of organic producers to combat these pests and how they achieved success, these pest control methods may also be used for conventional producers for a more environmentally friendly method instead of chemical applications.

The information level and attitudes of organic and conventional hazelnut growers on hazelnut pests and pest management methods were given Table 2. It can be said that the Curculio nucum, Xyleborus dispar, Gypsonoma dealbana and Phytoptus avellanae are the most common hazelnut harmful pests. However, approximately 30% of the organic hazelnut growers have no information on these pests. Approximately 10% of the organic hazelnut growers fought with one of these harmful pests and later gave up fighting. Around 20% of the organic hazelnut growers combat these pests.

**Table 2: Plant protection methods and attitudes according to the production system**

Pests and control methods	Production system	K- <sup>1</sup> (%)	K+ <sup>2</sup> (%)	A- <sup>3</sup> (%)	A+ <sup>4</sup> (%)	P- <sup>5</sup> (%)	P+ <sup>6</sup> (%)
Xyleborus dispar	Organic	30,9	12,7	-	25,5	10,9	20,0
	Conventional	17,9	41	-	10,3	2,6	28,2
Lepidosaphes ulmi	Organic	34,6	14,5	-	25,5	10,9	14,5
	Conventional	23,1	33,3	-	7,7	5,1	30,8
Curculio nucum	Organic	30,9	12,7	-	18,2	7,3	30,9
	Conventional	17,9	33,4	-	5,1	5,1	38,5
Gypsonoma dealbana	Organic	38,2	12,7	-	20	10,9	18,2
	Conventional	24,3	37,8	-	8,2	2,7	27
Phytoptus	Organic	35,2	13	-	24,1	11,1	16,7
	Conventional	60,9	15,2	-	15,2	4,3	4,3
Hyphantria cunea	Organic	35,2	16,7	-	24,1	11,1	13
	Conventional	54,5	25	-	4,5	2,3	13,6
Collection and burning	Organic	32,7	14,5	1,8	20	3,6	27,3
	Conventional	63,6	12,7	-	7,3	7,3	9,1
Chemical control	Organic	-	-	-	-	-	-
	Conventional	-	-	-	-	40,4	59,6

<sup>1</sup> No information <sup>2</sup>Have information <sup>3</sup> Negative attitude <sup>4</sup> Positive attitude <sup>5</sup> Practiced and gave up <sup>6</sup> Practicing

When Table 2 is examined, it is seen that maximum rate of conventional hazelnut producers have had no information about Phytoptus avellanae and Hyphantria cunea. However, conventional hazelnut growers seems to fight with Lepidosaphes ulmi (30.9%) and Curculio nucum (38.5%). Organic and conventional hazelnut producers when considered together; generally while awareness about hazelnut harmful pests is higher in conventional hazelnut producers (B+), organic hazelnut producers can be said they are more positive on the subjects they have the knowledge to fight (T+). In other words, while conventional hazelnut producers are not expected a change in pest control in future periods, it can be said that the research possibility of new alternative pest control methods of organic hazelnut growers is higher. This condition is thought to result from differences struggle in organic and conventional production. While organic growers has to struggle with the collection and burning methods against harmful they are exposed (27.3%), 59.6% of conventional growers are using chemicals to struggle with pest.

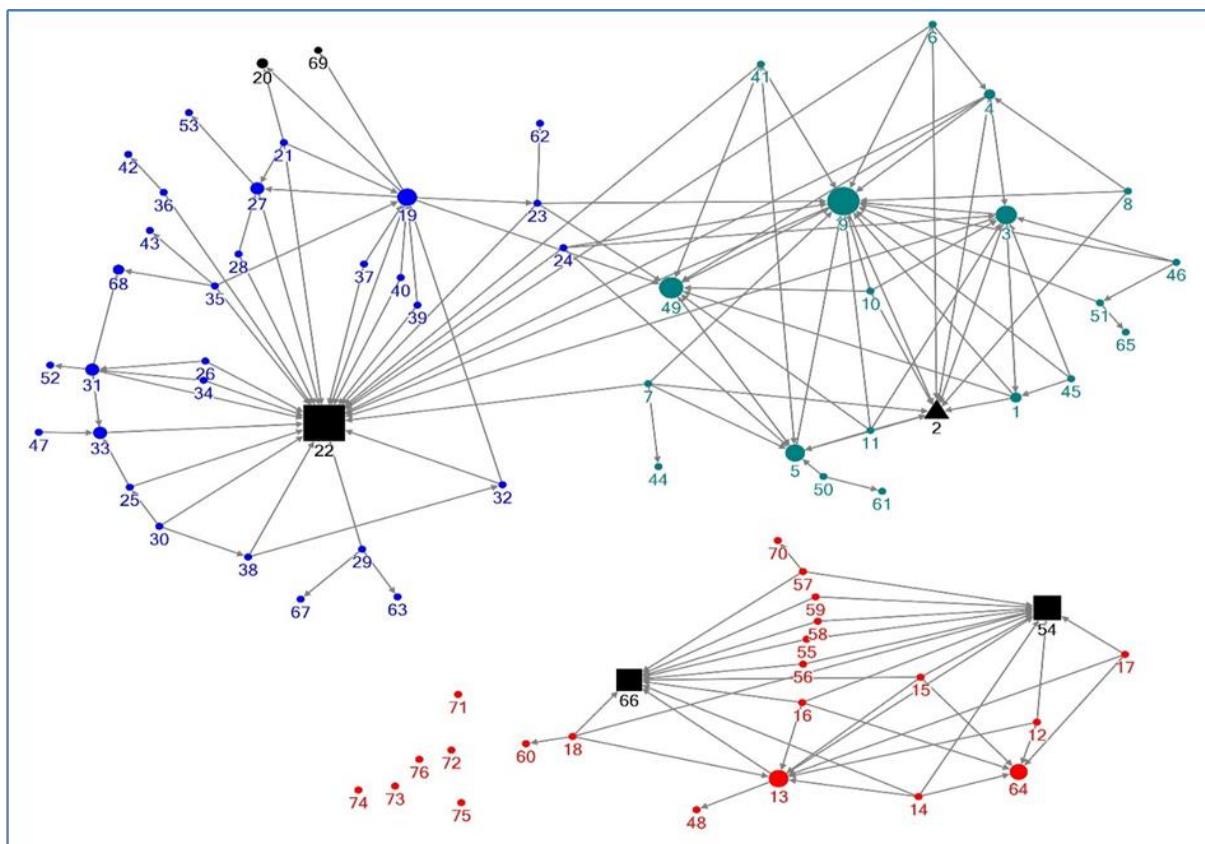
### 3.3. The communication networks of organic and conventional hazelnut producers

In this study, organic and conventional hazelnut producers are likely to exchange information with each other because they have been selected from same study area. According to this approach, organic and conventional hazelnut producers living in the same social environment was considered as a network. The network was named general interaction network. In this network, it was investigated that the organic and conventional hazelnut producers use of which communication channels and whom they receive information on pest control methods.

Communication networks in the village can be defined as networks of face-to-face relationships formed with kinship, friendship or neighborly relations. All actors in these networks know each other (Hoang et al., 2006). In this part of the study, firstly communication networks of organic hazelnut producers and conventional hazelnut producers were analyzed and later they were compared.

In Figure 1, black squares refer to public organizations, black triangles refer to the chambers of agriculture, blue circles refer to the organic hazelnut growers in the Çamlıca Village, green circles refer to the organic hazelnut growers in the Yüksekayla Village and red circles refer to the organic hazelnut growers in the Ağcagüney village. The arrow shows the direction of information exchange.

**Figure 1: The communication network of organic hazelnut growers**



Organic hazelnut producers' communication network consists of 55 organic hazelnut producers and 21 actors from outside the villages (Figure 1). The network density is 0,026 and average degree is 3.86. In other words, the ratio of actors' communication with each other in organic hazelnut producer network realized 3.86%. Also, it can be said that only 2.6% of possible relationships were established in this network. There are 8 groups in this network. Both groups were associated with each other, the actors of other groups were isolated. The largest group consisted of organic hazelnut growers in Çamlıca, Yüksekayla villages and their information sources. In this largest group, organic hazelnut growers exchanged information with each other via Terme Organic Hazelnut Producers Union.

There was no information exchange between Ağcagüney village with the largest group. The reason was that Ağcagüney village differed from other villages due to geographical distances and compulsory conversion to organic farming. However organic hazelnut growers in the Ağcagüney village formed a group among themselves. Contrary to the organic hazelnut growers in Çamlıca and Yüksekayla villages, there were 6 actors who did not participate in any group in Ağcagüney village. These actors applied the plant protection methods according to their experiences.

Considering how the establishment of communication within each group, it was seen that the importance degree of some actors was greater than others. These differences were expressed by size of the actors on the graph. In Figure 1; prayers (i.e. imam) of the village were symbolized by number 9 and 27; elected village headmen (i.e. muhtar) was symbolized by number 3 and 13; the president of organic hazelnut growers associations were symbolized by number 19 and 64; and the experienced organic producer with very high technical knowledge were symbolized by number 5 and 33. In addition, these opinion leaders were organic hazelnut growers. In other words, (in this network) organic hazelnut growers obtained the information about pest management from the people who were near to them and had a corporate identity. In Figure 1, the actors symbolized by number 22, 54 and 66 were the biggest size and actors in this property. The actors symbolized by number 22 and 66 refer to the extension workers in Çarşamba and Terme district directorate of Ministry of Food, Agriculture and Livestock (MFAL). The actors symbolized by number 54 was an agricultural engineer and official agricultural consultant who employed by MFAL within TAR-GEL project. In summary, organic hazelnut growers obtained information from the public agencies and institutions primarily, these information spread into the network by leader farmers who has corporate identity.

The communication network on pest management of conventional hazelnut growers presented in Figure 2.

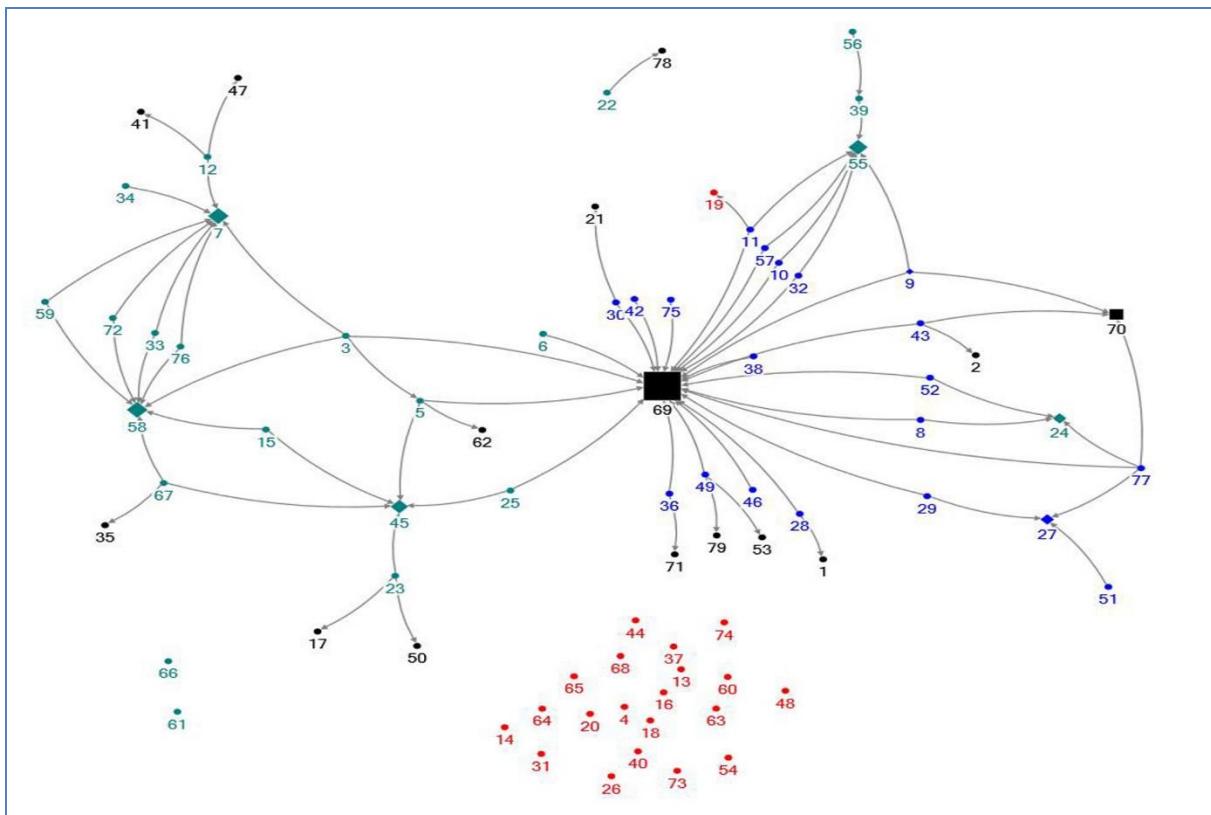


Figure 2: The communication network of conventional hazelnut growers

In Figure 2, black squares refer to public organizations and chambers of agriculture, blue circles refer to the conventional hazelnut growers in the Çamlıca Village, green circles refer to the conventional hazelnut growers in the Yüksekyayla Village and red circles refer to the conventional hazelnut growers in the Ağcagüney village, green solid diamonds refer to the organic hazelnut growers and black circles refer to the information sources from outside the villages. The arrow showed the direction of information exchange.

Conventional hazelnut producers' communicatin network contained of 57 organic hazelnut producers and 22 actors from outside the villages (Figure 2). The network density was 0,012 and average degree is 1.86. In other words, the ratio of actors' communication with each other in conventional hazelnut grower network realized as 1.86%. Also, it can be said that only 1.2% of possible relationships were established in this network. There were 24 groups in this network. Both groups were associated with each other, the actor of other groups were isolated. The largest group consisted of conventional hazelnut growers in Çamlıca, Yüksekyayla villages and their information sources. There were 54 conventional hazelnut growers in this largest group. As can be seen from Figure 2, all the conventional hazelnut growers in Ağcagüney village were isolated due to distance from other two villages. This situation contributed the fact that hazelnut harmful pests were less than other villages.

According to Figure 2, the flow of information controlled and diffused by some critical actors in the groups. The primary information sources of conventional hazelnut growers in the Çamlıca village were Terme district directorate of MFAL and Terme chamber of agriculture. In Yüksekyala village, the primary information sources of the conventional hazelnut growers were the organic hazelnut growers.

In the conventional hazelnut growers network, the flow of information among the actors and groups provided by the actors 7 (prayer of the village and organic grower), 58 (elected headman of the village and also organic hazelnut grower), 45 (president of the village association and also organic hazelnut growers), 55, 24 and 27 numbered actors (organic growers with very high technical knowledge).

Compared the communication and information resources on pest management of organic and conventional hazelnut growers, it was determined that organic hazelnut growers obtained the information about pest management from the people who were near to them and had a corporate identity. However, conventional hazelnut growers consulted on pest management to organic hazelnut growers in the same geographical region.

While relationships among the groups in the networkF were more dense and networking efforts were stronger in the organic hazelnut growers' communication network, relationships among the groups were disconnected and networking efforts were weaker in the conventional hazelnut growers' communication network.

#### 4. CONCLUSION

In this study, communication networks, information sources, communication channels to access information, actors and roles of actors of the organic and conventional hazelnut growers were analyzed. Socioeconomic characteristics, using state of the plant protection methods and communication networks of the organic and conventional hazelnut growers were compared. Obtained syntheses from the results of research and recommendations for solving the problems arising from the research are introduced in this section.

Protection of the economic interests and in order to have an active role in the markets, organization of organic farmers should be encouraged and supported. There should be more information support from outside information sources in organic hazelnut production; it was seen that the information support was not enough. Organic hazelnut producers to reach new or alternative information should be provided through public extension services. In addition, organic hazelnut producers may obtain the new information they need through their organizations through private agricultural consultants.

The new information and innovations transferred and spread into organic and conventional hazelnut producers' network by head of producer union, prayer, elected headman of the village or opinion leaders who trusted their technical knowledge. Therefore, transferring of new information from external resources should have been delivered by those leader farmers into this network.

In one of the important research findings, it was determined that conventional hazelnut producers consulted the organic hazelnut producers. Exemplifying of organic hazelnut producers to conventional hazelnut producers may work more effectively in order to transition of conventional farmers to more environmentally friendly and sustainable farming techniques.

Both organic and conventional hazelnut growers relied on the experience and the ideas of growers who assumed the role of leader farmer in the village. Thus, innovations and information transfer should be diffused into the network with this function of leader farmers.

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## **FOOD SECURITY AND FAMILY PLANNING IN OYO STATE, NIGERIA**

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### **ABSTRACT**

This study affirms the effect of family planning on rural household food security. The major thrust of this research is to profile the identified socio-economic characteristics of respondents, various family planning methods used, benefit of use and factors influencing household food security in the study area. The research was carried out in 4 Local Government areas (LGAs) of Oyo state, where five communities each were selected at random from the LGAs. A total of 272 households were sampled from the 20 communities. Structured questionnaires were used in gathering the information needed from the respondents. Both descriptive and multinomial logit regression were used to analyse data collected. The findings revealed that 64.4% of the respondents were female, mean age was 40years; about 80% of them were married most of the them had formal education with average 10years spent in school. The result also revealed that that most of the respondents adopt artificial method of family planning. The multinomial logit result shows that sex, marital status of respondent, number of children; primary occupation, traditional method, natural method and artificial method of family planning are the factors influencing household food security status. It was recommended that rural household should be enlightened on the advantages of the use of family planning to improve their household nutritional intake level as well as standard of living.

**Keywords:** food security, rural household, family planning, multinomial logit.

### **INTRODUCTION / PROBLEM STATEMENT**

Food security, according to Anderson (2009), is the provision of food to ensure its adequate supply for all people to live active and healthy lives. It also entails production of food that will go round every citizen both in quantity and quality. That is, the availability or adequacy of food supplies in terms of quantity and variety of food (Oriola (2009). In essence, it implies secure sustainable access to available supplies by all who need them for the maintenance of healthy and active life. Hence food insecurity can be referred to as the inability of a country to secure enough food and adequate dietary intake of all household members and at all times in order to live an active and healthy life.

Adefabi and Aderoju (2011) identify two major types of food insecurity namely, transitory and chronic insecurity. Transitory food insecurity according to them is said to occur when a household assess to sufficient food declines temporarily as a result of instability in food production income as well as prices of food. Chronic insecurity, on the other hand is referred to as continuous inadequate diet by the population of a given country which arises as a result of lack of income or lack of resources.

Income and price influence the consumption of food not necessarily or directly the consumption of nutrients derived from food. When people spend more on food, they may or may not obtain better nutrition. Some of their additional expenditures go for a larger quantity of food but much of it especially, above minimal income levels go for higher quality (Obodomu (2006). Quality can be viewed subjectively by the consumer following his or her tastes. Food regarded as higher in quality need not be more nutritious than less favoured ones and they may even

be nutritionally inferior. Every nutritionist can tell horror stories about the deterioration in nutritional standards as development proceeds: Carbonated beverages replace natural drinks, commercial infant foods replace mother's breast milk and various junk foods are being increasingly consumed by children and adults. Statistics make it clear however that these cases run against the general pattern of improved nutrition in relation to increasing income. The household spend an increasing amount but a decreasing proportion of income on food as their income rises, very poor households devote more than half of their income on food and have relatively high income elasticity of demand for food.

In Nigeria, the percentage of food insecure house was reported to be 18 per cent in 1996 and over 40 per cent in 2005 (Sanusi, et al 2008). Although, figures released by Food and Agricultural Organization in 2005 on the state of food insecurity in the world, indicated that 9 per cent of Nigeria's population was chronically undernourished between 2000 and 2002 (FAO, 2005). Food security is an age long concept as the quality of life of a people, and as such, a household needs to ascertain how to feed, and continue to feed its members (FAO, 2004). However, food security is said to exist when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Nyam, 2005). Consequently, in Nigeria, food security which goes with food self-sufficiency and sustainability is still elusive (Nworgu, 2006). This is because the agricultural sector has not been able to deal effectively with the problem of food security as related to increase in population which can be controlled by family planning.

Running down the memory lane, food security issues can be linked to two major theories: the Malthusian Population theory and Abraham Maslow's hierarchy of Need theory of human Motivation. According to Malthus as reported by Olimar, (2011) there exist a great dichotomy in the rate of growth of population and food production. He argued that while population increased in geometric progression, food production increased in Arithmetic progression. He therefore contends that in due course, there would be acute shortage in food supply which will bring about fall in the standard of living. He later advocated for preventive checks such as "moral restraints" such as abstinence from marriage, family planning and limit the number of progeny, to reduce high population growth rate. His theory has not been proved wrong concerning this issue in Nigeria and other African countries which is having the challenges of food security in the present time and the quest to satisfy man's primary need of food consumption. Therefore, to meet this need agriculture must be given serious attention.

On the other hand, family planning is known to allows individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births. It is achieved through use of contraceptive methods and the treatment of voluntary infertility. A woman's ability to space and limit her pregnancies has a direct impact on her health and well-being as well as on the outcome of each pregnancy (WHO 2011). This consequently enhance the overall welfare of the household at large especially in the area of food security. Family planning services are defined as educational, comprehensive medical or social activities which enable individuals, including minors, to determine freely the number and spacing of their children and to select the means by which this may be achieved.

Typically large family size has significant relationship with much greater risk of poverty. Obamiro et al (2003) reported that an increase in household size would likely lead the household membership to food insecure group. In Nigeria, the production of food has not increased at the rate that can match the food demand of the increasing population. While food production increases annually at the rate less than 2.5 per cent, food demand increases annually at a rate more than 3.5 per cent due to the high rate of annual population growth of 2.83 per cent (Oluyole and Lawal 2008). Recent study by Adebayo (2012) shows that large family size has negative effect on food security, the results of this study indicated that about 60 per cent had family size of 5and 8 members. Only 24.5 per cent were food secure; hence, the need for family planning.

Raising a child requires significant amounts of resources: time, social, financial and environmental resources. Family planning can help assure that resources are available. The purpose of family planning is to make sure that any couple, man, or woman who has the desire to have a child has the resources that are needed in order to complete this goal. These resources a couple, men or women can explore the options of natural birth, surrogacy, artificial insemination or adoption. In the other case, if the person does not wish to have a child at the specific time, they can investigate the resources that are needed to prevent pregnancy, such as birth control, contraceptives, or physical protection and prevention.

Food insecurity is common in less developed countries and Nigeria is no exception. Audu-Bida (2010) reiterated that about seven states of Nigeria were currently at the risk of food insecurity and nutrition crises. The persistence of hunger in many parts of the country being juxtapose with good surpluses and stocks in some other parts. The rising food prices results in wide spread of food insecurity, starvation and finally deaths due to wide spread poverty and poor implementation of government agricultural programmes.

As an illustration of food problems to come due to over population, Lester Brown (2012) projected the world is likely to witness severe starvation and economic dislocation over the next 30 years. Nigeria in 2011 was the world's 7th most populated country with a population of 162 million people and In 2050, Nigeria would be the world's 3rd most populated country after India and China , outstripping the USA with an estimated population of between 230 and 430million people. Nigeria is threatened by food insecurity presently and might face hunger, starvation and even death in the nearest future if the population is not controlled by family planning (Chinedu, 2001). Household food security depends not only on the availability, affordability and sustainability supply of food but also on the coping strategies employed by households for its acquisition among which is spacing of child birth.

In Nigeria presently, several issues can be identified as the causes of food insecurity among these are firstly, the spread and impact of war and conflict disrupts food production, creates refugees and displaced person and keep land out of cultivation e.g. Boko haram invasion in the northern part of the country and intercommunity clashes. Secondly, with huge debt burden, the country needed a significant proportion of export earnings hence, the need for covers supply at the expense of home use coupled with increase Globalized Market. This in combination with increased urbanization has led to shift from food crops to cash crops production on the best land. Thirdly is underdeveloped agricultural sector mostly characterized by over reliance on primary agriculture, low soil fertility, minimal use of external farm inputs, environmental degradation, significant food crop loss (both to pre and post-harvest) etc. the impact of oil boom on the agricultural sector has equally affected the sector as the mainstay of Nigeria economy which invariably reduce the sectors contribution to food production and culminate to food insecurity.

In addition to these, is the existence of disease and infection such as Malaria, tuberculosis and HIV/AIDS not only reduce the man-hours available to agriculture and household food acquisition but also increase the burden of household in acquiring food as well as climate change with its attendant impact as loss of biodiversity in the ecosystem and other physical access. Lastly, it is worthy to note that farming activities are being done mainly by the farmers who do not have access to necessary wherewithal for optimal production of food in Nigeria. The World Bank's (2013) statistics show that about 90 per cent of Nigeria's agricultural output comes from inefficient small farmers who have little or no access to fertilizers, irrigation or other modern inputs. Consequently, such farmers are only able or even struggle to produce enough food to sustain their immediate families.

A number of lessons emerge from the current and projected future population dynamics of Nigeria with major implications for agriculture and food security. Therefore, there is need for the articulation of a green deal for Nigeria. In view of these, this study examined the effect of family planning on food security. Specifically, it

profiled the respondents based on socio-economics characteristics, examined the expenditure pattern of the profiled respondents, identify the various method of family planning adopted in the study area, identify the perceived benefits of family planning on household food security and determine the factors influencing food security status of the farming household.

### **Hypothesis of the study**

$H_{01}$ : Selected socio-economic characteristics has no effect on the food security of the respondents

$H_{02}$ : There is no significant relationship between the use of family planning and the household food security status.

### **METHODOLOGY**

**Study area.** The study was carried out in Oyo state, Nigeria. Oyo states covers a total of 28,454 square kilometres of land mass. It is bounded in the south by Ogun state and in the north Kwara state, in the west by partly Republic of Benin while in the east by Osun state. By 2006 census, the population of Oyo state is 6,617,720 people with the capital located at Ibadan (NPC 2006). Agriculture is the main occupation of the people in Oyo state. The climate is equatorial, notably with dry and wet seasons and high relative humidity. The dry season last from November to March while the wet season starts from April and ends in October. Average daily temperature ranges between 25°C (77.0°F) and 35°C (95.0°F) almost through the year. The climate in the state favours the cultivation of crops such as maize, yam, cassava, millet, rice, plantains, cocoa, palm produce, cashew etc. There are also cattle ranches at Saki, Fasola and Ibadan as well as dairy farm at Monatan in Ibadan. In addition, there are a number of government established farm settlements in some parts of the state.

**Sampling procedure and sampled size:** A multistage sampling technique was employed for the study. In the first stage, random sampling technique was used to select two Agricultural Development Programme (ADP) agricultural zones from the four ADP agricultural zones in Oyo state. Stratified sampling technique which forms the second stage was used to divide the Local Government Areas (LGAs) under the selected ADP agricultural zones into urban and rural as indicated by the Ministry of Local Government and Chieftaincy offices of the state. The third stage involves the use of simple random sampling technique to select two rural LGAs from each of the two agricultural zones considered in the study. Five villages each were randomly selected from each of the selected LGAs at the fourth stage. Finally, using a proportionate to size sampling, 272 households were sampled in the study area.

**Analytical technique:** Primary data obtained analysed using descriptive and multinomial logit regression models. Household were categorized into food security levels using Food Expenditure Approach to food security measurement.

### **Measurement of Food Security**

Households' Food Expenditure Approach to food security measurement (Construction of Food Security Index). According to Omonona and Agoi (2007) the households were classified into food secure, moderately food secure and food insecure households using households' food expenditure approach to construct food security index which was also adopted by Adepoju and Olawuyi (2012); this was used to establish the food security status of various households. It is given by:

$F_i = \frac{\text{per capita food expenditure for the } i\text{th household}}{2/3 \text{ Mean per capita food expenditure of all households}}$

Where  $F_i$  = food security index

When  $F_i \geq 1$  = food secured ith household and

When  $F_i \leq 1$  = food insecure ith household (further categorised into moderately food secured and food insecure household)

A food secured household is therefore those whose per capita monthly food expenditure fall above or is equal to two-third of the mean per capita food expenditure. While moderately food secured are households whose mean per capita food expenditure falls between two-third and one-third of the mean per capita food expenditure. On the other hand, a food insecure household is that household whose per capita food expenditure falls below one-third of the mean monthly per capita food expenditure.

### **Multinomial Logit model**

Following Rahji and Fakayode (2009) multinomial logit regression model was used to express the probability of a household belonging to a particular food security category. The households were categorized into three based on their monthly expenditure on food. The food security categories include; food secured, moderately food secured and food insecure households. The general form of the multinomial Logit model is:

$$\Pr(y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^J \exp(X_i\beta_j)} \quad \dots \dots \dots 1$$

In order to ensure identifiability,

$$\Pr(y_i = 0) = \frac{1}{1 + \sum_{j=1}^J \exp(X_i\beta_j)} \quad \dots \dots \dots 2$$

where for the ith individual,  $y_i$  is the observed outcome and  $X_i$  is a vector of explanatory variables.  $\beta_j$  is the unknown parameters. For this study, the model was summarized as follows:

$$P_{ij} = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^3 \exp(X_i\beta_j)} \text{ for } j = 1, 2, 3 \quad \dots \dots \dots 3$$

$P_{ij}$  is the probability of being in each of the groups 1and 2.

$$P_{i0} = \frac{1}{1 + \sum_{j=1}^3 \exp(X_i\beta_j)} \text{ for } j = 0 \quad \dots \dots \dots 4$$

$$\ln = \frac{P_{ij}}{P_{i0}} X_i \beta_j \quad \dots \dots \dots 5$$

$P_{i0}$  is the probability of being in the reference group or group 0. In practice, when estimating the model, the coefficients of the reference group are normalized to zero (Greene 1993 and Kimhi 1994;). This is because, the probabilities for all the choices must sum up to unity (Greene 1993). Hence, for 3 choices only (3 -1) distinct sets of parameters can be identified and estimated. The natural logarithms of the odd ratio of equations (1) and (2) give the estimating equation as:

$$\beta_3 = -(\beta_1 + \beta_2) \quad \dots \dots \dots \quad 6$$

This denotes the relative probability of each of the group 1 and 2 (moderately food secured and food insecure) to the probability of the reference group (food secured). The estimated coefficients for each choice therefore reflect the effects of  $X_i$ 's on the likelihood of the respondents falling into the alternative relative to the reference group. The coefficients of the reference group however, may be recovered by using the formula (Rahji and Fakayode, 2009).

For each explanatory variable, the negative of the sum of its parameters for categories 1 and 2 is the parameter for the reference group. The partial derivatives otherwise called the marginal effects (" $\frac{\partial P}{\partial X_i}$ ") is obtained by differentiating equations (3) and (4) with respect to the particular explanatory variable. The derivation techniques implicitly indicate that neither the sign nor the magnitude of the marginal effects need to bear any relationship to the sign of the coefficients used in obtaining them (Greene 1993).

$P_{ij}$  = Food security status (0 = food secured, 1 = moderately food secured, 2 = food insecure).

$X_1$  = Sex (male=1, female=0)

$X_2 = \text{Age (years)}$

$X_3$  = Marital status (married = 1, otherwise = 0)

$X_4$  = Number of children (number)

$X_5$  = No of dependants (actual number)

X<sub>6</sub>= Number of working adults

X<sub>7</sub> = Level of education (years)

X<sub>8</sub> = Farming status (full-time=1)

$X_9$  = Membership in association (member = 1, otherwise = 0)

$X_{10}$  = Farm enterprise (crop production = 1, otherwise = 0)

$X_{11}$  = Traditional method (yes = 1, otherwise = 0)

$X_{12}$  = Natural method (yes = 1, otherwise = 0)

$X_{13}$  = Modern method (yes = 1, otherwise = 0)

## RESULTS AND DISCUSSION

#### **A. Socio economic characteristics of the respondents**

The socio economic characteristics of the respondents identified in this study are presented in Table 1. The profiled distribution of respondents according to the level of food security as indicated by the total figures reveals that 58.1% of the sampled household are food secured, 28.3 and 13.6 are moderately food secured and food in-secured respectively. This implies that majority of the respondents in the study area are food secured.

The distribution of the profiled respondents according to their age reveals that, about 39.71% of the respondents fall within the age range of 31-40 years and this accounted for the highest value. About 48% of these age category are food secured. The least value however is 4.78% and this accounts for those above 60 years. The mean age of the respondents is 40.33 years. This is an indication that, most of the respondents are in their productive and active age so their need for family planning to ensure household well-being. Majority of the respondents are female 65.44% while 34.56% of the respondents accounted for male respondents. The female counterpart has the higher percentage of representation due to the fact that most of the family planning methods are usually used by them.

It is also worthy to note that, the distribution of the respondents based on their marital status shows that 58.1% of the respondents are married. It is noteworthy to mention that none of the respondents have never being married at one point in time or the other even though 13.6 % of the respondents were divorced at the time the research was carried out. Also, none of the separated or divorced respondents falls under the food insecure category. About half of the respondents (54.0%) have between 7-9 household members while only 10% of them have above 12 household members. Forty-five percent each of respondents that are food secured and moderately food secured have between 4-6 members in their household. The mean household size in the study area is 8 members which signify that many of the rural households have fairly large family. The reason for this is not far-fetched as many need family labour to help on the farm to reduce their cost of production.

In addition, the educational level result indicates that 33.8% of the respondents spent between 13 and 18 years in school i.e. have a post-secondary education. This is closely followed by respondents with primary education (31.6%). However, the least value 1.1% accounted for those who are post graduates and they fall under the food secured household category. The mean of the years spent in school is 10 years which is higher than the basic 9 years of educational policy adopted in Nigeria. The implication of this is that education level results in awareness and/or adoption of potential family planning suitable for individual to enhance the household welfare. An average household (51.5%) in the study area have no less than two working adults in the household, while only 5.5% of them claim to have 4 adult working members within their household. The mean of working adults is 2, an indication that an average respondents has the maximum of two working adults in the household which influence the availability of resources which in turn affect enhance household food security. Results further reveals that 57.3% of the respondents have less than 10 years of farming experience and this accounted for the highest value while the least value 3.0% accounted for those who have above 25 years of farming experience. The mean year of experience is 13.1 years. This is an indication that majority of the farmers have been into farming for a long time, an activity that ensures food security of the household.

Table 1: Socio-economic characteristics of the respondents

Socio economic characteristics	Food secured freq (%)	Moderately food secured freq (%)	food insecure freq (%)	Total freq (%)	Mean (std. deviation)
<b>Age(yrs)</b>					
<30	19 (34.5)	26 (47.3)	10 (18.2)	55(20.2)	40.3 (9.9)
31 – 40	52 (48.2)	40 (37.0)	16 (14.8)	108 (39.7)	
41 – 50	61 (82.4)	8 (10.8)	5 (6.8)	74 (27.2)	
51- 60	20 (90.9)	1 (4.5)	1 (4.5)	22 (8.1)	
Above 60	6 (46.1)	2 (15.4)	5 (38.5)	13 (4.8)	
<b>Sex</b>					
Male	54 (57.5)	30 (31.9)	10 (10.6)	94 (34.6)	
Female	104 (58.4)	47 (26.4)	27 (15.7)	178 (65.4)	

<b>Marital status</b>					
Single	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Married	138 (87.3)	11 (7.0)	9 (5.7)	158 (58.1)	
Separated	72 (93.5)	5 (6.5)	0 (0.0)	77 (28.3)	
Divorced	35 (94.6)	2 (5.4)	0 (0.0)	37 (13.6)	
<b>Household size</b>					
<3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	8.2 (2.1)
4-6	27 (45.0)	27 (45.0)	6 (10.0)	60 (22.1)	
7-9	85 (57.8)	45(16.5)	17 (4.7)	147 (54.0)	
10-12	41 (74.5)	3 (5.5)	11 (20.0)	55 (20.2)	
Above 12	5 (50.0)	2 (20.0)	3 (30.0)	10 (3.7)	
<b>Education</b>					
0	14 (82.4)	2 (11.7)	1 (5.9)	17 (6.3)	10.3 (5.5)
1-6	43 (50.0)	24 (27.9)	19 (22.1)	86 (31.6)	
7-12	65 (87.8)	2 (2.7)	7 (9.5)	74 (27.2)	
13-18	33 (35.8)	49 (53.3)	10 (10.9)	92 (33.8)	
Above 18	3 (100.0)	0 (0.0)	0 (0.0)	3 (1.1)	
<b>Working adult</b>					
1	40 (61.50)	20 (30.8)	5 (7.7)	65 (23.90	2.1 (0.8)
2	81 (5.8)	46 (32.9)	13 (9.3)	140 (51.5)	
3	28 (53.8)	10 (19.2)	14 (27.0)	52 (19.1)	
4	9 (64.3)	1 (7.1)	4 (28.6)	14(5.5)	
<b>Pry Occupation</b>					
Civil service	58 (62.4)	20 (21.5)	15 (16.1)	93(34.5)	
Artisans	37 (62.7)	13 (22.0)	9 (15.3)	59 (21.7)	
Farming	49 (49.5)	42 (42.4)	8 (8.1)	99 (36.4)	
Trading	11 (91.7)	1 (8.3)	0 (0.0)	12 (4.4)	
Transport service	3 (33.3)	1 (11.1)	5 (55.6)	9 (3.3)	
<b>Farming experience</b>					
(yrs)					
<5	15 (100.0)	0 (0.0)	0 (0.0)	15 (5.5)	13.1(11.5)
6-10	69 (48.9)	56 (39.7)	16 (11.3)	141 (51.8)	
11-15	42 (68.9)	14 (22.9)	5 (8.2)	61 (22.4)	
16-20	25 (61.0)	5 (12.2)	11 (26.8)	41 (15.1)	
20-25	5 (83.3)	1 (16.7)	0 (0.0)	6 (2.2)	
Above 25	2 (25.0)	1 (12.5)	5 ( 62.5)	8 (3.0)	
<b>Total</b>	<b>158 (58.1)</b>	<b>77 (28.3)</b>	<b>37 (13.6)</b>	<b>272 (100.0)</b>	

Source: Fieldwork 2014

#### A. Household distribution of monthly expenditure

The average distribution of the monthly expenditure for the households in the study area is presented in Table 2. The highest proportion of the monthly expenditure by household is on food and this accounted for 49.9 % of the

total expenditure. This is followed by expenses on education expenses of the respondents' children which has also accounted for 14%. The proportion of expenses spent on housing is minimal relative to other basic needs of life (4%) of total monthly expenditure is spent on rent allowance. This may be due to the fact that majority of the respondents claim non-payment for housing because they live within their family house while others who reside in their personal houses did not indicate how much it could cost them if it was not their house. The least cost for an average household in the study area is water (1%). Many of the respondents claimed that they source their water from nearby streams or wells that were close to their homes. In all, an average total of ₦43,975.52 was spent monthly by each household, which is about ₦1,500/household/day irrespective of the household size.

**Table 2: Distribution of household monthly expenditure**

Monthly expenditure	Average value (₦)	Percentage
Food	21,931.69	49.9
Toiletries	955.11	2.2
Clothing/ foot wear	2854.98	6.5
Rent allowance	1777.90	4.0
Water	477.10	1.1
Electricity	1204.78	2.7
Health	1102.39	2.5
Education	6191.73	14.1
GSM maintenance	1643.93	3.7
Firewood /Gas/ Kerosene	1712.21	3.9
Generator fuel	1531.03	3.5
Transport	1441.51	3.3
Remittances	1161.65	2.6
<b>Total</b>	<b>43,975.52</b>	<b>100.0</b>
<b>Mean per capita expenditure</b>	<b>5,483.61</b>	

Source: Fieldwork 2014

### **C. Household monthly expenditure pattern by categories**

The household expenditure which is used as a proxy for household income, because most respondents rarely disclose their actual income, as an individual is not expected to spend more than they earn. Based on the three categories of household food security, it worthy to note that only the food secured household spent less on food expenditure (₦30,382.39) relative to non-food expenditure (₦ 33,477.72) when compared to their other counterparts. The mean household food expenditure for moderately and food insecure are ₦11, 228.71 and ₦8,118.78 respectively. About 73%, 37% and 41% of total household expenditure accounted for the expenses made on non-food for food secured, moderately food secured and food insecure household respectively.

**Table 3: Distribution of Household based on monthly expenditure pattern by categories**

Household Monthly Expenditure	Food secured freq (%)	Moderately food secured freq (%)	food insecure freq (%)	Total freq (%)
<b>Food</b>				
< 15,000	7 (6.4)	67 (60.9)	36 (32.7)	100 (40.4)
15,001 -30,000	76 (87.3)	10 (11.5)	1 (1.2)	87 (32.0)
30, 001- 45,000	59 (100.0)	0 (0.00)	0 (0.00)	59 (21.7)
45,001 – 60,000	16 (100.0)	0 (0.00)	0 (0.00)	16 (5.9)
Mean N (%)	<b>30,382.39 (47.6)</b>	<b>11, 228.71 (63.3)</b>	<b>8,118.78 (59.5)</b>	<b>49,729.88 (52.2)</b>
<b>Non-food</b>				
< 15,000	5 (4.3)	75 (64.1)	37 (31.6)	117 (43.0)
15,001 -30,000	67 (97.1)	2 (2.9)	0 (0.00)	69 (25.4)
30, 001- 45,000	58 (98.3)	1 (1.7)	0 (0.00)	59 (21.7)
45,001 – 60,000	27 (100.0)	0 (0.00)	0 (0.00)	27 (9.9)
Mean (N)	<b>33,477.72 (73.5)</b>	<b>6,520.13 (36.7)</b>	<b>5,524.11 (40.5)</b>	<b>45,521.96 (47.8)</b>
<b>Household total expenditure N (%)</b>	<b>63,860.11(100.0)</b>	<b>17,748.84 (100.0)</b>	<b>13,642.89 (100.0)</b>	<b>95,251.84 (100.0)</b>

Source: Fieldwork 2014

#### D. Identification of the various methods of family planning

The distribution of the respondents according to methods of family planning adopted is presented in Table 4. About 63% of the respondents indicated that they use traditional method of family planning to prevent unwanted pregnancy. Four different types of traditional method were identified during the cause of the study and these include the use of incisions, herbal, vinegar and charms. While 33.1% of the respondents used herbal method while 8.5% used vinegar and charms.

Furthermore, 63.2% of the respondents claim to use natural method of spacing children. Some of the acclaimed methods utilized in the study area are abstinence from sexual intercourse, prolonged lactations for nursing mothers, celibacy, withdrawer methods among others. Absent menstruation accounted for 29.8% which is the highest closely followed by prolong lactation (26.8%). However, these methods can only be used by nursing mothers. On the contrary, celibacy method which accounted for the least value is embraced by 4.0% of the respondents.

In addition, the distribution of the respondents according to the natural methods of family planning reveals that, majority i.e. 81% of the respondents claimed to use menstrual period as the basis for encouraging family planning. 11.03% abstain from sex, 26.84% prevent unwanted pregnancy through injection of prolactin, 29.78% prevent unwanted pregnancy through celibacy, 4.78% encourage family planning through exercise, 5.15% indulge in polygamous act as a means of prevent unwanted pregnancy while 15.81% practiced withdrawal methods. However, the least value i.e. 3.68% of the respondents uses douching method for family planning. Among the food secured category, about 86% of them uses polygamy method as a way of spacing children i.e. by marrying more than one spouse while only 3.3% of the food insecure adopted the abstinence method as a way of child spacing.

It should however be noted that majority of the sampled housed embraced the use of the modern methods of family planning 82.0%. some of the identified methods includes the use of pills, injectable male and female condoms, **intrauterus contraceptive device** (IUCD), vasectomy and contraceptive patch. About 24% and 23.5% of the respondents claimed to use male condoms while the least method used by them is of use vasectomy method (surgical procedures used to remove part or all of the vas deferens) to prevent unwanted pregnancy. None of the food insecure uses IUCD and vasectomy as a means of preventing unwanted pregnancy.

**Table 4: Methods of family planning adopted by categories**

Family planning method	Food secured freq (%)	Moderately food secured freq (%)	food insecure freq (%)	Total * freq (%)
<b>Traditional methods</b>	<b>69 (40.4)</b>	<b>71 (41.5)</b>	<b>31 (18.1)</b>	<b>171 (62.9)</b>
Incisions	11 (27.5)	21 (52.5)	8 (20.0)	40 (14.7)
herbal	45 (5.0)	30(33.3)	15 (16.7)	90 (33.1)
Vinegar	9 (39.1)	9 (39.1)	5 (21.8)	23 (8.5)
Charms	11 (47.8)	11 (47.8)	1 (4.4)	23 (8.5)
<b>Natural methods</b>	<b>91 (52.9)</b>	<b>61 (35.5)</b>	<b>20 (11.6)</b>	<b>172(63.2)</b>
Abstinence	25 (83.4)	4 (13.3)	1 (3.3)	30 (11.0)
Prolong lactation	13 (17.8)	40 (54.8)	20 (27.4)	73 (26.8)
Absent menstruation	35 (43.2)	32(39.5)	14 (17.3)	81 (29.8)
Celibacy	3(27.3)	5 (45.4)	3 (27.3)	11 (4.0)
Exercise	5 (38.5)	7 (53.8)	1 (7.7)	13 (4.8)
Polygamy	12 (85.8)	1 (7.1)	1 (7.1)	14 (5.1)
Douching	9 (90)	0(0.0)	1 (10.0)	10 (3.7)
Withdrawal	30 (69.8)	12 (27.9)	1 (2.3)	43 (15.8)
<b>Modern methods</b>	<b>139 (62.3)</b>	<b>54 (24.2)</b>	<b>30 (13.5)</b>	<b>223 (82.0)</b>
Pills	54 (84.4)	10 (15.6)	0(0.0)	64 (23.5)
Injections	42 (82.4)	7 (13.7)	2 (3.9)	51 (18.6)
Male condoms	55(84.6)	5 (7.7)	5 (7.7)	65 (23.9)
IUCD	11(100.0)	0(0.0)	0(0.0)	11 (4.0)
Vasectomy	2(20.0)	8 (80)	0(0.0)	10 (3.7)
Contraceptive patch	4 (13.8)	12 (41.4)	13 (44.8)	29(10.7)

\*Multiple choices.

Source: Fieldwork 2014

#### E. Identification of the reasons for family planning

The distribution of the respondents according to reasons for utilization of family planning is presented in Table 5. The result reveals that majority of the respondents claimed they adopt family planning as a strategy to enhance mothers' health stability i.e. 81.99% and this accounted for the highest value. Next to this are respondents who claim to space their children so that they will have enough resources for their wards upbringing, this has a representation of 80.5%. Some of the respondents adduce engaging in family planning create for them the ability to educate children within the household (68.4%) and close to this is having the enablement to improve the standard of living of the household in terms of their general well-being (69.1). the least reason given for participating in family planning as affirmed by the respondents is to prevent sexually transmitted diseases .

**Table 5: Households' reasons for engaging in family planning**

Variables	Frequency	Percentage
<b>Reasons</b>		
Provision of quality education for wards	186	68.4
For mothers health stability	223	82.0
To stop malnutrition and poverty	196	72.1
Have resources for child upbringing	219	80.5
To improve household living standard	188	69.1
To prevent sexually transmitted diseases	75	27.6

Source: Fieldwork 2014

#### F. Factors influencing household food security

The factors influencing household food security level is presented in Table 7. The table reveals that sex significantly affect food security status at 10%. A male respondent who adopt family planning has the probability of being moderately food secured compared to their female counterpart however, the female respondents are better off than the male counterpart in the food insecurity category. Age is also significant at 1% but have a negative relationship with food security status. This implies that a year increase in age of the respondents will reduce the probability of being secured by 0.0011. on the other hand it was not significant for the probability of moving from food insecure to moderately food secured household.

Marital status is significant at 1% and positive related to household food security level. This implies that being married will increase the possibility of improving food security status by 0.013.household food security level is also negatively related to the number of children in rural household. This is an indication that decrease in the number of children by 0.0051 will enhance household food security status from food insecurity status to moderately food secure and moderately food secure to food secure status. The result further ascertains that farming status of a household significantly affect the level of food security of the respondents. An increase in the number of farmers among the respondents will positively improve the food security status of the food insecure category by 0.0045. However, this may not have effect on the moderately food secured category.

Contrary to apriori expectation, farm experience has a significant but negative effect on household food security status of the food insecure category. This implies that that an increase in years of farming experience will reduce the food security status of the food insecure by 0.0002. Type of farming enterprise households engage in significantly determine the level of food security of respondents among the moderately food secured category. Furthermore, results reveals that that other than crop production activities, engaging in other farm enterprise will enhance the food security level of the moderately food secured households by 0.0073.

Household monthly expenditures on food significantly influence food security status of the household and negatively too. This indicates that an increase in household expenditure on food by the moderately food secured and food insecure households deteriorates their food security status (conflicting apriori expectation) by 0.00004. An explanation to dis can be deduce from the expenditure pattern of the three household food security categories where nonfood expenditure is far less than expenses on food consumption monthly. The result reveals the level of impoverishment of the two categories as most of their income earnings are expended on food to keep the family alive.

Artificial family planning method significantly affect food security level for the moderately food secured category but negatively an indication that the use of other methods of family planning other than the artificial method will enhance their food security status. Also, in the food insecure category, both the traditional and

natural methods of family planning positively and negatively influences food security status respectively. This is an indication that the use of other methods apart from the natural method will enhance household food security status and on a contrary for traditional method, increase in the use of this method will further enhance household food security status.

The foregoing therefore permits the rejection of the hypotheses that socio economic characteristics and use of family planning do not influence the household food security status of rural households in the study area.

**Table 7: Multinomial Logit regression result**

Variables	coefficient	Std Error	p-value	coefficient	Std Error	p-value	dy/dx
<b>0 (base outcome)</b>							
<b>1</b>				<b>2</b>			
Sex	2.3101*	1.3430	1.72	-4.0718*	2.1028	-1.94	-0.0215
Age	-0.2036***	0.0850	-2.40	0.0013	0.1150	0.01	0.0011
Marital status	9.3120***	3.0670	3.03	12.8388**	4.0400	3.18	0.0134
No. of children	-0.9509*	0.5027	-1.89	-4.1531***	1.1854	-3.50	-0.0051
No of dependents	-0.4199	0.6625	-0.63	0.2366	1.1891	0.20	0.0022
No of working adults	0.7592	0.8099	0.94	2.1455	1.3086	1.64	-0.0040
Education (years)	0.1577	0.1208	1.31	0.1173	0.1580	0.74	-0.0008
Pry occupation	-0.7207	1.3029	-0.55	3.9249*	2.2576	1.74	0.0045
Farming experience	0.0313	0.0687	0.46	-0.2087**	0.0989	-2.11	-0.0002
Association Member	-0.370	1.1752	-0.31	1.6275	1.5633	1.04	0.0019
Farm enterprise	-1.3674*	0.7239	-1.89	-1.9019*	1.0548	1.80	0.0073
Traditional method	1.3163	1.5991	0.82	10.9843***	3.6991	2.97	-0.0064
Natural method	-3.3485	1.3281	-0.26	-7.1515***	2.7514	-2.60	0.0020
Modern method	-3.8501**	1.8624	-2.07	1.6289	2.9999	0.54	0.1106
Food expenditure	-0.0008***	0.0002	-3.66	-0.0033***	0.0008	-4.42	4.27e-06
Constant	11.5061*	6.0121	1.91	-0.2763	10.0717	-0.03	
No of observations= 272;							***significant at 1% level of significance
LR chi2 (30) = 427.14;							**significant at 5% level of significance
Prob>chi2 = 0000; Pseudo = 0.8382							*significant at 10% level of significance
Log likelihood= 41.2339							

Source: Fieldwork 2014

### SUMMARY AND CONCLUSION

The results of the findings revealed incidences of level of impoverishments of the rural households with regard to food security. It was discovered that rural household will be food secured or there will be food sufficiency if they engage more in family planning and increase farming activities. In conclusion, the contribution of family planning goes beyond gap filling, paying due attention to family planning has a significant role in addressing household food security in the future. The study therefore recommends that rural households should be more enlightened of the merits of child spacing to reduce food shortage in other to improve their nutritional intake level as well as standard of living.

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## ORTAK TARIM POLITİKASI VE GELİŞMELER

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### ÖZET

Tarım sektörü insanların en temel ihtiyacı olan beslenme gereksinimini karşıladığı için, ülke ekonomilerinde ve toplumların gündelik hayatında oldukça önemli bir yere sahiptir. Dünyadaki tarımsal gündemin önemli bir parçası olan Avrupa Birliği Ortak Tarım Politikası (OTP) tarımsal üretimin artırılması, üreticilere daha iyi bir yaşam düzeyi sağlanması ve piyasaları istikrara kavuşturarak arzın devamlılığının sağlanması hedeflerinin yanında aynı zamanda AB bütünlüğünün sağlanmasında da önemli paya sahiptir. Dolayısıyla OTP sadece bir tarımsal politika bütünü olmayıp, aynı zamanda tarihsel gelişimi içinde AB'ye üye ülkelerin tarım gibi çok teknik ve siyasi boyutu olan bir alandaki politika becerisini de yansıtmaktadır. Avrupa Birliğinin ilk ortak politikası olma özelliğine sahip Ortak Tarım Politikası (OTP), sürekli bir değişim içindedir. Toplumsal bekenti ve taleplere cevap verebilmek için OTP, zaman içinde birçok kez temel reformlardan geçmiştir. Bu çalışma ile Avrupa Birliği (AB) Ortak Tarım Politikası (OTP) hakkında temel bilgiler verilmekte, geçirdiği reform süreçleri, son dönemdeki reformlar özellikle 2014-2020 yıllarına ilişkin Çok Yıllı Mali Çerçeve'nin temelindeki son değişikliklerin incelenmesi amaçlanmaktadır. Yakın dönemde AB'ye girmesi beklenen Türkiye'nin ekonomik ve sosyal hayatın bütün alanlarında olduğu gibi, tarım sektöründe de bazı reformlarla AB'ye uyum sağlaması gereklidir. Bu anlamda tarım sektörü ile ilgili bazı düzenlemeler yapılmış ve uygulamaya geçirilmiştir. Ülkemiz ekonomi ve istihdam alanında önemli bir yere sahip olan tarım sektörünün yeri düşünüldüğünde OTPlarındaki bilgilendirmeler, çok önem kazanmaktadır.

**Anahtar Kelimeler:** Avrupa Birliği, Ortak Tarım Politikası, tarım sektörü, 2014-2020 çok yıllık mali çerçeve.

## COMMON AGRICULTURAL POLICY AND DEVELOPMENT

### ABSTRACT

Agricultural sector has a very important place in country's economy and everyday life of society. Because agriculture is to meet the nutritional needs of people's most basic needs. The European Union Common Agricultural Policy (CAP) is an important part of world agricultural agenda. That it has an important role increase agricultural production, alongside producers a better standard of living provision and ensure continuity of supply, folded market stability target also in achieving the EU integration. Therefore, the CAP is not whole just an agricultural policy, as well as it reflects policy skills as agriculture which is very technical and political dimensions of the EU member states in the historical development. The Common Agricultural Policy (CAP), has the distinction of being the first common policies of the European Union, is in constant change. CAP has undergone fundamental reform many times over time to respond to social expectations and demands. With this study, The European Union (EU) Common Agricultural Policy (CAP) are given basic information, spend the reform process, reforms in recent years especially aims to examine the recent changes in the basis of 2014-2020 multiannual financial framework. In the near future, Turkey's accession to the EU is expected, it is necessary to ensure harmonization in the agricultural sector with some reforms as in all areas of economic and social life. In this sense, related to the agricultural sector, some adjustments were made and implemented. Our country, which has an important place in the economy and employment areas, where the agricultural sector is concerned,

informing them about the CAP is crucial.

**Keywords:** European Union, Common Agricultural Policy, the agricultural sector, 2014-2020 multiannual financial framework.

## GİRİŞ

Birleşmiş Avrupa ülküsü, gerçek bir siyasi projeye dönüşüp ülkelerin hükümet politikaların da uzun vadeli bir hedef haline gelmeden önce, sadece filozoflarla önsızlı kimselerin düşüncelerinde yaşıyordu. Avrupa Birleşik Devletleri hümanist ve barışçı bir hayalin parçasıydı. Avrupa yüzyıllarca, sık sık yaşanan kanlı savaşlara sahne oldu. 1870-1945 yılları arasında Fransa ve Almanya üç kez savaştılar. Bu savaşlarda birçok insan yaşamını kaybetti. Bu felaketler üzerine bazı Avrupalı lider ve düşünürleri, barışın sürdürülebilmesinin tek yolunun, ülkelerinin ekonomik ve siyasi yönlerden birleşmesi olduğu fikrine vardılar.

İkinci dünya savaşı sonrasında Avrupa ülkeleri, aralarındaki çıkar tartışmalarını ortadan kaldırmak ve savaşlarla yaşanan yıkımların önüne geçmek amacıyla bir birlük oluşturulması fikri üzerinde yoğunlaşmışlardır. Bu yaklaşımla bugünkü Avrupa Birliği'nin (AB) temellerini oluşturan üç antlaşma imzalanmıştır. Bunlardan ilki olan Avrupa Kömür Çelik Topluluğu Antlaşması 1951 yılında imzalanmış ve 50 yıl süreklükte kalmıştır. Diğer iki antlaşma, Avrupa Ekonomik Topluluğu Antlaşması ve Avrupa Atom Enerjisi Topluluğu Antlaşması 1957 yılında imzalanmıştır. Bu tarihlerde başlayan Avrupa'daki bütünlleşme hareketi önemli aşamalar geçirerek günümüze kadar ulaşmıştır.

İkinci Dünya Savaşı yıllarında ve sonrasında Avrupa kıtasında çok ciddi bir sorun olarak ortaya çıkan gıda yetersizlikleri, stratejik bir düzenleme olarak, Ortak Tarım Politikası'nın (OTP) oluşturulmasında önemli bir etken olmuştur. Savaş koşullarının doğurduğu sonuçlarla birlikte Avrupa kıtasında gıda arzının güvence altına alınmasının şart olduğu anlaşılmış ve bu alanda dışa bağımlılığın azaltılması gerektigine dair bir bilinc oluşmuştur. Böylelikle, Topluluk ülkeleri, vatandaşlarının gıda ihtiyacının Topluluk içinden karşılanabilmesi için gerekli adımları atmaya başlamıştır. Tarımsal üretimin miktarının yeterli seviyeye ulaştırılıp, bu düzeyin korunabilmesi için pazarın mümkün olduğunda geniş olması gerektiği düşüncesinden hareketle, ortak bir tarım politikası etrafında toplanmak kaçınılmaz bir yöntem olarak görülmüştür.

Tarım ürünlerinin fiyatlarının hayat standartlarında belirleyici olması; Avrupa Ekonomik Topluluğunun kurucuları olan Almanya, Fransa, İtalya, Hollanda, Belçika ve Lüksemburg'un tarım politikaları ve pazarlarını bütünlştirmeleri ihtiyacını doğurmuştur. 1960'lı yılların başında söz konusu 6 ülkede tarım sektöründe çalışanlar, aktif nüfusun beşte birine denk düşmektedir. Bugün ise 28 üyeden meydana gelmiş AB'de, tarımda çalışan kesimin oranı aktif nüfusun yirmide biri seviyesindedir. O dönemde nüfusun bu kadar önemli bir bölümünü oluşturan bir kesimin gelir düzeyinin korunması ve artırılması gerekliliği, OTP'nin hayatı geçirilmesinde rol oynayan unsurlardan biri olmuştur. Tarım kesiminin olası fiyat dalgalandırmalarından etkilenmesinin önüne geçilmesi, bunun için de piyasalara zaman zaman müdahale edilmesi zorunluluğu bulunmaktadır. Etkin bir müdahalenin ise ancak ülkelerin alacağı ortak bir tavır ve politika ile mümkün olabileceği gerçeği de Topluluk üyelerini ortak bir politikaya yönlendirmiştir.

Ortak Tarım Politikası'nın uygulanmasından önceki dönemde Avrupa ülkelerinin ulusal tarım politikaları tarımsal yapılarına göre farklılıklar göstermekteydi. Örneğin Almanya gibi tarım sektörünün ekonomide diğer sektörlerle göre daha az yer tuttuğu ülkeler, net ithalatçı konumunda oldukları için, ulusal pazarlarını ithalat vergileri ve kotalarıyla korumaktaydılar. Diğer yandan başını Fransa'nın çektiği, tarımın önemli bir faaliyet alanı olduğu net ihracatçı ülkeler ise, ihracat vergi ve kotaları yanında destekleme fiyatları ve ihracat teşvikleri ile koruma mekanizmalarını oluşturuyordu. Değişik müdahale ve koruma araçlarıyla oluşturulan piyasa mekanizmaları arasındaki farklılıkların giderilmesinin ancak ortak ve tek bir politika etrafında birleşilmesi ile

sağlanabileceğinin görülmesi de OTP'nin oluşumunu hızlandıran etkenlerden biri olmuştur.

Avrupa Ekonomik Topluluğu (AET) içinde oluşturulan gümrük birliği, ilk haliyle, sanayi mallarının serbest dolaşımının sağlanması anlamına geliyor ve tarım ürünleri bunun dışında kalıyordu. Bu durum, sanayi sektörü Fransa'ya göre daha güçlü olan Almanya'yı tatmin ederken, nüfusunun dörtte biri tarım sektöründe çalışan Fransa'yı rahatsız ediyordu. Dolayısı ile OTP'nin sanayi mallarını kapsayan gümrük birliğini dengeleyici bir politika ve Fransa ile Almanya arasındaki çıkar ilişkisinin bir yansımıası olarak da gündeme geldiği söylenebilir. Yukarıda belirtilen etmenlerin bir araya gelmesi neticesinde Avrupa'daki tarım sektörü için ortak bir politika belirlenmesi kararlaştırılmış, böylece 1 Ocak 1958 yılında yürürlüğe girerek AET'nu kuran Roma Antlaşması ile OTP'nin yasal temeli oluşturularak amaçları belirlenmiştir. (Ekeman, 2000).

### **Ortak Tarım Politikası Reformları (1988-2015)**

1985 yılında Ortak Tarım Politikasının Geleceği" konusundaki Green Paper belgesi ile arz ve talebin dengeye getirilmesini ve tarımın sorunlu alt sektörlerinde üretimin azaltılmasını sağlayacak yeni yollar gösterilmesi ve genel olarak OTP'nin geleceği için alternatif çözümlerin analizi amaçlanmıştır. Avrupa Birliği 1988 yılında üretimi azaltmaya, ihtiyaca göre ürün desenini yeniden şekillendirecek ve tarım harcamalarında mali disiplin sağlayacak önlemler içeren bir dizi değişiklik yapmıştır. Radikal önlemler içeren **1988 Reformu**, OTP'nin AB bütçesindeki payının azaltılması hedeflenmiş, bu sistemin aşırı üretimle bozulmasını önlemek amacıyla, arz-talep dengesini sağlamaya yönelik bütçe dengeleyiciler oluşturulmuştur. Üretimi azaltmaya yönelik bir yaklaşım da, satılamayacak, depolanacak, daha sonra ucuz fiyatlarla dışsatımı yapılacak ürünlerde bütün bu işlemler için gerekli harcamalar yerine, baştan ekim alanlarını daraltmak, girdi kullanımını azaltmak yoluyla üretimini kısan üreticiye ödeme yapılması esasına dayanmaktadır. Bu şekilde ödenecek tazminatlar Topluluk bütçesine daha az yük getirebilecektir. Ayrıca çevre korunması ortak politikası çerçevesi içinde düşünülen gubre kullanımını kısıtlayıcı politikalar da dolaylı olarak verimi azaltıcı etkiye sahiptirler. Bu reformu izleyen dönemdeki genel eğilim tarım ürünleri fiyatlarının artık artırılmaması, hatta zaman içinde yavaş yavaş geriletilmesi yönündedir. Böylece üretim artışı en fazla ve en hızlı etkide bulunan bir politika aracının kullanımını kısıtlanarak, üretim artırıcı etkisi bir ölçüde de olsa azaltılmıştır. (Eraktan, 2009, Kilit, 2012a.). **1992 MacSharry Reformları**, tarım ürünleri fiyatlarını Topluluk içi ve dünya piyasalarında daha fazla rekabet gücüne kavuşacak şekilde düşürmek, bu yüzden üreticilerin karşılaşacakları gelir düşmelerini telafi edecek, piyasa mekanizmasının işleyişini düzenleyecek ve çevre faktörünü üretim alanına her yönyle sokacak önlemleri. (Eraktan, 2009, Stead, 2007). Yapılacak teşviklerin ürün desteği olarak değil üreticiye yapılacak doğrudan destek olarak değiştirilmesini sağladı. Reform Avrupa Birliği tarım sektöründe rekabeti geliştirmeyi, tarım piyasasının istikrarını sağlamayı, üretimi çeşitlendirmeyi, çevreyi korumayı ve Avrupa Birliği bütçe harcamalarını dengelemeyi hedefliyordu. İlk olarak hububat müdahale fiyatlarında yüzde 35 ve sığır eti müdahale fiyatında yüzde 15 oranında indirim sağlanırken, üretimi fazla ürünlerin üretiminden vazgeçilmesi desteği, tarım ve çevre uyumu programları, ağaçlandırma, erken emeklilik, ürün çeşitliliği ile ilgili destek verildi. (Koç, 2014) **Gündem 2000 Reformu**, Merkezi ve Doğu Avrupa Ülkelerine (MDAÜ) yönelik genişleme sürecine paralel olarak, Berlin Avrupa Konseyinde, 26 Mart 1999 tarihli Gündem 2000 (Agenda 2000) çerçevesinde, birtakım mali düzenlemeler gerçekleştirılmıştır. Gündem 2000 çerçevesinde gerçekleştirilen OTP Reformu, destekleme fiyat sistemi yerine doğrudan ödemelere ve kırsal kalkınma politikalarına yönelik 1992 Reformunu daha köklü ve yaygın hale getirmeyi amaçlamaktadır. Gündem 2000'le genişleme sürecinde, tarımsal harcamaları, özellikle, destekleme fiyat politikası yoluyla yapılan tarımsal harcamaları daha çok kısmayı amaçlayan, telafi ödemelerine, yapısal politikalara, sosyal politikalara, bölgesel politikalara ve çevre politikalarına ağırlık veren bir reform sürecine girilmiştir. (Varol, 2003). **2003 Reformları ile**, öne çıkan düzenlemelerden ilki çiftçilere üretikleri ürün dikkate alınmaksızın yılda bir kez gelir desteği verilmesidir. Üreticilerin doğrudan ödemelerden faydalananı bilmeleri için

tarım arazilerinin belirli bir oranını ekim dışı bırakmaları gerekmektedir. 2005 yılında uygulanmaya başlanan bu ödeme planından yararlanabilmeleri, geçmişte yalnız gönüllülük ile uygulanan ve Gündem 2000 reformunda da bahsedilen çapraz uyum ilkesine dayanmaktadır. Tarım arazilerinin iyi çevresel ve tarımsal koşullarda tutulmasına yönelik Üye Devletler tarafından belirlenen standartlar ve çevrenin koruması, gıda güvenliği, bitki, hayvan sağlığı ile hayvan refahı konularında belirlenmiş standartlara uymayan üreticilerin doğrudan ödemelerinin azaltılması veya tamamen askıya alınması öngörlülmüştür. (Ülkü, 2006). **2005 yılına** gelindiğinde Avrupa Birliği daha önce uygulamaya koyduğu reformların gelişiminin hızlandırılması için OTP'nin sadeleştirilerek daha anlaşılır bir dile kavuşmasını istedİ. Sadeleştirilmiş bir OTP'nin tarım üreticilerinin ve yöneticilerinin üzerindeki aşırı bürokrasi yükünü azaltacağını ve mevzuat yoğunluğunu gidererek kuralların her kesim tarafından daha anlaşılır olmasını sağlayacağı hedeflendi. Bunun neticesinde OTP sadeleştirildi, sayıları yüzleri aşan bürokratik işlemlerin çoğu kaldırıldı ve tarım kesiminin reformlara uyumu daha hızlı bir şekilde sağlandı. Avrupa Birliği 2008 yılında OTP'nin modernize edilmesini, sadeleştirmesini ve daha verimli hale getirilmesini amaçlayan ‘değerlendirme’ yapılmasını kabul etti. Bu sayede çiftçiler üzerindeki kısıtlamaların kaldırılması, sektörün piyasa koşullarına daha iyi cevap verebilmesinin sağlanması ve iklim değişikliği, su sorunu ve biyoenerji gibi gelişen yeni olaylara karşı mücadelein güçlendirilmesi amaçlandı. Hem daha önce uygulamaya konulan 2003 reformlarının durumu hem de değişen koşullara karşı OTP'nin uyum kapasitesi artırıldı. (Kilit, 2012b). **AB'nin 2007–2013 dönemi reformları**, beş kategoride değerlendirilmektedir. Katılım Öncesi Yardım; AB aday ve aday olması muhtemel ülkelere siyasi, ekonomik ve kurumsal reformları gerçekleştirebilmeleri için destek sağlamaktadır. Bu, geniş çapta çeşitli türlerdeki (tarım, çevre, taşımacılık, bilgi teknolojileri, insan hakları, sivil toplum, medya, vb.) projeler için mali desteği içermektedir. Dış Yardım; AB'nin dış yardımları üye ülkeler arasındaki ülkeleri; kriz yaşamakta olan ülkeler/bölgelerin yanı sıra siyasi, ekonomik stabilité ve çeşitli türlerde reformları desteklemeyi hedeflemektedir. Bölgesel Yardım; AB, bölgeler arasındaki kalkınma farklılıklarını düşürmek, sosyal ve ekonomik refaha erişmek amacıyla üye ülkeler arasında bölgesel gelişmeyi finanse etmeye ve bu da harcamaların büyük kısmını oluşturmaktadır. Doğal Kaynaklar bölümü tarım, kırsal kalkınma, çevre ve balıkçılık gibi birkaç mali firsattan oluşmaktadır. Topluluk Programları; AB geniş çapta araştırma, rekabet ve yenilik, medya, eğitim, sağlık, gençlik, kültür gibi alanlarda farklı topluluk programları yoluyla mali yardım sağlamaktadır. Üye olmayan ülkeler de AB ile anlaşmaları doğrultusunda bu yardımdan faydalananabilmektedirler. (Elçi, 2007)

### **Avrupa Birliği'nin 2014-2020 Dönemi Çok Yıllı Mali Çerçeve**

Avrupa Birliği (AB)'nin önumüzdeki yıllarda hangi politika alanlarına ne kadar fon tahsis edeceği ve gelirlerini nasıl yöneteceğine ilişkin genel rotasını ortaya koyan en temel belge olan 2014-2020 Çok Yıllı Mali Çerçeve, Avrupa Parlamentosu'nun 19 Kasım 2013 tarihli onayının ardından 2 Aralık 2013 tarihinde Bakanlar Konseyi tarafından kabul edilmiş ve 1 Ocak 2014 tarihinde yürürlüğe girmiştir. Bu düzenlemeler ile temel olarak iki unsur üzerine odaklanmıştır. Bunlardan birincisi, harcamalara ilişkin 2014-2020 Mali Çerçeve'sinin nitelik ve içeriği; ikincisi ise Birlik bütçesinin gelir kalemlerini düzenleyen Öz Kaynaklar Sistemi kurallarında yapılması öngörülen köklü değişikliklerdir. (Anonim, 2015a)

2014-2020 Mali Çerçeve'sinde toplam altı Genel Harcama Kategorisi bulunmaktadır. Bunlar;

**Akıllı ve Kapsayıcı Büyüme:** Büyüme ve istihdam, rekabet edebilirlik, Ar&Ge, KOBİ desteği, eğitim, mesleki eğitim, gençlik ve spor programları, nükleer güvenlik, sosyal kalkınma gündemi, gümrük, Fiscalis Programı ve sahbetcilikle mücadele, enerji, ulaşım ve Avrupa'yı Birleştirme Mekanızması (Connecting Europe Facility) ile ekonomik, sosyal ve bölgesel uyum programlarını kapsayan Akıllı ve Kapsayıcı Büyüme başlığı için 450,763 milyar Avro tahsis edilmiştir. 1a.Büyüme ve İstihdam için Rekabet Edebilirlik ve 1b.Ekonominik, Sosyal ve Bölgesel Uyum alt başlıklarını içeren Akıllı ve Kapsayıcı Büyüme başlığına 2007-2013 Mali Çerçeve'sine

kıyasla %1'lik bir artış getirilmiştir.

**Sürdürülebilir Büyüme:** Doğal Kaynaklar, Ortak Tarım Politikası kapsamında yer alan pazara yönelik harcamalar ve doğrudan ödemeler ile kırsal kalkınma, çevre ve iklim değişikliği ile mücadele gibi programları içermekte olan “Sürdürülebilir Büyüme: Doğal Kaynaklar” başlığı için 373,179 milyar Avro tutarında kaynak ayrılmıştır. Yeni Mali Çerçeve’de bu başlık için ayrılan kaynak miktarı 2007-2013 Mali Çerçeve’sine kıyasla %11,3'lük bir azalmıştır.

**Güvenlik ve Vatandaşlık:** Göç yönetimi fonu, iç güvenlik, bilgi iletişim sistemleri, adalet, vatandaşlık ve temel haklar, gıda güvenliği, kamu sağlığı, tüketiciyi koruma gibi programlara tahsis edilen kaynakları kapsayan başlık altında 15,686 milyar Avroluk ödenek ayrılmıştır.

**Küresel Avrupa:** Katılım Öncesi Yardım Aracı (IPA), Avrupa Komşuluk Politikası, istikrar, güvenlik, nükleer güvenlik işbirliği aracı, garanti fonu ve dış eylemlere yönelik harcamaları içeren harcama başlığı 58,704 milyar Avro tutarındadır.

**Yönetim Giderleri:** AB kurumlarının giderleri için tahsis edilen 61,629 milyar Avroluk kaynak miktarından oluşmaktadır.

**Karşılıklar:** Mali Çerçeve’nin ilk yılında oluşabilecek bütçe dengesizlerinin giderilmesi amacıyla ayrılan 27 milyar Avro tutarında fonu içermektedir. (Anonim, 2015b)

## SONUÇ

Tarım sektörü; ulusal gelire katkısı, toplam aktif nüfus ve tüketim harcamaları içindeki payının yüksekliğinin yanı sıra beslenme ve sanayi açısından temel ihtiyaç maddelerini üreten bir sektör olması nedeniyle, ulusal ekonomide stratejik bir öneme sahiptir.

Ortak Tarım Politikası, Avrupa Topluluğu'nun en eski yönergelerinden ve temel amaçlarından biridir. Bu politikanın, tarımsal üretimi artırmak, ürün stoklarında kesinlik sağlamak, tarımla uğraşan kimseler için iyi bir yaşam standardı sunmak, pazarda istikrarı oturtmak, tüketiciler için uygun fiyatlar belirlemek gibi amaç ve görevleri vardır. Politika yakın zamana kadar bir deVLET desteği düzeni ve pazar müdafahesiyle işliyordu. Tarıma verilen destek 70'lı yıllarda o zamanki Avrupa Ekonomik Topluluğu'nun yıllık bütçesinin % 87'i kadardı. Tarım desteği bugünkü Avrupa Birliği Bütçesi'nin % 35'ini oluşturmaktadır. Birlik kurulduğundan beri OTP'yi sürekli geliştirmiş ve temel stratejisi haline getirmiştir. Günümüze kadar gelen bu süreçte AB OTP'si; birçok başarı sağlamış tarımsal politika ve stratejiler ile AB ülkelerini Dünya piyasalarında rekabet edebilir hale getirmiştir.

Son yüzyılda dünyada giderek artan küreselleşme süreci ile Ülkemiz tarım sektöründe birçok düzenleme yapılmış ve uygulamaya geçilmiştir. Ancak AB' ye tam üyelik sürecinde ekonomik ve sosyal hayatın bütün alanlarında olduğu gibi, tarım sektöründe de bazı reformların yapılması, AB OTP'sinde yapılan uygulamaların yakından takip edilerek Türkiye'deki tarımsal yapıya uygun reform paketlerinin hazırlanması ile etkin bir hal alacaktır. Böylece Türkiye'de tarım sektörü AB ve diğer ülkelerle Dünya tarım piyasalarında rekabet edebilir hale gelecektir.

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## RISK MANAGEMENT STRATEGIES ADOPTION OF FARMING HOUSEHOLDS IN KWARA STATE OF NIGERIA: A PRAGMATIC APPROACH

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### ABSTRACT

Risk is an unavoidable element in the business of agriculture especially with the prevalent issue of climate change which hitherto affects production. Production can vary widely from year to year due to unforeseen weather and market conditions, causing wide swings in commodity prices. But risk, while inevitable, is often manageable. Risk management involves choosing among alternatives for reducing risks that threaten the economic success of production process and well-being of the households; hence, determinants of risk management strategies adoption among farming households in Kwara State of Nigeria was investigated.

Multistage sampling technique was used to select 122 farming households used for the study. Data collected through a well-structured questionnaire was analyzed through descriptive statistics such as frequency counts, percentages and mean values while inferential statistics such as Tobit regression was used to test the formulated hypothesis.

The result revealed a mean age of 49.25 years while the average household size was estimated at approximately 12 persons; also, the average years of formal education was estimated at 6.31 years. 92.62% of the respondents engaged primarily in farming while majority are faced with production risks. The prevalent risk management strategies adopted are: obtaining credit facilities from social organizations, irrigation practices, borrowing from friends, use of family labour and distress sales of assets. And, determinants of risk management strategies adoption are: years of formal education ( $p<0.1$ ), household size ( $p<0.1$ ), social organization membership ( $p<0.01$ ) and outcomes ( $p<0.05$ ).

This study concludes that human capital (proxied by years of formal education) and social capital endowment (proxied by social organization membership) have a strong influence on the adoption of risk management strategies.

**Keywords:** Risk Management Strategies, Adoption, Farming Households, Tobit, Nigeria

### INTRODUCTION

Risk management strategies in agriculture vary with farm characteristics and the risk environment. Farmers' risk perceptions, risk attitudes as well as the available resource base, influence their decisions and actions. Farm size, age, innovativeness and risk aversion determine the choice of risk management strategy by farmers. The identification of the sources of risk is important because it helps to choose the appropriate management strategy. The array of risk management strategies available to farm operators includes crop diversification, distress sales, loan, controlling cash flow, production contracting, forward pricing, and acquiring crop and revenue insurance (Dennis et al., 2000).

Risk is also regarded as a central issue that affects many different aspects of people's livelihoods in the developing world. It affects whether people can maintain assets and endowments, how these assets are transformed into incomes via activities and how these incomes and earnings are translated into broader development outcomes. In rural area, risk is present in all management decisions of agricultural systems as a result of price, yield and resource uncertainty. The existence of such risks has been found to alter household behaviour in ways that at first glance seem suboptimal and highly vulnerable to low frequency. Indeed, farmers take their decisions in a risky environment so that the consequences of these decisions are often not known with certainty until long after those decisions occur. As a result, outcomes may be better or worse than expected (Alderman, 2008).

Risk management is, in general, finding the combination of activities most preferred by an individual farmer to achieve the desired level of return and an acceptable level of risk. Risk management strategies reduce risk within the farming operation (e.g. diversification or vertical integration), transfer a share of risk outside the farm (e.g. production contracting or hedging), or build the farm's capacity to bear risk (e.g., maintaining cash reserves or evening out cash flow). Using risk management does not necessarily avoid risk altogether, but instead balances risk and return consistent with a farm operator's capacity to withstand a wide range of outcomes. Although farms vary widely with respect to enterprise mix, financial situation, and other business and household characteristics, many sources of risk are common to all farmers, ranging from price and yield risk to personal injury or poor health. But even when facing the same risks, farms vary in their ability to weather shocks. For example, in an area where drought has lowered yields, falling prices resulting from large worldwide production could have devastating consequences for local farm incomes (Dennis et al., 2000).

However, the economic performance of the agricultural sector is usually uncertain due to its biological nature in addition to relying mainly on rain fed agriculture and livestock rearing under natural conditions. This type of production is inherently risky because of variability of rainfall, animal mortality due to livestock diseases and fluctuations in output prices. The environment in most of low income countries is characterized by crop diseases, flooding, illness of household members and crime. All these create uncertainty (Capitanio, 2008). As a result of a combination of many factors, many farmers face many risks and uncertainties which arise from natural, economic and socio-political environments. A number of studies show that farmers are risk averse; they manage risk by preferring enterprises that provide satisfactory levels of security even if at the expense of higher income; they diversify into a number of activities to spread risk; they also prefer to use established techniques of production, and to be self sufficient in food requirement through increased food production (Nyikal and Kosura, 2005).

Risk plays an important role in farmer decision making and therefore affects agricultural productivity and thus growth and development. Lack of institutional innovations like crop insurance and affordable credit in developing countries to shift part of the risks from the private to the public sector makes risk management an important part of smallholder production decisions (Besley, 1995). Private sector provided insurance products have not developed due to problems of moral hazard and adverse selection (Hazell and Norton, 2003). An increasing number of smallholder farmers now derive part of their income from non-farm sources. As much as 40-45 % of household income by 1997 was derived from non-farm sources in sub-Saharan Africa (Reardon, 1997).

Agricultural risks are prevalent throughout the world and they are particularly burdensome to small-scale farmers in developing countries. Production activities of these farmers are characterized by scattered small land holdings (Encyclopedia Britannica, 2004). Agricultural risks are especially important if they result in income and consumption fluctuations. Fluctuations in consumption usually imply relatively high levels of transient poverty.

High income risk may also be a cause of persistent poverty. This is likely when insurance and credit markets are absent or incomplete as it is the case for developing countries. The failure to cope with income risk is not only reflected in household consumption fluctuations but affect nutrition, health and education and contribute to inefficient and unequal intra-household allocations (Dercon, 2002). Understanding the relationship between farm characteristics, farmers' risk attitude and risk perception and their use of risk management strategies is important for two reasons. First, the literature reveals that most producers are averse to risk when faced with risky outcomes. Someone who is risk averse is willing to accept a lower average return for lower uncertainty. This means that strategies cannot be evaluated solely in terms of average or expected return, but that risk must also be considered. Second, knowledge of small-scale producer's attitudes to risk and their risk management strategies is important in determining strategies and formulating policies for agricultural development (Harwood et al., 1999).

### **Problem Statement**

Smallholder farmers face many risks in their farming activities; for example, in the past, the country has recorded drought, crop and animal diseases and pests as well as fluctuations in prices of both farm produce and inputs. As a result, there has been variability in household income. Risk hinders farmers from pursuing their farming as a business. The risk situation is complicated by the fact that they operate in an environment with weak markets. They do not have access to sufficient support institutions that can help them cope with risks. Risks have negative implications to agricultural productivity and farmers' income, in that it affects the types of investments which farmers make. Ultimately, it affects the level of farm output and economic growth. Nigerian agriculture is commonly known to be in crisis, the greatest failure is that food production has not kept pace with population growth, the rate of growth of Nigeria's food production is 2.5 percent per annum in recent years, while food demand has been growing at the rate of more than 3.5 percent per annum due to high rate of population growth of 2.83 percent (Kolawole and Ojo, 2007). This is obvious as agriculture is the mainstay of Nigeria's economy contributing about 42% to total GDP and employing about 77% of the working population (Adeolu and Taiwo, 2004). Understanding risk is a starting point to help producers make good management choices in situations where adversity and loss are possibilities, information on the risk management strategies adoption employed by farming households represent important contribution to existing body of the knowledge. Hence, the need for this study as it examined the various dimensions of risks faced by the farming households in the study area, the risks management strategies adopted as well as the determinants of risk management strategies adoption among farming households. And, the study hypothesized that there is no significant relationship between households' specific socio-economic and human capital development characteristics and adoption of risk management strategies.

### **Empirical Evidence on Agricultural Risks and Management Strategies**

In an empirical analysis of Dutch livestock farmers' risk perception and risk management decision, Hardaker et al., (2004) found that in general, price and production risks were perceived as important sources of risk. Salimonu and Falusi (2009) in their study on "Sources of risk and management strategies" classified market failure, price fluctuation, drought, pest and diseases attack and erratic rainfall are the most important sources of risk facing by food crop farmers in Osun State, Nigeria. Results from Tru and Cheong (2009) show that, in general, price and production risks were perceived as the most important risk in Vietnamese Catfish Farming. Okunmadewa (2003) in his study on risk and vulnerability assessment identified some types of risk in Nigeria to include natural risk, environmental risk, gender risk, conflict and crime risks. Others are labour market risk, life events risk and macroeconomic risks. The risk management strategies used in Nigeria includes prevention, mitigation and coping strategies. Prevention strategies seek to reduce the probability of welfare reducing risk through activities such as education, immunization, irrigation and extension services.

Mitigation strategies seek to decrease the impact of a future welfare reducing risk through activities such as insurance policy, crop diversification, mixed farming, storage programme and price support, while coping strategies relieve the impact once the risk (the event) has occurred. Examples of coping strategies include sales of assets, reducing consumption, taking children out of school and borrowing (Olaniyan et al., 2008). Key risk management arrangements in Nigeria as identified by Adubi et al., (2002) include informal, (social network and informal savings groups) and formal private (public education and social safety net). Granted that different risk management strategies and arrangements exist in Nigeria, there however exist gaps in knowledge with respect to how Nigerians in the rural areas manage risk. Alayande (2003) identified rural Nigerians (especially farming households) as the most vulnerable in terms of shocks to their well-being. This study however failed to unmask farming households' extent of vulnerability to shocks or risks and management of such risks.

### **Type and sources of risks in Agriculture**

Ellis (1988) identified four types of risks: natural hazards (weather, pests and diseases), market fluctuations (of output prices), social uncertainty (due to differences over control of resources) and state actions and wars. According to Hardaker et al., (2004), three major types of risk in farming can be identified; yield, price and transaction risks. Hazell and Norton (2003) reported that the types of risks farmers face depend on the type of farming system, climate change and policy as well as the institutional environment. Some risks are unique to agriculture, such as the risk of unfavorable weather and climatic conditions caused by climate change which significantly reduce yields within a given year. Other risks, such as the price or institutional risks, while common to all businesses, reflect an added economic cost to the producer; if the farmer's benefit-cost tradeoff favours mitigation; then, he or she will attempt to lower the possibility of adverse effects (Harwood et al., 1999).

#### **Production or Yield Risk**

Production or yield risk occurs because agriculture is affected by many uncontrollable events that are often related to weather, including excessive or insufficient rainfall, extreme temperatures, hail, insects and diseases. Technology plays a key role in production risk in farming. The rapid introduction of new crop varieties and production techniques often offers the potential for improved efficiency, but may at times yield poor results, particularly in short term. In contrast, the threat of obsolescence exists with certain practices (for example, using machinery for which parts are no longer available), which create another and different kind of risk (Harwood et al., 1999). This is the risk associated with changes in the prices of output or inputs which may occur when the farmer has made a commitment to produce. Farmers are exposed to unpredictable competitive markets for inputs and outputs. It includes risks that result from unpredictable exchange rates (Hardaker et al., 2004).

#### **Price or Market Risk**

Price and yield risks are not independent, they are related. High transportation and marketing costs in developing countries isolate local rural markets from national and international markets. Since yield fluctuations are correlated within a small area, local prices determined by local production and demand are volatile, and for an individual farmer are negatively correlated to their production; the farmers therefore face yield and price risks that are correlated depending on the level of regional market integration. Thus, price uncertainty generally leads to inefficient resource allocation (Dorward et al., 2007).

#### **Institutional Risk**

Institutions are mechanisms that are used to structure human interactions in the presence of uncertainty. They help to reduce uncertainty and risk in human exchange; this includes political risk, which is the risk associated with unfavorable policy changes. An example is changes in tax or credit policy and restriction on the use of a

certain pesticide that alters the cost of production. Also under institutional risk is transaction risk which results from opportunistic behaviour and the reliability of transacting partners. It is represented by the losses incurred as a result of the failure in: (a) enforcing exclusive property rights, (b) enforcing required attributes, (c) completing the intended transaction or (d) protecting transaction benefits from third party predation (Dorward et al., 2007). Other risks include: human or personal risks (this is the disruptive change that may result from such events as death, divorce, injury, or the poor health of a principal in the firm), asset risk (involves theft, fire, or other loss or damage to equipment, buildings, and livestock) and financial risk (results from the way the firm's capital is financed (Hardaker et al., 2004).

## MATERIALS AND METHODS

### The Study Area

The study was conducted in Kwara State, Nigeria; specifically, Asa Local Government Area (LGA). Its' headquarters is in Afon town with an area of 1,286 km<sup>2</sup> and a population of 126,435. It shares boundaries with Ilorin-west, Ilorin-south, Offa, Oyun, Moro (LGAs) of Kwara State. The Local Government comprises of three (3) districts which is further divided into seventeen (17) political wards. The area is blessed with vast arable land which makes farming the prevalent occupation of most people in the LGA. This rural population comprises of peasant farmers who cannot afford the capital involvement of mechanized farming. And, the inhabitants are predominantly yorubas.

### Sampling procedure and sample size

A multi-stage sampling technique was used to select the representative farming households for the study. The first stage involved purposive selection of Asa LGA because of its rurality, fund and time as well as the predominance of farmers in the area. The second stage involved random selection of ten (10) villages from the identified villages in the study area. Then, strictly proportionate to size sampling technique was used to select 125 registered farming households from the available registered farming households listing information available in the Agricultural Development Program (ADP) zone office in the area. Hence, 125 registered farming households made up the sample size for this study, but responses from 122 respondents were found useful for the analysis due to incomplete response.

### Data collection

Primary data was obtained from structured questionnaire which was administered to the selected respondent through one on one interview. The data collected includes: household socio-economic characteristics, farming activities, risks faced by households, risk management strategies employed and the household expenditure pattern, among others.

### Data analytical techniques

Descriptive statistics such as frequency counts, percentages and mean values were used to describe selected socio-economic characteristics of the respondents while inferential statistics such as Tobit regression model was used to test the formulated hypothesis.

### Tobit Model Specification

$$Y_i^* = \beta X_i + e_i$$

$$Y_i^* = 0, \text{ if } Y_i = 0$$

$$Y_i^* = Y_i \text{ if } 0 < Y_i \leq 1$$

where:

$Y_i^*$  is the observed dependent variable (Risk management strategies proxied by its' index);

$\beta$  is a vector of unknown parameters;  $X_i$  is the vector of independent variables; where

$i = 1, 2, \dots, n$ ; and the hypothesized explanatory variables are:

$X_1$  = age of the farmers (years),  $X_2$  = age squared (years) to capture the life cycle hypothesis,  $X_3$  = years of formal education (years),  $X_4$  = primary occupation (farming = 1, 0, Otherwise),  $X_5$  = household size (actual),  $X_6$  = no of working members(actual),  $X_7$  = social capital endowment (Yes =1, 0, Otherwise),  $X_8$  = outcomes,  $X_9$  = monthly expenditure (₦),  $e_i$  is a disturbance term assumed to be independent and normally distributed with zero mean and constant variance  $\sigma$ .

## RESULTS AND DISCUSSION

### Selected socio-economic characteristics of the sampled respondents

The result revealed that majority (81.97%) of the respondents are male while the remaining 18.03% account for the female counterpart; this suggests that male are dominant among the sample respondents.

It was also shown that 28.7% of the respondents each fall within the age group of 41-50 and 51-60 years respectively while the mean age was estimated at 49.25 years; this suggests that the respondents are in their active and productive age. It was also shown that majority (95.08%) of the respondents are married while the 4.92% account for the single counterpart. The average years of formal education was estimated at 6.31 years which implies that majority of the respondents had elementary education level.

Farming which account for about 92.62% is the predominant occupation while majority (73.77%) engaged in food crops farming. Other primary occupation activities identified are: livestock farming, food processing, civil service and artisanship; the estimated mean years of experience in primary occupation was found to be 33.04 years. The findings also showed that half (50.82%) of the respondents have their farm size within 2.1-5 ha, 29.52% operates above 5ha while only 19.68% have access to farm size which is less or equal to 2ha; the mean farm size is estimated as 3.25ha which suggests that only few of the respondents did not have access to a relative large area of farmland. It was further revealed that 9.02% of the respondents have household size ranging between 1-6 members, 43.46% have between 7-12 members, while 40.17% have between 13-20 members and 7.38% of the respondent have above 20 members. The estimated average household size was 12.06 persons; which suggests that there exist about 120 persons in every 10 households. This is relatively large compared to the national average. In the same vein, the estimated average number of household working members was approximately 3.6 persons which suggests that about 25% of household members have income generating activities; this could have a negative impact on the household considering the prevalent large household size in the study area. Also, majority (75.41%) of the respondents claimed membership of social group(s). Furthermore, the result showed that 0.82% did not encounter any risk, 69.93% specified weather related risk type as a result of climate change, 45.08% specified production related risk type, 25.41% specified as market related risk while 49.18% specified financial risk. About 59.84% of the respondents took to loans from social organizations as risk coping and mitigating strategies, 38.52% employed irrigation and 42.62% borrowed from friends; other strategies employed are: use of herbicides, family labour, fertilizer use, planting of resistant varieties as well as distress sales; based on this finding, it is worthy to note that these strategies were adopted by the respondents as both ex-ante and ex-post risk management strategies depending on their economic power. The respondents also specified the production risks management and mitigation strategies employed; it was shown that 48.36% adopted cultural practices, 22.13% adopted self-insurance and 61.48% adopted family labour supply while 40.98% adopted sales of perishable proceeds at a subsidized price. Any risk management strategies adopted is

expected to yield some notable outcomes; based on this, it was revealed that only 36.07% of the respondents claimed not to observe any significant outcome with the risk management strategies employed, 50.0% claimed to observe an increase in production, 20.49% claimed increase in the quantity available for consumption, while 17.21% claimed increase in disposable income. The expenditure analysis of the respondents showed an estimated monthly mean expenditure of ₦21,013; this suggests that the monthly expenses was relatively minimal considering the prevalent meager income in the rural area and the observed large household size in the study area.

**Table 1: Socio-economic characteristics and risks information of the respondents**

Variable	Frequency	Variable	Frequency
<b>Gender</b>		<b>Number of children schooling</b>	
Male	100 (81.97)	1-5	95 (77.86)
Female	22 (18.03)	6-10	25 (20.5)
<b>Age group (years)</b>		Above 10	2 (1.64)
< 30	8 (6.6)	Mean (4.47)	
31-40	25 (20.5)	<b>Number of working members</b>	
41-50	35 (28.7)	< 2	37 (30.33)
51-60	35 (28.7)	3-4	73 (59.83)
> 60	19 (15.5)	Above 4	12 (9.84)
Mean (49.25)		Mean (3.55)	
<b>Marital status</b>		<b>Social organization members</b>	
Single	6 (4.92)	No	30 (24.59)
Married	116 (95.08)	Yes	92 (75.41)
<b>Years of formal education (years)</b>		<b>*Type of risk faced</b>	
0	48 (39.34)	None	1 (0.82)
1-6	36 (29.51)	Weather	78 (63.93)
7-12	31 (25.41)	Production	55 (45.08)
Above 12	7 (5.74)	Market	31 (25.41)
Mean (6.31)		Financial	60 (49.18)
<b>Primary occupation</b>			
Non-Farming	9 (7.38)		
Farming	113 (92.62)		
<b>Primary occupation activities</b>		<b>*Risks coping strategies</b>	
Crop farming	90 (73.77)	Loan	73 (59.84)
Livestock farming	13 (10.66)	Use of herbicides	12 (9.83)
Food crops processing	10 (8.2)	Irrigation	47 (38.52)
Civil service	5 (4.09)	Family labour supply	17 (13.93)
Artisanship	04 (3.28)	Borrowing from friends	52 (42.62)
<b>Years of experience in primary occupation</b>		Fertilizer use	6 (4.92)
1-10	4 (3.28)	Planting of resistance varieties	3 (2.38)
11-20	26 (21.39)	Distress sales	12 (9.84)
21-30	34 (27.87)	<b>*Production risk mgt strategies</b>	
31-40	36 (29.51)	Cultural practice	59 (48.36)
Above 40	22 (18.08)	Self insurance	27 (22.13)
Mean (33.04 years)		Family labour supply	75 (61.48)

<b>Farm size (ha)</b>		Subsidizing perishable goods	50 (40.98)
< 2	24 (19.68)	<b>*Outcome of the mgt strategies</b>	
2.1-4	62 (50.82)	Not significant	44 (36.07)
Above 4	36 (29.52)	Increased yield	61 (50.0)
Mean (6.61)		Increased consumption	41 (33.61)
<b>Household size</b>		Increased disposable income	67 (54.92)
< 6	11 (9.02)	<b>Expenditure (₦)/month</b>	
7-12	53 (43.46)	< 10000	21 (17.22)
13-20	49 (40.17)	10001 – 20000	41 (33.62)
Above 20	9 (7.38)	20001 – 30000	45 (36.9)
Mean (12.06)		Above 30000	15 (12.3)
		Mean (21013.44)	

Figures in parenthesis are percentage values, \* - multiple response

Source: Field survey, 2014

#### **Tobit estimate of the risk management strategies among artisanal fishermen**

The empirical estimation of the Tobit regression model as shown in Table 2 revealed a log-likelihood of -74.5598 and pseudo R<sup>2</sup> of 0.3802 which suggest that fitted model is good. Years spent in school which is a proxy for human capital development was found to have a positive and significant ( $p<0.1$ ) relationship with adoption of risk management strategies which suggest that a unit increase in years spent in school will bring about 45% increase in adoption of risk management strategies because as expected, education exposes individuals to have a better, privilege and useful information on how to mitigate and manage any potential risks. In the same vein, household size has a positive and significant ( $p<0.1$ ) relationship with risk management strategies which suggests that a unit increase in household size will bring about 28% increase in adoption of risk management strategies; this is because of the expected responsibility of the household head to ensure food security and well-being of the household.

On the other hand, social capital endowment proxied by social organization (group) membership has a negative but significant ( $p<0.01$ ) relationship with risk management strategies adoption which suggests that a unit increase in social organization membership will bring about 7.5% decrease in adoption of risk management strategies; this does not conform with a-priori expectation as a result of the direction of movement (negativity) of the coefficient because there is shortfall in the expected benefits from being a member of social group(s) despite their involvement in social organization but this finding further suggests that the social capital endowment in the study area is ‘the missing link’. The outcomes of risk management strategies adopted is also significant ( $p<0.05$ ) but have an inverse relationship with adoption of risk management strategies employed; which implies that a unit increase in outcome of risk employed will bring about decrease in adoption of risk management strategies by 2.9; this also negates a-priori expectation because the visible outcome from adopting one or more risk management strategies does not correspond with their over-bloated level of expectations from risk management strategies employed; this could also be attributed to ‘the missing link’ as pointed out earlier.

**Table 2: Tobit Regression Result**

Adoption of Risk Management Strategies	Coefficient	Standard error	t-value	P> t
Constant	2.6545	1.8177	1.46	0.147
Age	-0.4167	0.7277	-0.57	0.568
Years of formal education	0.4563	0.2358	1.94***	0.055
Primary occupation	-0.1088	0.4231	-0.26	0.797
Household size	0.2797	0.1412	1.98***	0.130
Number of working members	-0.2438	0.8686	-0.28	0.779
Social organization	-0.7573	0.2509	-3.02*	0.003
Outcomes	-2.9110	0.1400	-2.08**	0.040
Expenditure	0.0002	0.0001	1.20	0.233

Log-likelihood = -74.998, LR-chi<sup>2</sup> = 98.54,

Prob>chi<sup>2</sup> (8) = 0.0008, Pseudo R<sup>2</sup> = 0.3802

\*    \*\*    \*\*\* - significant at 10%, 5% and 1% probability levels respectively

Source: Field survey, 2014

## CONCLUSION AND RECOMMENDATION

The study concludes that most of the respondents are still in their active age with elementary educational status. Majority of the risks being faced with are climate change related risks, production risks as well as financial risks. Most of the respondents take to credit facilities from social organization, irrigation practices, borrowing from friends, family labour supply and distress sales among others, as risk management, mitigation and or coping strategies employed. Human capital development, household size, social capital endowment as well as the outcome from strategies employed have strong influence on the adoption of risk management strategies. Hence, the null hypothesis is not accepted while the alternative hypothesis is hereby accepted.

Based on the findings of this study, the following recommendations are of significant importance to policy making:

- Adequate funding of basic education for all should be given utmost attention by the government.
- Social organization membership should be encouraged for the purpose of access to credit and proper usage of such so as to derive maximum and expected benefits of being a member of social group.
- Birth control strategies and campaign should be given paramount attention by the government and NGOs because of the observed large household size in the study area.

## Suggestion for further study

It was identified from the study that there exists risks facing the agrarian population; these are predominantly climate change induced risks as well as production and financial risks. Both ex-ante and ex-post risk management strategies were employed; but significant percentage of the respondents still claimed not to observe any significant outcome thereby necessitated the call for the social capital endowment in the study area which is ‘the missing link’. Despite the existence of social group, the respondents seem not to do well from the expected

flow of information from these groups; hence, there is need to fill the gap on the level of benefits derived from social group membership so as to know if the benefits derived from social groups influence the risk management strategies employed by the rural households, being the food basket of the nation because food is essential to keep the world at peace.

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## CHILDREN EDUCATION AND RURAL DEVELOPMENT IN EGYPT

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### ABSTRACT

There are 150 million street children and another 250 million children who will never see a book. While books might reach them at some point, socioeconomic circumstances and language barriers may become a hindrance for a child to read the book. An analytical study of human development reports shows that there are gaps among the different governorates, rural and urban areas, and males and females. This problem refers to the gaps between human development indicators for education, health, and GDP per capita indicators. This study discusses linkages between children education and standard of living with a view to promoting rural development in Egypt. In order to suggest suitable model for rural development, and how to enhance standard of living in the case of Egypt in order to create employment opportunities and income, especially for the poor. The results indicate that there is a predominant form of children work in Egypt, which is children working as unpaid family workers on their own family's farm or non-farm household enterprise.

**Keywords:** children, rural development, Egypt

### 1. INTRODUCTION

According to the latest data from the UNESCO Institute for Statistics (UIS), 61 million children of primary school age were out of school in 2010, girls accounted for 53% of out-of-school children, compared with 58% in 2000, Arab States (5.0 million). The number of illiterates in the Arab States is estimated about 68 million (of which 63 per cent are women). Despite the expanded efforts, one fourth of these is found in one country: Egypt (17 million), and 70 per cent in five countries: Egypt, the Sudan, Algeria, Morocco and Yemen. In most of these countries illiteracy is accompanied by population size, high population growth rates, poverty and concentration of population in rural areas.

There are 150 million street children and another 250 million children who will never see a book. While books might reach them at some point, socioeconomic circumstances and language barriers may become a hindrance for a child to read the book.

Children from poor households are far more likely to drop out of school than children from wealthier homes. Given that access to education can help people lift themselves out of poverty, it is vital that governments provide opportunities for the poorest to enroll. Increasing poor families' income can enhance education prospects. Several countries have introduced cash transfers with eligibility linked to school attendance.

The majority of the poor – 70%, or about 1 billion people – live in rural areas, predominantly in low and some middle income countries. They are heavily concentrated in sub-Saharan Africa and South Asia, where most are dependent on a combination of small-scale farming, seasonal casual labour and micro entrepreneurial activities with low earnings potential. As the world population continues to grow and demand for food rises while land becomes scarcer, skills development is vital so that young people in rural areas can learn to adopt new technologies in agriculture, and have greater opportunities for non-farm work.

In spite of the existence of poverty and ignorance in earlier eras, but awareness of the inherent values and culture was thriving. Where education is the integrated life system, education is the way to enhance the social status prestigious. This study discusses linkages between children education and standard of living with a view to promoting rural development in Egypt. Drawing on international experience regarding the reforms needed to strengthen those linkages, the paper addresses the following objectives:

- Evaluate education system capable of enhancing children education in a way that creates employment opportunities, reducing poverty, hence developing rural Egypt.
- Create scenario in order to enhance rural development indicators in Egypt (children education approach)

## 2. MATERIALS AND METHODS

This study discusses linkages between children education and standard of living with a view to promoting rural development in Egypt. Data is collected from Human Development Report, 2014, Results of the 2010 National Child Labour Survey and Focus group meeting or discussions with the targeted groups in order to suggest suitable model for rural development in the case of Egypt.

Data analysis depends on trends, Annual Growth Rate, distribution per sent and change rate between groups.

## 3. RESULTS AND DISCUSSION

### Human Development Indicators in Egypt

Each year since 1990 the Human Development Report has published the Human Development Index (HDI) which was introduced as an alternative to conventional measures of national development, such as level of income and the rate of economic growth.

Table (1) Human Development Index: Trends 1980 – 2013

Year	Medium human development	Egypt	Arab States	World
2013	0.614	0.682	0.682	0.702
2012	0.612	0.681	0.681	0.700
2011	0.609	0.679	0.678	0.698
2010	0.601	0.678	0.675	0.693
2008	0.587	0.667	0.664	0.685
2005	0.565	0.645	0.644	0.667
2000	0.528	0.621	0.611	0.639
1990	0.474	0.546	0.551	0.597
1980	0.420	0.471	0.492	0.559
<b>Annual HDI (1980-1990)</b>		1.91	1.14	0.66
<b>Growth Rate % (2000-2013)</b>		0.72	0.85	0.73

Source: UNDP, Human Development Report, 2014.

The HDI represents a push for a broader definition of well-being and provides a composite measure of three basic dimensions of human development: health, education and income (1980 – 2013) (Table 1).

Egypt's HDI rose by 2.1% annually from 0.471 to 0.682 today, which gives the country a rank of 110 out of 187 countries with comparable data. The HDI of Arab States as a region increased from 0.492 in 1980 to 0.682 today, placing Egypt in the regional average. The HDI trends tell an important story both at the national and regional

level and highlight the very large gaps in well-being and life chances that continue to divide our interconnected world.

Education for sustainable development is an emerging but dynamic concept that encompasses a new vision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future. Egypt's HDI for 2013 is 0.682. However, when the value is discounted for inequality, the HDI falls to 0.485, a loss of 24 per cent due to inequality in the distribution of the dimension indices. Loss due to inequality in education is 41 per cent but for income and health is 14.2, 13.4 per cent .The average loss due to inequality for medium HDI countries is 25.6 per cent and for the Arab States it is 24.9 per cent.

### **Egypt education system**

Education will shape the world of tomorrow — it is the most effective means that society possesses for confronting the challenges of the future. Progress increasingly depends upon educated minds: upon research, invention, innovation and adaptation. Educated minds and instincts are needed not only in laboratories and research institutes, but also in every walk of life. While education is not the whole answer to every problem, in its broadest sense, education must be a vital part of all efforts to imagine and create new relations among people and to foster greater respect for the needs of the environment.

The public education system in Egypt consists of three levels: the basic education stage for 4–14 years old: kindergarten for two years followed by primary school for six years and preparatory school for three years. Then, the secondary school stage is for three years, for ages 15 to 17, followed by the tertiary level. Education is made compulsory for 9 academic years between the ages of 6 and 14. Moreover, all levels of education are free in any government run schools. According to the World Bank, there are great differences in educational attainment of the rich and the poor, also known as the “wealth gap.” Although the median years of school completed by the rich and the poor is only one or two years but the wealth gap reaches as high as nine or ten years. In the case of Egypt, the wealth gap was a modest 3 years in the mid1990s. Overall, the composite education Index in the MENA Flagship Report: The Road Not Travelled showed promising results of Egypt's relative educational achievements. Of the 14 MENA countries analysed, Egypt achieved the universal primary education and has also reduced the gender gap at all levels of instruction, but there is still a need to improve the quality of education.

Egypt launched its National Strategic Plan for Pre-University Education Reform (2007/08 – 2011/12). The Strategic Plan (which has the subtitle ‘Towards an educational paradigm shift’) mirrors Egypt's commitment to a comprehensive, sustainable, and collective approach towards ensuring an education of quality for all and developing a knowledge society. Its key elements are: access and participation; teachers; pedagogy; curriculum and learning assessment; textbooks and learning materials; management and governance; and a quality improvement strategy. Promotional examinations are held at all levels except in grades 3, 6 and 9 at the basic education level and the grades 11 and 12 in the secondary stage, which apply standardized regional or national exams. The Ministry of Education is responsible for making decisions about the education system with the support of three centers: the National Center of Curricula Development, the National Center for Education Research, and the National Center for Examinations and Educational Evaluation. Each center has its own focus in formulating education policies with other state level committees. On the other hand, the Ministry of Higher Education supervises the higher education system. There is also a formal teacher's qualification track in place for basic and secondary education levels. The teachers are required to complete four years of pre-service courses at university to enter the teaching profession. Specifically with respect to teacher's professional development to raise mathematics, science and technology teaching standards, the Professional Academy for Teachers offer several programs. Local teachers also take part in the international professional training programs.

As of late 2009, the pilot showed few if any problems, and the expected results were materializing quite well, in terms of stimulating community participation, allowing schools to spend more efficiently and assess their own priorities, and increasing the seriousness of school-based planning by creating a means to finance such plans, among other expected results. An informal assessment of the pilot revealed that the funding formula money precipitated an increase in community donations. The survey results show that the ratio of the median values of community donations of the pilot year to the previous year was 2.20. Parallel to these efforts in the education sector, other sectors (for example, certain aspects of housing and municipal services) in Egypt are planning to decentralize decision-making and spending, now nation-wide (without a pilot stage in limited governorates), in a phased approach. Education plans to be one of the lead sectors in this process. In addition to administrative and financial decentralization, there is an increasing emphasis on involving elected local popular councils (which exist at governorate and district level) in the horizontal oversight of expenditure and planning across the decentralizing sectors, and as they come on stream in the decentralization process. Within the education sector, as of late 2009 plans are being made to decentralize certain lines of funding and planning for capital equipment and infrastructure, in all governorates, all the way to school level in the case of smaller units of capital equipment, or levels higher than the school for items such as new infrastructure. The education sector does expect to continue to use the original 3 pilot governorates as a special observatory to assess and understand how well the process is proceeding.

## Schooling

Pre-university schooling in Egypt is currently divided into two stages: a basic stage, which is mandatory and consists of nine years of schooling, and a secondary stage, which is optional and consists of three years of schooling in either a general (university-bound) track or a technical (mostly terminal) track. The minimum age of enrolment in first grade is six, but a significant proportion of children enroll in pre-school or kindergarten prior to that age. Given that there are nine years of mandatory schooling, if a child enters on time at age six, s/he would complete mandatory schooling by age 14. However, it is not uncommon for parents to delay their children's schooling until age 7. As evidence of this gradual transition into school attendance rises from 28% for 5-year olds to 74.6% for 6-year olds to a nearly universal 97.4% among 7-year olds.

## Employment & unemployment

Egypt's population at the beginning of 2010 was estimated at 77.8 million people. According to the latest population census in 2006, 56.9% of the population was living in rural areas and 31.7% was under 15 years of age. The population of 5 to 17 year olds, targeted by the NCLS, was estimated in 2010 at 17.1 million children or 22% of the overall population. The size of the labour force 15 and older in Egypt was 26.2 million in 2010, of whom 23.8 million are employed. This results in a labour force participation rate of 49.3% and an employment to population ratio of 44.9%. Labour force participation rates for males are about three times as high as for females and employment to population ratios are four times as high. Participation is close to universal for males 25 to 64 (93%), but is only 26.9% for females in the same age group. The highest participation rates for women are reached at the 20-24 age <sup>(9)</sup>.

The overall unemployment rate of 9% is an average that conceals significant variations by both sex and age. The female unemployment rate, at 22.6% is 4.6 times higher than the male rate of 4.9%, one of the highest such ratios in the world. We also note that the unemployment rate is much higher among youth than among adults, reaching a maximum of 27.6% among those 20-24, as compared to 4.8% among those 25 to 64. Young women in particular experience unemployment rates in excess of 50%.

These are five of the many reasons why education should be the centre of any development agenda – especially at the Rio+20 conference. The flipside of every potential development benefit of sending children to school is that, for the millions of children who are out of school, there are devastating effects. As the new data presented in this fact sheet point out, these children are typically poor and rural. In other words, those who are missing out on these benefits are often those who need them the most.

Children who are hungry, malnourished or ill are not in a position to gain the skills needed for later learning and employment. There are signs that early childhood health is improving, but from a very low base in some countries and not fast enough to meet international development goals. The annual rate of decline in child mortality accelerated from 1.9% in (1990–2000) to 2.5% in (2000–2010). Recent estimates suggest that just over half the decline in child deaths can be attributed to more education among women of reproductive age <sup>(1)</sup>.

### **Child employment**

Out of Egypt's 17.1 million children, the national children work survey of 2010 reports 1.8 million to be engaged in some type of employment, a rate of 10.5%. Employment rates are more than three times higher for boys than for girls and also increase significantly with age for both genders. The employment rate for 15 to 17 year olds is five and the half times higher than for children 5 to 11. This multiple is higher for boys (5.9 times) than for girls (4.5 times) <sup>(9)</sup>.

### **Distribution of employed children**

The distribution of working children by major area of economic activity confirms that the majority works in agriculture, mostly on their own families' farm. As one would expect, a higher proportion of working girls is found in agriculture than working boys. The shares of those working in industry and services are about the same. The distribution by detailed economic activity reveals that about 10% of working children work in manufacturing and 8% work in construction, the vast majority of whom are boys. Within services, the largest share is in retail trade, which makes up 11.5% of all working children (Table 2).

Table (2) Distribution of employed children by major areas of economic activity, by sex

	Male	Female	Total
Agriculture	63.8	59.9	76.9
Industry	17.7	20.6	7.8
Services	18.5	19.4	15.3
Total	100.0	100.0	100.0

Source: CAPMAS, Labour Force Survey, 2010.

### **Participation in unpaid household services**

Participation in unpaid household services is relatively high for children of all ages in both urban and rural areas, but is predictably higher for girls. Participation in unpaid household services peaks at 77.5% at the age of 14 for urban boys and at 74% at age 13 for rural boys. For urban girls, it peaks at 85% at age 15 and remains high. For rural girls and continues to rise up to age 17 for rural girls, reaching 95% at that age.

### **Children's multiple activities**

Children routinely combine activities in Egypt. About two thirds of economically active children combine work and school, with 52% combining all three activities and an additional 15% combining work and school. Similarly the vast majority of those engaged in household chores (90%) also go to school. Very few children are

exclusively engaged in economic activity (1.4%) and almost no girls are (0.2%). A larger percentage (2.2%) combine economic activity with household chores and an even larger percentage (4.7%) are exclusively engaged in household chores. The pattern of children's activities differs significantly by age and sex.

### **Suitable scenario in order to enhance rural development indicators in Egypt (children education approach)**

An analytical study of human development reports shows that there are gaps among the different governorates, rural and urban areas, and males and females. This problem refers to the gaps between human development indicators for education, health, and GDP per capita indicators. While agriculture is a main activity in the Egyptian economy and remains the most important source of income and employment to the rural poor, research results have proved that poverty in rural Egypt cannot be significantly reduced by promoting agricultural growth in old lands alone. This is due to land scarcity and labour saturation, hence a low elasticity of agricultural employment with respect to growth in both agricultural value added and overall GDP.

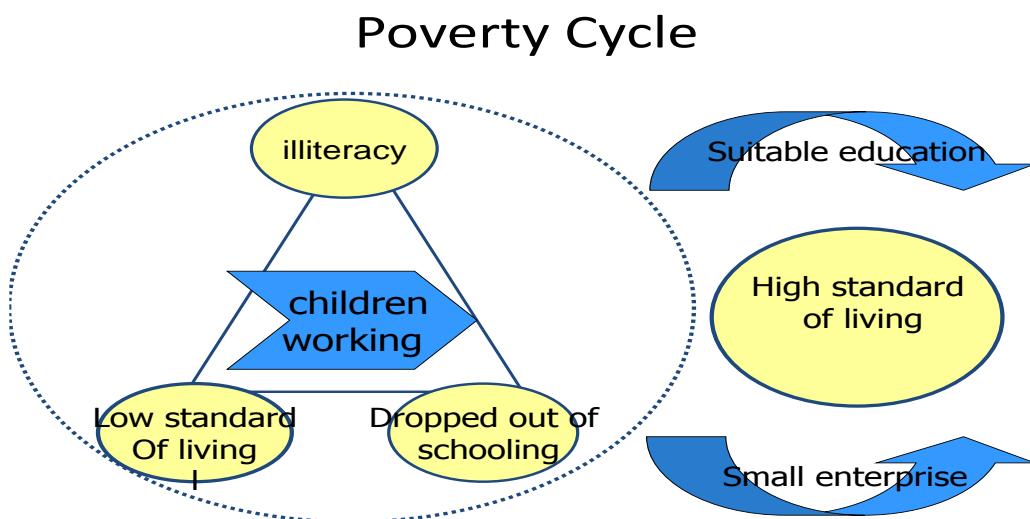


Figure (1) Suggested scenario in order to enhance rural development indicators in Egypt (Children education approach)

The results presented above indicate that there is a predominant form of children work in Egypt, which is children working as unpaid family workers on their own family's farm or non-farm household enterprise. This type of children work cannot be effectively addressed by regulations banning children work and must be addressed by policies that support families to help them do what is best for their children. Such policies would include raising awareness about hazardous conditions children on farms can be exposed to such as dust inhalation, exhaustion, bending for long periods of time, or exposures to pesticides, in an attempt to make the work safer for children. A minority of working children, about 30%, work for wages in hazardous industries or occupations or for very long hours. These are the children that can be reached by policies that either ban or strongly regulate children work. Laws and regulations addressing such hazardous working conditions are already on the books in Egypt. What is required now is their effective enforcement. However, enforcement of existing laws alone is not going to be sufficient to stamp out children work in Egypt. Our findings show that children work is clearly linked to poverty, negative shocks affecting households, and poor parental education. More effective social programs to support families in crisis and to alleviate poverty can go a long way in reducing their need to put their children to work as showed in (figure 1) as a suggested Suitable model in order to enhance rural development indicators in Egypt (children education approach).

#### 4. CONCLUSION

There are 150 million street children and another 250 million children who will never see a book. While books might reach them at some point, socioeconomic circumstances and language barriers may become a hindrance for a child to read the book. An analytical study of human development reports shows that there are gaps among the different governorates, rural and urban areas, and males and females. This problem refers to the gaps between human development indicators for education, health, and GDP per capita indicators.

The results presented above indicate that there is a predominant form of children work in Egypt, which is children working as unpaid family workers on their own family's farm or non-farm household enterprise. This type of children work cannot be effectively addressed by regulations banning children work and must be addressed by policies that support families to help them do what is best for their children. Such policies would include raising awareness about hazardous conditions children on farms can be exposed to such as dust inhalation, exhaustion, bending for long periods of time, or exposures to pesticides, in an attempt to make the work safer for children. A minority of working children, about 30%, work for wages in hazardous industries or occupations or for very long hours. These are the children that can be reached by policies that either ban or strongly regulate children work. Laws and regulations addressing such hazardous working conditions are already on the books in Egypt. What is required now is their effective enforcement. However, enforcement of existing laws alone is not going to be sufficient to stamp out children work in Egypt. Our findings show that children work is clearly linked to poverty, negative shocks affecting households, and poor parental education. More effective social programs to support families in crisis and to alleviate poverty can go a long way in reducing their need to put their children to work.

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## THE IMPACT OF CHANGING THE POLITICAL CONDITIONS ON THE EGYPTIAN CONSUMER PATTERN

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### ABSTRACT

The study focus is on providing detailed assessment of the food consumption patterns in rural and urban Egypt during the interim period 2009-2013 .the finding of the study expect to form a base for further evaluation of the food consumption patterns in the pre / post the revolution in 2011. Some of the study results showed: (1) rising the rural household food expenditure share relative to the total one when compared to urban households. This is despite having a reduction in the relative importance of what is spent on food in Egypt between 2008/2009 and 2012/2013; (2) despite enjoying a relative food quantity improvements in the per-capita share, this was not matched by an improvement in food quality; and (3) the study indicated to widening of the food gap one year after the other and more reliance on food imports in Egypt.

**Keywords:** Lorenz curve, Gini coefficient, Groups of Expenditures, The parity purchasing power, food consumption, Egypt.

### 1. INTRODUCTION

The study focus is on providing detailed assessment of the food consumption patterns in rural and urban during for further evaluation of the food consumption patterns in the pre / post the revolution in 2011.The main objective of this study is to analyze the Egyptian consumption expenditure patterns, specifically (1) the development of food hierarchy of the Egyptian citizens,(2) the development of relative importance of the principal and food consumption groups ,(3) measurement of equality distribution of the food groups based on family budget research, (4) estimation of consumer demand functions of the principal and food consumption groups, (5) estimation the parity purchasing power for the Egyptian citizens.

### 2. MATERIAL AND METHODS

This research was based on descriptive and quantitative statistical methods for economic analysis of data. It included percentages, averages, Gini coefficient and Lorenz curve. The Gini coefficient is usually defined mathematically based on the Lorenz curve, which plots the proportion of the total income of the population (y axis) that is cumulatively earned by the bottom x% of the population.

$$G = \sum x_i y_{i+1} - \sum y_i x_{i+1} / 10000$$

where:  $X_i$ : Cumulative % population ,  $Y_i$ : Cumulative % income

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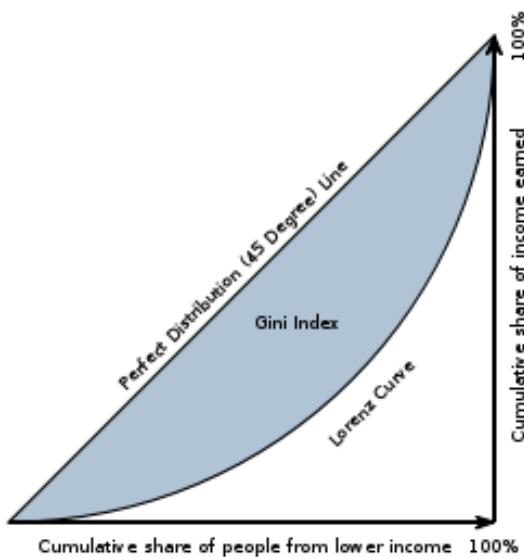


Fig1. Lorenz curve

The line at 45 degrees thus represents perfect equality of incomes. The Gini coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve. If all people have non-negative income (or wealth, as the case may be), the Gini coefficient can theoretically range from 0 (complete equality) to 1 (complete inequality); it is sometimes expressed as a percentage ranging between 0 and 100. For secondary data sources Government, family budget studies for the years 2008/2009, 2012/2013 were included as well as books, theses and relevant scientific research. Scientific websites of relevance were also tapped.

### 3. RESULT AND DISCUSSION

#### 3-1 .Self Sufficiency for major food commodities

the production and consumption economics of food groups in Egypt. The food grains group. This group was considered top important, with basic food commodities and supplied most of human food requirements.

**Table1.Self Sufficiency for major food commodities ,2009-2013**

Year	Grain	Meat	Sugar	Oils & Fats
2009	74.35	92.60	99.06	48.92
2010	51.37	85.71	69.33	23.53
2011	54.69	89.66	69.40	29.49
2012	54.12	88.02	70.49	23.10
2013	53.11	87.69	70.88	23.76

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): **Consumption Bulletin**, Various Issues, Cairo, Egypt.

While the self sufficiency of meat group included red meat, white meat and fishes ( it considered the main source of animal proteins) was decreasing during the period 2009-2013,also the self sufficiency of sugars and oils and fats groups were also decreasing during the period (2009-2013) .

The development of food consumption patterns of the Egyptian citizens. The research had shown imbalances of food components of the principal food groups, although Egyptians people expended more than half of their income on food, during the periods (2008/2009 –

2012/2013): (1) The Egyptians food was based mainly on daily consumption of food grains as these supplied about 60.3% of total calories consumption (2) The average per capita share of proteins, oils and fats had decreased (3) Average per capita consumption from fruits, vegetables and sugars had increased during the past period.

**Table 2. Main and Sub-Groups of Expenditures during the periods 2008/2009 -2012/2013**

Main and Sub-Groups of Expenditure	2008/2009		2012/2013	
	Urban	Rural	Urban	Rural
<b>Bread and cereals</b>	13.27	17.24	10.76	12.97
<b>Meat</b>	26.44	25.31	29.14	30.11
<b>Fish and seafood</b>	6.36	5.35	6.24	4.98
<b>Milk , cheese and eggs</b>	14.17	11.55	16.3	12.09
<b>Oils and fats</b>	8.81	9.44	6.53	7.68
<b>Fruit</b>	6.61	6.12	6.88	6.74
<b>Vegetables</b>	14.1	15.45	14.41	16.38
<b>Sugar,</b>	4.55	4.79	3.97	3.7
<b>Non-Alcoholic Beverages</b>	3.64	3	1.93	1.81
<b>Other food products</b>	2.05	1.75	3.84	3.54
<b>Food and Non-Alcoholic Beverages</b>	100.00	100.00	100.00	100.00
<b>% Food Of Total consumption expenditure</b>	43.59	48.56	59.09	61.16

**Source:** CAPMAS: Household Income Expenditure and Consumption Survey (HIECS), Various Issues (2008/2009 and 2012/2013), Cairo, Egypt.

The annual percentage individual expenditure on food groups in had shown that (1)Percentage decrease of per capita expenditure on food grains and bread, Percentage increase of per capita expenditure on meat in urban areas while it relatively decreased in rural areas , (2) Percentage increase of per capita expenditure on milk and milk products , fish and seafood ,fruits, vegetables , oils and fats in both urban and rural areas (3) Percentage decrease of per capita expenditure on sugars, both in urban and rural areas , during the periods (2008/2009 -2012/2013).

### 3.2.Lorenz curve

Lorenz curve is measurement of equality distribution of consumption expenditure on food, the study had shown that (1) there was an unequal distribution of expenditure on food between different consumption groups both in urban and rural areas, (2) Food grains ranked first among other food groups, then fruits and vegetables, and fats and oils exchanged second and third places during the budget years of 2008/2009 and 2012/2013, The sugar group ranked fourth , the meat group was placed at the back, both in rural and urban areas.

### 3.3Gini concentration

Gini concentration rate was used to measure equality distribution of consumption expenditure in rural and urban areas. This value was indicated by the ratio of the area confined between Lorenz curve and the equality line, where it ranges from zero (perfect equality) and one (perfect inequality). This value was estimated for the food grains and bread group in urban areas at 0.06, 0.22 in 2008/2009 and 2012/2013, respectively. For rural areas, it was 0.30 and 0.41, respectively for the latter periods. This value had indicated more inequality distribution in rural areas than in urban areas. For meat, the Gini coefficient was 0.15 and 0.22, respectively for the years 2008/2009 and 2012/2013 in urban areas; while in rural areas it was 0.35, 0.38, respectively for the above period.

Finally, for food and drinks group, Gini coefficients in urban areas were estimated at 0.12 and 0.26 respectively for the years 2008/2009 and 2012/2013; while in rural areas these were 0.33 and 0.38 for the years 2008/2009 and 2012/2013, respectively. The research had shown that the maximum Gini coefficient value for food groups was in the year 99/2000.

Table3.Gini concentration rate for major food commodities, 2008/2009-2012/2013

Main and Sub-Groups of Expenditure	2008/2009		2012/2013	
	Urban	Rural	Urban	Rural
<b>Bread and cereals</b>	0.22	0.41	0.08	0.15
<b>Meat</b>	0.22	0.38	0.08	0.16
<b>Fish and seafood</b>	0.11	0.52	0.16	0.27
<b>Milk , cheese and eggs</b>	0.25	0.39	0.04	0.06
<b>Oils and fats</b>	0.17	0.3	0.01	0.01
<b>Fruit</b>	0.62	0.45	0.13	0.23
<b>Vegetables</b>	0.42	0.28	0.13	0.02
<b>Sugar,</b>	0.26	0.36	0.07	0.18
<b>Food and Non-Alcoholic Beverages</b>	0.26	0.38	0.05	0.12

Source: CAPMAS: Household Income Expenditure and Consumption Survey (HIECS), Various Issues (2008/2009 and 2012/2013), Cairo, Egypt.

### 3.4 The parity purchasing power

The parity purchasing power showed that, a poor man in 2009 is that whose income is less than 699 pounds per month (the population live below national poverty line \$ 2) , while, a poor man in 2013 is that one whose income is less than 1111 pounds per month. If a poor man is to maintain the same standard of consumption of 2009, his income has to be increased by almost 59 % of the 2009 level of income.

### 3.5 The income elasticity of demand

The study on the relationship between total consumption expenditure and per capita expenditure on the food groups had shown: (1) The income elasticity of demand for food grains, in both urban and rural areas, was considered low, respectively in 2012/2013 and indicated necessary commodities , (2) The income elasticity of demand for meat indicated that it had changed from necessary to semi- necessary goods in both urban and rural areas:, respectively in 2012/2013,(3)The fishes group was considered semi-necessary commodities both in urban and rural areas. The same was true for milk and milk products, (4) the oils and fats group had changed from necessary to semi-necessary goods in urban, (5) While the vegetables had changed from necessary to semi-necessary goods, both in urban and rural areas,(6) The fruits group was indicated semi-necessary commodities in urban areas,(7) The sugars group had changed in urban and rural areas from as necessary goods to semi-necessary goods.

## 4. CONCLUSION

This paper analyses the changes in food expenditure patterns Egypt during the period 2009-2013 in the pre / post the revolution in 2011 with special emphasis on the differences between urban and rural sectors. Food consumption expenditure patterns have changed over the four consecutive years as a result of political and economic changes. Estimated expenditure elasticity for food groups are positive and less than one. The estimated expenditure elasticity for food groups have decreased significantly over the time. Elasticity tend to be higher in

rural areas than urban ones. These results provide the guideline for future policy implication in respect of the demand management and food consumption in Egypt

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## ENSURING RURAL DEVELOPMENT IN PLACE USING YOUR METHODS OF SUSTAINABLE AGRICULTURE

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### **ABSTRACT**

Turkey's rural economy is based on agriculture. With this feature of the agricultural sector in the countryside, employment, income distribution and poverty levels plays a decisive role. There will be positive developments or to be applied in the agricultural sector directly affects the rural population. Today, the greatest achievements in agriculture, reducing the adverse environmental conditions, through being able to perform the required increase in production. This is only possible with the implementation of durable solutions and sustainable agricultural methods.

Sustainable agriculture means agriculture that promotes the health of the people and the land in the long term. Sustainable farming methods provides not only food, but also to increase the quality of the yield of the soil, water waste prevention, the protection of valuable seeds, biodiversity and soil for future generations, ensures the continuation of life. Sustainable agriculture is the foundation of approach, in rural areas, where farmers engaged in manufacturing that located is to maintain its activities, reach a level of prosperity they deserve, infrastructure, education and health services to be taken of farmers, the realization of economic activities, the evaluation of the local potential, protection of the natural and cultural assets, aimed at achieving a rural development is one of the main goals of sustainable agriculture.

In this research, the provision of rural development in Turkey and for improving the current situation, by region as appropriate sustainable farming method and also the determination of soil, water, energy and the environment, while maintaining continuity has sought to demonstrate that there is a necessity.

**Keywords:** Turkey, Agricultural Sector, Sustainable Agriculture, Rural Development

### **ÖZET**

Türkiye kırsalında, ekonomi tarıma dayanmaktadır. Tarım sektörü bu özelliği ile kırsalda, istihdam, gelir dağılımı ve yoksulluk düzeylerinde belirleyici rol oynamaktadır. Tarım sektöründe yaşanacak ya da uygulanacak olumlu gelişmeler kırsal nüfusu doğrudan etkilemektedir. Günümüzde tarımda en büyük başarı, olumsuz çevre koşullarını azaltarak, istenilen üretim artışını gerçekleştirebilmekten geçer. Bu da yalnızca, tarımda sürdürülebilir yöntemlerin ve kalıcı çözümlerin uygulanması ile mümkün olabilir.

Sürdürülebilir tarım uzun dönemde insanların ve toprağın sağlığını gözetlen tarım demektir. Sürdürülebilir tarım yöntemleri sadece gıda sağlamakla kalmaz, aynı zamanda toprağın verim kalitesinin artmasını, suyun israf edilmesinin önlenmesini, değerli tohumların korunmasını, biyoçeşitliliğin ve toprakta gelecek nesiller için hayatın sürmesini garantilemektedir. Sürdürülebilir tarım yaklaşımının temeli olan, kırsal alanda üretim yapan çiftçilerin bulundukları yerlerde faaliyetlerini sürdürmeleri, hak ettikleri refah düzeyine ulaşmaları, çiftçilere altyapı, eğitim ve sağlık hizmetlerinin götürülmesi, ekonomik faaliyetlerin gerçekleştirilmesi, yerel potansiyelin değerlendirilmesi, doğal ve kültürel varlıkların korunmasını amaçlayan bir kırsal kalkınmanın sağlanması sürdürülebilir tarımın ana hedeflerindendir.

Bu araştırmada, Türkiye'de kırsal kalkınmanın sağlanması ve mevcut durumun iyileştirilmesi için bölgelere göre uygun olan sürdürülebilir tarım yöntemlerinin belirlenmesi ve ayrıca toprak, su, enerji ve çevrenin korunarak sürekliliğinin sağlanması için nelerin gerekligi olduğu ortaya konmaya çalışılmıştır.

**Anahtar Kelimeler:** Türkiye, Tarım Sektörü, Sürdürülebilir Tarım, Kırsal Kalkınma

## 1. INTRODUCTION

The concept of sustainable agriculture, environmental changes pressures of emerged on the production and the four different policy (ecological pluralism, economic sustainability, social justice, and human-heartedness), is a system of thought proposing to take into account the principles simultaneously. Sustainable agriculture needs of the rapidly growing world population with sufficient and good quality food at reasonable costs of production, to improve the protection of environment and natural resource system and includes agricultural applications.

In Turkey, agriculture in the developed countries of the world as the industrial character win completely, although, on the one hand, synthetic unsupervised of production inputs is used, and nowadays the technology without thinking about the consequences that created quite negative processing techniques and intensive agricultural production. Today, this practice through impact and the deterioration of the natural balance of the food chain, creating life-threatening, as well as people who live with access to all the features of industrial or urban pollution has attracted much attention. Protection of water and soil resources in sustainable agricultural approach, but there are many other applications such as integrated medication management, medication, synthetic fertilizer as unnatural avoiding use of input quality, health and organic farming techniques that meet environmental standards play a key role.

Rural development is a political choice aimed at improvement of over population. Rural development, the natural environment is protected, rural living standards have been developed with the principles of equality and justice; economic, social and cultural aspects of a process that. Live in rural areas and production reflection rate of technological development is delayed. Affect the lifestyles and traditions and rules is more difficult. Lifestyle and consumption patterns are traditional (Anonymous 2004, 430). For this reason, the "future generations" could be needed to maintain natural capital necessary for economic development. Also, one of the first priorities of the food security, sustainable agriculture and rural development approach. For the sustainability of food production, the preservation of agricultural land is of utmost importance. However, it shows especially on agricultural land gradually increase housing.

In this study, sustainable agriculture, requirements and as well as developments in this field to achieve rural development to be in Turkey and the determination of appropriate sustainable farming methods by region for improving the current situation as well as land, water, energy and what to ensure the environmental preservation of continuity to be revealed as a necessity It was studied.

## 2. MATERIAL AND METHOD

The study is based on the literature, the publication of the relevant national and international organizations, theses, articles, magazines, and Internet resources were utilized. Supplementary sources are classified according to their interests after the case is evaluated in terms of content.

## 3. RURAL DEVELOPMENT

### 3.1. Rural Development and Rural Development Concept

Rural areas, where fewer than 150 people per km<sup>2</sup>, population density and population amount as administrative boundaries of the settlements, which are considered to be less than 20 thousand rural areas.

Of rural areas has been adopted by the world but is not a common definition for the first time the United Nations Organization is by definition made "community development" definition, "rural development" are also accepted. According to this definition of rural development, "they are in the small community of economic, social and cultural conditions of the state of the efforts they undertook to improve combining their efforts in this field, the fully fused to the nations of this community and is the process of ensuring their contribution in full form to the national development efforts" (Anonymous, 2004).

The population in rural development is a political choice aimed at improvement. Is a form of employment of rural labor force to be productive. Developing rural areas and inter-regional socio-consciously to eliminate the economic abyss, respecting environmental values, rural areas, the problems of the rural population in accordance with the potential and priorities, has been trying to obtain shares remains in place from the country of development and prosperity. When it looks at the employment and demographic distribution of the population of Turkey; both need high agricultural population and the size of agricultural holdings and agricultural techniques and it is possible to see that the desired characteristics of economic feasibility. Therefore, ensuring coordination between the relevant organizations in the implementation of all projects aimed at rural development, local government, civil society organizations and beneficiaries in decision-making and ensuring participation in the implementation process and natural resources, it is being studied in the framework of a sustainable way, using principles.

Ministry of Agriculture required in Turkey, as well as TÜBİTAK, Ministry of Development and the European Union has allocated significant resources to support the agricultural sector in recent years, the scope of rural development (Ozturk, 2011). The main purpose of incentives and policies for the use of renewable and idle resources in agricultural activities, the sustainability of agricultural production in Turkey and to protect the country's food security by providing quality, raise the living standards of the rural population, is to realize the sector to ensure a competitive edge to its contribution to the national income and foreign trade.

### **3.2. Rural Development Objectives**

Rural development; irregular living and working environment located outside of urban areas, without causing the exploitation of the natural resources, through to evaluating the applicability and sustainability, improving the living standards and income levels, includes the work of increasing prosperity. This area between disparities abolition of improving the agricultural structure, improving the quality of agricultural production, food security, reducing unemployment, for purposes such as preventing an unhealthy immigration, is aimed to support agricultural development.

## **4. SUSTAINABLE AGRICULTURE**

### **4.1. Concept and Basic Principles of Sustainable Agriculture**

The concept of sustainable agriculture, agricultural production in the agronomic, environmental, is a form of approach which aims to balance social and economic dimensions. Aims, on the one hand while maintaining productivity in agriculture by reducing damage to the environment on the other hand, short and long term to keep the economy alive, to improve the quality of life of those engaged in agriculture, and to this end is to develop applications. In fact put forward the concept of sustainable agriculture in order to solve the problems caused by industrial agriculture are proposed solutions. Here basic rules to be adopted first; of the resources required for agricultural production in the world is not unlimited and cannot disrupt the natural balance and achieving a desired degree of sustainable development. He faced the problems arising from human nature also include socio-economic studies. Therefore, development and environmental protection plans, should be considered in both regional and global dimensions.

The concept of sustainability in agriculture, the importance of winning and existing agricultural systems in the world since the early 1990s began to be questioned about it. However, in the year 1910 organic farming, biodynamic farming methods in 1924, and in 1930 a "closed system farming" has emerged ideas and thoughts. Agriculture, Food Security in the Brundtland Report, Species and Ecosystems, Energy and Industry, under the title are discussed from different angles. This transnational report, based on national interests in many countries, have been analyzed in accordance with national foresight and began to apply different understanding (Anonymous 1991b). Leaders in the world who participated in many countries in 1983, and international sustainable by groups established by Agriculture Wedding name organizations, sustainable agriculture, "ecological voice, resume economic entity, based on social justice and humane" is defined as. These four objectives, processing, and consumption of agricultural production and marketing can be applied to each system. (Anonymous, 2004).

Provide essential indicators for sustainable agriculture is given in Table 4.1. Income producers in the long-term sustainable agriculture is very important. Planning for a sustainable future for life must be made and will reduce the living standards of the people of these plans, care must be taken not lead to restriction of personal freedom. The protection of natural resources are essential for sustainable agriculture. Failure to state a period as a result of excessive and spontaneous activities of future encounter difficulties in the long term people will be inevitable. Therefore, first target in this regard should be identified and should not be given good support to sustainable non-agricultural activities. Governments should take measures against practices that can harm the environment various organizations. In addition, a database should be created for sustainable agriculture, it is necessary for technical, alongside the creation of social and economic data banks, these opportunities should be created easily and quickly.

**Table 4.1. Basic Determinants of Sustainable Agriculture**

Determinants	Indicators
<b>The manufacturer's long-term revenue</b>	*Net income obtained from manufacturers long-term *Increase the marketing power of the manufacturer and the development of foreign trade *Ensuring the efficiency of the production of resources that makes it effective.
<b>Natural resources</b>	food quality and safety *The condition of the soil *Assortment *Water resources
<b>Environment</b>	*Chemical wastes *Water salinity in *The impact of agriculture on natural resources
<b>Administrative features</b>	* Dissemination of sustainable agricultural practices for the fulfillment of training
<b>Socio-economic impact</b>	* Agriculture, human - oriented development and workforce training for the development of the study

**Resource:**Sustainable Agriculture: Assessing Australia's Recent Performance(1998). A report to the Standing Committee on Agriculture and Resource Management of the National Collaborative Project on Indicators for Sustainable Agriculture

Especially biological control in sustainable farming practices, integrated pest management system is located and alternative methods to chemical control. Integrated combat human health, a sustainable balance that takes into account the environmental and natural systems is a challenge. Integrated Pest Management (IPM) or Integrated Pest Control (IPC) and is referred to simply as the "Pest management system" is defined as (Crucefix, 1998). Integrated pest management, taking into account the relationship between the environment and the population

dynamics of the pest species, using all appropriate control methods and techniques in a harmonious way, is a pest management system that keeps their populations below economically damaging levels. Here, increasing crop production, quality and obtaining pesticide residues in products without the natural protection of harmful and supporting field, periodically checking the garden and vineyard, its fields of farmers, to become experts in the garden or look, pesticides on the environment (soil, water and air) it is aimed to prevent contamination. Integrated pest management, disease in certain agricultural ecosystems, harmful and not separate the fight against weeds, with their all done with, and appropriate control methods and techniques, foresees the integration to complement each other (Fire, 2004).

#### **4.2.Sustainable Agricultural Practices**

Other practices related to sustainable agriculture, promotion of product diversification, and thus protect the soil, reducing the product of disease pests and pest and weed problems, used to combat weeds animals, thereby reducing the use of chemicals and still need to producers of chemical fertilizers and pesticides use technical information and dissemination of extension work to gain the skills necessary to be done for the protection of natural areas and forest studies among others.

In European Union countries, especially protect certain agricultural products, PDO to ensure continuity of production without losing its natural properties, PGI, TSG systems have been developed. Through this system also aims to ensure the protection of consumers and recognize the products they buy and to ensure the reliability of these products. Some agricultural products in the light of these considerations and EC No 331/2000 numbered laws in order to promote better consumer PDO, PGI, TSG systems created logos under the name and logo, which are provided guarantee to consumers in terms of food safety and food quality in both vegetable and animal products. These systems are described below:

**PDO (Protected designation of Origin):** The original is a logo owned by optimally grown products. PDO products located in both production and processing in the classification and maintains the geographic features in the preparation of both.

**PGI (Protected Geographical Indication):** Preparation of products having the logo, the processing or production phase is desirably maintained in at least one of geographic features.

**TSG (traditional specialty guaranteed):** The logo in the region where they are the traditional products that have properties that preserves products.

In European Union countries PDI/PGI/TSG are among the products that contains the logo; fresh meats, cheeses, and other animal products (eggs, honey, dairy products, butter, etc.) oils, fruits and vegetables, grains, fish, beer, beverages made from plant extract a variety of bread, pastry, cakes, biscuits, chocolate and confectionery is located.

Work related to sustainable agriculture in Turkey Although parallels with the world study the harmonization process in the agricultural sector related institutions and organizations, was seen entering a little late to the area, and the first regulations on the subject was issued in 1994. VI Turkey. and VII. Five-year Development Plan for sustainable economic development opportunities that can give way to ensure the management of natural resources for future generations and a decent natural, physical and social environment has been adopted as the basic principle and policy. Turkey, are carried out by institutions and organizations and non-governmental organizations associated with agriculture in sustainable agriculture. This eco-friendly producers to promote agricultural sustainable for training in agriculture, raise awareness and producing sustainable to use methods that do not harm the environment during and to ensure that no production will not harm the consumer Agriculture Federation shows activities. Also on Sustainable Rural and Urban Development Association and the Sustainable Agriculture Farmer Solidarity Association in Ankara,

Sustainable Agriculture Development Association Bolu, Sustainable and Ecological Agriculture Association in Ankara and Sustainable Living Association are making a sustainable beneficial work for the implementation of agricultural life in Istanbul.

## **5. SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT**

Many policies created by the past to the present government in place in Turkey and in the provision of rural development projects have been implemented. National rural development plans and strategies for the continued sustainability of rural development especially in recent years has been to be developed and implemented. Agriculture and Rural prepared under the coordination of the Ministry and completion of the Rural Development Plan in 2011 2010-2013, 9th National Development Plan and the National Rural Development Strategy, the EU Pre-Accession Assistance to (IPARD) matching purpose is prepared with.

Changes in Turkey's rural development policies and approaches, strategic changes in the World Bank's approach is influenced by three institutional approaches, including changes in the UN millennium development goals and the EU rural development policy. Dynamic national developments and changes and perceived priorities and considering the transfer application is important in terms of sustainability.

In agricultural development approach, strengthening the rural economy and to solve the structural problems of the sector is of paramount importance. For this purpose, covering the years 2006-2010 "Agricultural Strategy Paper" prepared and implemented. Agricultural Strategy, mainly in the agricultural sector, and aims to achieve a sustainable competitive structure in the process of structural transformation; National Rural Development Strategy, in order to increase the prosperity of rural community's aims to accelerate rural development. In this context, the development of the agricultural sector is of particular agri-environment relations and sustainable conservation of natural resources in the framework for the development and adaptation of two strategy documents and integrity matter. This strategy document is the basis for agricultural development as well as to non-agricultural rural development initiatives, both complementary strategy document poses.

Another application, the 2007-2013 period shorter name by the EU IPARD (Instrument for Pre-accession- Rural Development) as the one described and the IPA components "rural development" related funds, Turkey is also in use for the candidate countries, where It has to offer. (IPARD) The purpose of the Rural Development Component, the Community is to support policy development and the completion of preparations for the implementation and administration of OTP's. The overall objective of the support; the agricultural sector in the candidate countries and to contribute to the sustainable adaptation of rural areas and to contribute to the preparatory work for the implementation of the Community legislation on the CAP Rural Development Policy.

Introduction to the mutual search for solutions that people at the local level, the creation of a society that is shared social values and the strengthening of rural development can play a role in facilitating relations. Sustainable rural development; poverty and the destruction of poor nutrition, natural resources, responsible and conscious use, the modernization of rural life, rural communities to develop the self-confidence of education, social security, housing, transportation, development environment and employment, reducing the urban-rural and socio-cultural and economic differences which aims to ensure a proper balance allows.

## **RESULTS**

As a result, today, future generations are extremely important concept of sustainable agriculture in terms of creating a society that meets the needs without compromising. Conservation of soil and water resources, preservation of natural resources, combating erosion and forest fires, the provision of biodiversity, integrated medication management to increase the productivity of our agricultural land, using appropriate farming

techniques in agriculture and organic farming to increase gradually its importance in recent years, the key to sustainable living and sustainable agriculture. There appears to be a need.

Sustainability, cultural integrity, includes an administrative process related to meeting the needs of the local people in the rural areas of biodiversity. While meeting the needs of local public sector in terms of sustainability in the future to protect the value of existing resources is important. The sustainability of agriculture in territorial size, remains the same in line with the sustainability of rural development.

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## DETERMINANTS OF HOUSEHOLD FOOD SECURITY AMONG WOMEN IN SOUTH-EAST AGRICULTURAL ZONE, NIGERIA

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### ABSTRACT

Concerns over food security situation in Nigeria are reflected in the Millennium Development Goal (MDG) to reduce the number of food insecure by half by 2015. Given that land plays a role in the livelihood of majority of people living in the rural communities of Nigeria, food security and poverty reduction cannot be achieved unless issues of access to land and security of tenure among women are addressed. Therefore, study examined rural women access to productive resource in order to attain food security in the State. Multi stage sampling procedure was used to select 150 women farmers. Data were collected with the use of interview schedule and participation observation. Household food security access scale was used to assess food insecurity of the respondents. Data collected were analyzed using descriptive statistics while logit regression was used to determine the determinants of food insecurity at  $P = 0.05$ . The results revealed that access to land (5.669\*\*\*), credit (2.592\*\*), extension contact (1.781\*) and tenure security (3.685\*\*\*) were positive and significantly related to food security. The paper suggests that land is central in promoting rural livelihoods in Nigeria, because access to land and security of tenure are the main means through which food security and sustainable development can be realized.

**Keyword:** Food security, Access to land and Tenure security

### INTRODUCTION

Nigeria has about 65% of its Population in the rural areas and agriculture remains the dominant sector of the economy, contributing significantly to the GDP, export earning and providing employment to the active workforce than any sector of the economy. This is apart from providing food for her growing populace which is the basic and fundamental role of this sector. Though there are other causes of hunger and food insecurity, agriculture is an important contributor to food security at both macro and micro levels. Nigeria has a favorable climate and edaphic potentials that are suitable for agricultural productions, it is plausible to expect that as a country, should be prosperous and food secure but instead, Nigeria has a remarkable distinction of being one of the countries in the world where a good number of her populace lives under one dollar per day and have no physical access to sufficient and safe food to live a healthy and productive life (Gwang, 2008).

The scenario is projected to increase rather than decline in the next decades, despite several laudable programmes such as: technological advances, improved crop varieties, genetically modified animals and irrigation systems, among others put in place by successive governments. This is because the expected growth in agriculture to keep pace with increasing demand for food has not occurred. There is the fear therefore that, Nigeria may not be able to achieve the Millennium Development Goal (MDG) to eradicate extreme poverty and hunger by the year 2020. This is in addition to weather, a key factor in agricultural production and the issue of climate change has remained another global and most serious developmental and environmental problem that threatens food security worldwide and Nigeria is not an exception.

Food security is defined as a situation in which one has both physical and economic access to adequate food both in quality and quantity and not at the risk of losing such access so as to ensure healthy, fulfilled active and healthy life. Also, Pretty and Hine (2000), stated that food exist when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active productive life (Oluyomi, 2009). By this definition food security is conventionally viewed in terms of four components which are food availability, access, utilization and stability of food system (FAO, 2008). Therefore the broad objective of this study is to determine factors influencing household food security among farmers in south-east Nigeria, with the specific objectives of ascertaining the food security status of the respondents.

## MATERIAL AND METHOD

The study was carried out in south eastern Nigeria which is made up of five states Abia, Anambra, Ebonyi, Enugu and Imo. The population of the study includes all rural women farmers. Multi-stage sampling technique was adopted for sample selection while semi-structured questionnaire was used for data collection. Out of the five states, three states were randomly selected. They include Abia, Enugu and Ebonyi. Each state has three agricultural zones .In each of the agricultural zones in the state, 5 blocks were randomly selected, and in each of the blocks, five circles were randomly selected. At the circle level 225 rural women were randomly selected and interviewed. The researcher with the aid of ADP staff in each state collected the data. Data collected were analyzed with simple description and inferential statistics. Objective 2 which is to determine the food security status of the household was done by constructing food poverty line in order to categorize the respondents into food secure and nonfood secure group using one single question.

Which of the following best describe the amount of food eaten in your household in the last 12 months.

- a. Have enough to eat
- b. Sometimes do not have enough food to eat
- c. Often do not have enough food to eat.

In this study, households who responds to (b) and (c) above were regarded as food insecure and those in (a) above were regarded as food secure. This operational research has been used and found to be valid and reliable. Logit mode was used to investigate the determinants of food security among the rural women. Socio-economic characteristics (independent variables) of the women were used as regressors. Model specification is stated below.

Age ( $x_1$ ) measured in years.

Sex ( $x_2$ ) dummy variables/male1; female 0.

Marital status = married 1; not married 0.

Household size ( $x_4$ ) Number of people living together in a house.

Educational level ( $x_5$ ) Number of years of formal education

Climate change effect ( $x_6$ ) Has effect 1; no effect 0.

Income from major occupation (N) In Naira.

Decision making power. Favourable 1; not favourable 0

E=error term.

In explaining the determinants of food security status among the respondents the regressed (i.e. the food security index = 1 for food secured and zero for otherwise).

## **RESULTS AND DISCUSSION**

**Table 1: Distribution of respondents based on their food security status.**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
Food secure	61	27.2
Food insecure	164	72.8
<b>Total</b>	<b>225</b>	<b>100</b>

Source: field data, 2015.

The results show that about 27% of the rural women households were food secure while 73% of the respondents were food insecure. According to Eastenling et al., (2007) sub-saharan Africa would likely surpass Asia as the major food insecure region. Food security is vulnerable to extreme weather and dependent on rainfall pattern. This affects the age-long practices of farmers to predict when to plant their crops (Aluko, 2008). According to him, the unpredictable changes in the onset of rain in the past years had led to situations where crops planted with the arrival of early rain get smoothed in the soil to the unexpected dry spell that can follow early planting. The late arrival of rain due to climate change variability relies on rain-fed agriculture. Pendleton and Lawson (1989) suggested that agriculture production needs to be increased by 2.3% annually over the next decades in order to maintain the currently sub-standard nutritional level.

**Table 2: Determinants of Food Security Status Among the Rural Women**

<b>Socio-economic variable</b>	<b>Coefficient</b>
X <sub>1</sub>	0.0317* (0.0172)
X <sub>2</sub>	0.1251*** (0.0916)
X <sub>3</sub>	0.1679 (0.0452)
X <sub>4</sub>	0.557*** (0.232)
X <sub>5</sub>	0.1932*** (0.0993)
X <sub>6</sub>	0.2496*** (0.2101)
X <sub>7</sub>	0.2736 (0.1960)
X <sub>8</sub>	0.1297*** (0.1024)
X <sub>9</sub>	-0.5207
Constant	0.1726

Source: field data, 2015.

No of observation 225

Standard errors are in parenthesis

Log likelihood 87.314681

\*\*\* Significant at 1%

\*\* Significant at 5%

\* Significant at 10%

Prob > chi 2 = 0 > 0.001000

**Table 2: Determinants of Food Security among the Respondents using logit-**

**Regression.**

In explaining the determinants of food security status among the rural women in south-east Nigeria, the regressed (ie the food poverty index-1 for food secure and zero otherwise) was regressed against the socio-economic characteristics, age, marital status, household size, educational status, income, belonging to social organization and climate change using a logit model.

The results show that age, educational level, income, belonging to social organization and climate change are positive and related to the respondent food security status. In other words, an increase in the value of any of these variables is associated with the likelihood (log odds) of an increase in the value of the regressed. Example, as education status of the respondent increase, their food security status also increases as well. An educated person may earn a higher salary and also likely adopt new technologies for best practice. However, household size was negatively related to food security. For instance, as household size increases, there is the likelihood of household being food-insecure. This is because increase in household size indirectly reduces income per head, and this affects household expenditures on food, thereby increasing the likelihood of the household being food insecure.

**CONCLUSION AND RECOMMENDATION**

From the results, it was discovered that apart from socio-economic characteristics of the respondents affecting their food security status, climate change variability also has its adverse effect on food security of the respondents as well.

The study therefore recommends women empowerment to acquire skills to manage their farm business. Still important is to be consciousness of the effect of climate change on national food security viz a viz creating deserved attention to the management of our environment.

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## **RELATIONSHIP BETWEEN INNOVATION AND SUSTAINABILITY IN FARMS PRODUCING PADDY IN BAFRA DISTRICT OF SAMSUN, TURKEY**

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### **ABSTRACT**

The purposes of the study focused on the relationship between innovation and sustainability were to (i) measure the sustainability level and the level of benefiting from innovation in farms producing paddy in Bafra district of Samsun and (ii) explore the relationship between innovation and sustainability. The research data sources were farms producing paddy, previous studies related paddy, related institutions, view of academician and technical person in the research area and field observation. The farm level data covered the period of 2013 and collected from randomly selected 60 farms by using well-structured questionnaire. To measure economic, environmental and social sustainability, sustainability index was used while we used innovation index for exploring the level of benefiting innovation. Research results revealed that economic performance and innovation capacity of second group farms was better comparing to rest. Research results also showed that the sustainability was higher in farms that their benefiting level from innovation is high. Positive effects of innovation on sustainability were lower than of second and third ones. The study suggests initiating the farmers' education program based on farmers' need. For small scale farms that their benefiting level from innovation was low, financial and infra structure support may strength the relationship between innovation and sustainability.

**Keywords:** Paddy farms, innovation, sustainability, Samsun,

### **1. INTRODUCTION**

Nowadays, the more appropriate strategy to be sustainable for any firm are benefiting innovation and increasing competitive power by means of innovation. Since agriculture sector has the strategic position for human and animal nutrition, enhancing the competitive power of firm by using innovation was important in agriculture, as well as all the other sectors. According to the last agricultural census, approximately 3 million farms have conducted their activities and serve the employment opportunities nearly 35% of the active population in Turkey. Most Turkish farm has not used their production factors efficiently due to their structural problems and they have not satisfied from innovation adequately even if they have produced sufficient revenue. This fact has emerged in the farms that produce raw material to agriculture based industry such as paddy.

In last decade, there have been increasing attentions to measure production efficiency and to explore inefficiency determinants in paddy farming like other crops all over the world. In one hand, some researches have focused on the efficiency in paddy production. Tadesse and Krishnamoorthy (1997), Goyal et al. (2006), Umanath and Rajasekar (2013) in India, and Xiao and Li (2011) in China measured the production efficiency of paddy farming by using data envelopment analysis. Similarly, Ghee et al. (2012) examined the efficiency by using stochastic frontier in Nigeria. On the other hand, some researchers have focused on the relationship between risk and efficiency in parallel with the development in world. Villano and Fleming (2006) in Philippine and Chang and Wen (2011) in Taiwan explored the relationship between risk and efficiency scores in paddy farming. However, the case was a little bit different in Turkey. There have been pioneer researches focused on the relationship between risk and efficiency scores (Ceyhan, 2003; Cinemre and Ceyhan, 2006), variation of the efficiency measures associated with time (Candemir and Deliktaş, 2006, Özok, 2006) and relationship between

sustainability and efficiency (Gündüz et al., 2011) for different crops in Turkey. But, there has been no study focusing on the production efficiency in paddy farming in Turkey up to now.

At the present day, the issues of agricultural innovation, intellectual property rights, trade of biological innovation and the role of education in the transfer of innovation and risk taking have been taken place in the research agenda and many researchers have been concentrated to these issues worldwide (Horbuky; 1993; Lawett, 1996; Graff, 2002; Alfranca and Rama, 2003; Woldehanna et al., 2003; Padgett, 2013; Vanclay et al., 2013; Zamzow, 2013). Exploring the level of benefiting from the innovations and measuring innovation capacity has increased their importance. Some researchers, therefore, have focused on these kinds of research. The research conducted by Ariza et al. (2013) was one of the examples to analyze the benefiting level of the farms from innovation by using innovation matrix and probit analysis. However, the innovation issue was the relatively new research topic in Turkey. In Turkey, many researches have been conducted on adoption of innovation up to now (Kumuk and Özerin, 1997; Bayav, 2007; Yılmaz, 2008; Sezgin, 2010; Kaya, 2011; Öztürk, 2010; Yener, 2013). Unfortunately, there has been limited study focusing on exploring the level of benefiting from the innovations and measuring innovation capacity (Özertan, 2013; Elmacı and Yalçın, 2013). Although some pioneer study related the relationship between efficiency and sustainability such as Gündüz et al., 2011, there has been no study focusing on sustainability measurement and exploring the link between sustainability and innovation capacity in paddy production.

Therefore, the purposes of the study were (i) to measure the innovation capacity of paddy farms in Bafra district of Samsun province, (ii) to explore the economic, social and environmental sustainability of paddy farms and (iii) to reveal the link between innovation and sustainability.

## 2. MATERIAL AND METHODS

### 2.1. The Research Area

Bafra is located in the coordinates of 41.3355° N latitudes and 35.5342° E longitudes in Turkey. The land area is 175 square kilometers. The population stands at 143 thousand people. Bafra is one of the main actors in Turkish paddy production due to having good ecological conditions. There have been 2080 paddy farms and 8 rice plants in the research area. Based on the statistics, Bafra constituted the 9% of the total Turkish paddy production. The paddy yield 734 kg per hectare and the price of paddy is approximately \$4 per kilogram in the research area.

### 2.2. Research data

Research data were collected from randomly selected 60 paddy farms out of 2080 active paddy farmers by using via well-structured questionnaire. Stratified random sampling procedure was followed when determining the optimum sample size. Sample farmers were grouped as small, medium and large farms. If the farms had 10-79 hectares of farmland, 80-129 79 hectares of farmland and more than 130 79 hectares of farmland, it was classified as small, medium and large farms, respectively. 42, 5 and 13 sample farms were assigned as small, medium and large farms, respectively. The precision and confidence levels were 10% and 95%, respectively during the sampling process. Farm level panel data covering last three years was collected in the study. Questionnaires were administered to the sample farmers to collect management data by considering the 2011-2013 production years. The variables measured in the study were age of operators, experience of operators, schooling of operators, family size, labor, total asset, working capital, input-output coefficients, labor use, machinery use, fertilizer use, chemical use, paddy yield, paddy price, profit, revenue, solvency, liquidity and credit use.

### **2.3. Exploring innovation capacity of paddy farms**

Innovation index was developed by using 16 different innovation indicators to explore the innovation capacity of the sample paddy farms. When calculating the innovation index, innovation summarized into 4 different subgroups such as products innovation, processes innovation, marketing innovation and organizational innovation. Indicators for products innovation were the share of farms used certified seed (%), the share of farms followed crop rotation (%), the share of farms used seedling use (%) and the share of farms changing paddy variety (%). The variables of the share of farms invested money for new machinery (%), the share of farms used new production technology (%), the share of farms having GAP certificate (%) and the share of farms followed soil analysis (%) were included for processes innovation. For the subgroup of marketing innovation, the indicators of the share of farms changing marketing place (%), the share of farms storing option (%), the share of farms marketing peeled paddy (%) and the share of farms marketing dried paddy (%) were used. Indicators for organizational innovation were the share of farms joined insurance pool (%), the share of farms recorded management data (%), the share of farms participated education program (%) and the share of professional paddy farms (%). After calculating these indicators based on the farm level panel data collected from sample paddy farms via questionnaire, total innovation index varied from 0 to 1 was calculated by summing the subgroup indexes. Then total innovation index value was multiplied by 6.25 to express the index as a percentage.

### **2.4. Measuring the sustainability of paddy farms**

Sustainability of the sample paddy farms was measured by using sustainability index, which was based on sustainability indicators. Three dimensions of the sustainability such as economic, social and environmental were examined in the study by using 15 different indicators. The economic sustainability was measured by using the variables of return to capital (%), total factor productivity, risk (%), agricultural income per person (TL) and credit use (TL). The social sustainability indicators were having social security (%), distance to medical care (km), and the share of own land (%), existence of off farm income (%) and membership to farmers' union. The variables of technical efficiency, synthetic fertilizer use (%), synthetic pesticide use (%), diversification and having good agricultural practices certificate (%) were used to explore environmental efficiency. Based on the data collected via questionnaire, sustainability indices, which varied between 0 and 1, were calculated for three dimensions of sustainability. Sum of the indices of three dimensions of sustainability was attributed to the total sustainability index for each paddy farms.

### **2.5. Exploring the link between innovation and sustainability**

Regression analysis was used to reveal relationship between innovation and sustainability. Sustainability index values was the dependent variables of the regression model. The independent variables of the model were innovation index values, labor, return on equity, schooling and experience of the operators, agricultural income per hectare and working capital per hectare. The variables of household size, cooperative membership and the level of benefiting from technical advice were also included the model. However, these variables were removed from the model due to they were superfluous variables based on the solution of Frisch' Conflict. Since we assumed that it was impossible to reach social and environmental sustainability without ensuring the economical sustainability, constant term was not included the model when estimating the regression model. After checking the all possible function such as logarithmic, semi logarithmic and linear, we selected the linear functional form to explore relationship between innovation and sustainability based on the statistical significance level of coefficients and the size of disturbance term. The multiple regression model used in the study was depicted below:

$$Y = b_1Q + b_2R + b_3S + b_4T + b_5W + b_6X + b_7Z + e$$

Where Y was sustainability index, Q was innovation index, R was labor (AWU/ha), S was return on equity, T was experience of operators, W was schooling of the operators, X was agricultural income (TL/ha), Z was working capital (TL/ha) and e was the disturbance term.

The problems of multi-collinearity and heteroscedasticity in the model were tested by using Frisch' Conflict solution and White test, respectively. Since we used the cross sectional data in the model, we did not test the auto correlation problem.

### **3. RESEARCH RESULTS AND DISCUSSION**

#### **3.1. Socio-economic Characteristics of Sample Farms**

Socio-economic characteristics of sample paddy farms were depicted in Table 1. In the research area, most operators were man and their age varied from 26 to 64. They have 19 years of experience in paddy production and their education level was moderate. Approximately, 97% of the sample paddy farms joined the social security pool and 21% of them had the retirement pension. Approximately two people conducted their activities on 13 hectares, on average, in paddy farms. They allocated nearly 80% of the farmland to paddy production. Land per capita varied from 4 hectares to 10 hectares and it was almost 5 hectares, on average. Their paddy yield was 7710 kilograms per hectare and sold them with the price of \$0.37 per kilogram. The maximum yield was observed in large paddy farms, while the large paddy farms obtained the maximum price. The mean value of total asset and working capital per hectare used in sample paddy farms were approximately \$55000 and \$10000, respectively. Agricultural revenue per capita and per hectare increased associated with the farm size. Return on equity and total asset varied from 2% to 14%, and increased associated with farms size. Medium and large scale paddy farms had the positive net profit per hectare, while the reverse was the case for small paddy farms (Table 1).

**Table 1. Some socio-economic characteristics of sample paddy farms**

	Farm size		
	Small	Medium	Large
Farmland (ha)	7.66	17.75	28.26
Labor (person)	1.79	2.85	2.65
Land allocated to paddy (ha)	4.70	11.40	24.00
Paddy yield (kg/ha)	7500.00	8500.00	8080.00
Paddy price (\$/kg)	0.48	0.52	0.56
Total asset (thousand \$/ha)	59.60	55.10	39.40
Working capital (thousand \$/ha)	11.00	6.80	7.70
Land per capita (ha/EİB)	4.42	6.62	10.67
Agricultural revenue per hectare (thousand \$)	1.50	2.10	4.20
Agricultural revenue per capita (thousand \$)	6.34	12.68	45.03
Net profit per hectare(thousand \$)	-0.20	0.70	3.10
Return on equity (%)	2.19	6.02	13.71
Return on total asset (%)	2.01	3.82	9.84

#### **3.2. Innovation Capacity of Sample Farms**

Research results showed that the innovation capacity of sample farms was unsatisfactory level. The innovation index was 37% and varied associated with farm size. The most satisfactory innovation capacity was observed in medium size farms due to their adoption capability to new production technology. Since large farms had already all necessary machinery and equipment and changed their production techniques before, innovation index of

large farms was smaller than that of large farms. In the research area, the lowest level of benefiting innovation was observed in small size farms (Table 2).

Regarding the components of the innovation index, there have been differences among the sample farms. In small scale size farms, marketing innovation was the weakest, while that of the medium size was satisfactory level. Medium size farms had the advantages in aspect of process, marketing and organizational innovations comparing to others. When focusing on the product innovation, large farms were more innovators comparing the rest (Table 2).

### **3.3. Economic, Social and Environmental Sustainability of Sample Farms**

Sustainability index values of the sample farms showed that sustainability index values varied from 48 to 63 associated with farm size and the mean sustainability index was 50% in the research area, indicating that there has been some factors hindered the sustainability of sample farms. The lowest sustainability was observed in small size paddy farms, while the highest was in medium size paddy farms. Interestingly, sustainability of the medium size paddy farms was higher than that of large ones due to low level of financial risk. For all size of paddy farms, the most important problem was the economic sustainability. Risk faced the sample paddy farms and low level of agricultural income were the main problems for economic sustainability of small and large paddy farms (Table 3).

**Table 2. Innovation capacity of sample paddy farms**

Index values	Farm size		
	Small	Medium	Large
<b>Products innovation</b>	1.12	1.40	1.75
The share of farms used certified seed (%)	0.76	0.60	0.92
The share of farms followed crop rotation (%)	0.26	0.40	0.39
The share of farms used seedling use (%)	-	-	0.15
The share of farms changing paddy variety (%)	0.10	0.40	-
<b>Processes innovation</b>	1.08	2.60	1.77
The share of farms invested money for new machinery (%)	0.17	0.20	0.31
The share of farms used new production technology (%)	0.19	0.40	0.23
The share of farms having GAP certificate (%)	0.24	0.80	0.54
The share of farms followed soil analysis (%)	0.48	0.80	1.00
<b>Marketing innovation</b>	0.91	1.80	1.77
The share of farms changing marketing place (%)	0.12	0.20	0.08
The share of farms storing option (%)	0.12	0.60	0.62
The share of farms marketing peeled paddy (%)	-	-	0.08
The share of farms marketing dried paddy (%)	0.67	1.00	0.99
<b>Organizational innovation</b>	1.75	2.40	2.16
The share of farms joined insurance pool (%)	0.50	0.60	0.54
The share of farms recorded management data (%)	0.24	0.60	0.54
The share of farms participated education program (%)	0.10	0.40	0.31
The share of professional paddy farms (%)	0.91	0.80	0.77
<b>Innovation index (%)</b>	30.38	51.25	44.75

**Table 3. Sustainability index for sample paddy farms**

Index values	Farm size		
	Small	Medium	Large
<b>Economic sustainability</b>	1.60	2.64	1.58
Return on equity (%)	0.19	0.25	0.35
Total factor productivity	0.47	0.68	0.50
Risk (%)	0.00	0.80	0.10
Agricultural income per capita (TL)	0.06	0.05	0.13
Credit use (TL)	0.88	0.86	0.50
<b>Social sustainability</b>	2.45	2.98	3.11
Benefiting social security (%)	0.95	1.00	0.92
Distance to medical care (km)	0.85	0.87	0.88
Own farmland/total farm land*100 (%)	0.15	0.34	0.56
Having off farm income (%)	0.10	0.20	0.23
Cooperative membership (count)	0.40	0.56	0.52
<b>Environmental sustainability</b>	3.15	3.79	3.22
Technical efficiency	0.81	0.92	0.92
Synthetic pesticide use (%)	0.81	0.60	0.62
Synthetic fertilizer use (%)	0.95	1.00	0.85
Diversification (unit)	0.34	0.47	0.30
Having good agricultural practices certificate (%)	0.24	0.80	0.54
<b>Total sustainability index (%)</b>	47.94	62.67	52.76

### 3.4. The link between sustainability and innovation

It was clear based on the results of regression analysis that there was a positive causal relationship between sustainability and innovation. Also, the variables of return on equity, schooling and experience of operators, working capital and agricultural income affected the sustainability positively. However, labor variable had the negative effects on sustainability. In the research area, sustainability index value of the paddy farms would increase by 0,436 when innovation index value increased one unit. This findings confirmed the results of previous study conducted by Gündüz et al. (2011). Gündüz et al. (2011) stated that increasing efficiency through innovation increased the sustainability of the farms. Expectedly, the most magnificence factor positively influenced the sustainability of sample paddy farms was return on equity. The profile of operators was the another important factor influenced the sustainability of the sample paddy farms (Table 4)

**Table 4. Parameter estimates and their standard errors of the regression model**

Variables	Coefficient	Standard error	t-value	p
Innovation index (Q)	0.436	0.150	2.901	0.005
Labor per hectare (R)	-31.170	46.759	-0.667	0.508
Return on equity (S)	8.140	2.908	2.799	0.007
Experience of operators (T)	0.211	0.101	2.089	0.042
Schooling of operators (W)	0.877	0.407	2.156	0.036
Agricultural income per hectare (X)	0.002	0.001	2.177	0.034
Working capital per hectare (Z)	0.001	0.001	0.273	0.786

#### 4. CONCLUSION

Under the light of the research findings, it was clear that not only the benefiting level from innovation of paddy farms but also sustainability level of them was unsatisfactory level in research area. Unfortunately, small size paddy farms did not utilized from positive contribution of the innovation due to scale problem. Insufficient revenue gained from efficiency increase for necessary innovation was the basic problem of paddy farms. Utilizing the economies of scale in paddy farms may be the starting point to increase total factor productivity and benefit positive contribution of the innovation. Cooperation is the most effective strategy for small scale paddy farms is the research area. Efficient cooperation may increase the likelihood of benefiting innovations and sustainability. Simultaneously, stimulate the farmers to use certified seed, changing paddy variety and activities to increase value added of paddy such as marketing peeled and dried paddy via well designed extension and farmers' education programs may be beneficial to increase sustainability via total factor productivity increase in the research area. Organizing the effective credit system having low interest rate and suitable repayment plan to enhance the farmers' access to credit for the necessary machinery and equipment and new production systems may contribute to the efficiency of stimulation activities related to effort for increasing value added of paddy. Municipal administration should increase the storage facilities for paddy and simplify the farmers' accesses to them in order to increase time value of utility from paddy. To stabilize the revenue of paddy farms in Bafra, policy makers should organize some incentive to enhance the benefiting from agricultural insurance scheme against to catastrophic risks such as hail, fluid, fire, earthquake etc. and disseminate it among the farmers. Motivation of the farms having sufficient revenue for suggested innovation via suitable education and extension programs may increase the innovation capacity and sustainability of the paddy farms in the research area.

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## THE ECONOMIC EFFICIENCY OF THE RED MEAT PRODUCTION FARMS IN NUBERIA REGION AT THE NEW LANDS.

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### ABSTRACT

The main objectives of the study were to estimate the production function of red meat production farms in Nubaria region, to determine the main factors affect the dimension and degree oh using the agricultural economic resources efficiently at the red meat production farms in the area under the study.

The study is depending on primary data collected from a sample of 75 red meat production farms in Nuberia district. The sample was divided into tow categories, the first category includes 40 farms that contains 1-5 animal units each, while the second category include35 farms of more than 5 animal units .the statistical analysis used include step-wise multi-regression as well as some other models such as linear, logarithm, semi-long and quadratic for both categories under study.

The results of the study has shown that the most important variables that affect the red meat production farms category are; number of animal units( $x_1$ ),quantity of concentrated forage per ton( $x_4$ ), and ,quantity of green feed per ton( $x_5$ ), the production elasticity estimated to these variables were 0.49 ,0.32 and 0.063 respectively . the estimated ratio of MPV to opportunity cost of these resources in order to identify economic efficiency of the utilization of the above use both concentrated and the green feed, and to receive equivalent values of MPV and opportunity cost, it is recommended that must reduce the quantity used of the both feed.

The result of the study has shown that the most important variables that affect the red meat production farms of the second category are; ;number of animal units( $x_1$ ),quantity of concentrated forage per ton( $x_4$ ), and ,quantity of green feed per ton( $x_5$ ), the production elasticity estimated to these variables were 0.34 , 0.23 0.20 respectively . the estimated ratio of MPV to opportunity cost of these resources in order to determine economic efficiency of the utilization of the above mentioned resources were about 8.34 ,4.16 and 1.09 respectively, which means the MPV was better than the opportunity cost of these three variables . The producers can increase their profit from the meat production through increasing the animal units and quantity used from both concentrated and green forage ,in order to get equivalent values of MPV and opportunity cost.

### 1. INTRODUCTION:

Achieving food security and providing the nutritional needs of the population consider of the most important goals of the Egyptian agricultural policy seeks to achieve animal protein shortage represents of main problem in feeding the Egyptian individual as the minimum limit daily needs per anom of animal protein is about 30 grams, while what currently gets about 15.6 grams per day, something which indicates a food that there is in production capacity is unable to meet consumer needs from it, which points to the need for attention to work to overcome this gap. Given that the likelihood of horizontal expansion for the production of animal protein ancient land in Egypt is relatively limited, the options to increase the average per capita of those needs are limited in :-

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1. vertical expansion by increasing the productivity of livestock unit by:

(A) follow modern technologies in production, (B) genetic improvement

2. The development of wealth of livestock in new land.

Here it should be noted that increase the productivity of the animal unit is considered a short-term goal of a development can be achieved in a relatively short period, but faces many obstacles difficult to overcome the majority of private farms and it is related to old lands, and in this light.

It can be said that the development of livestock in Egypt is at the current stage and future goals nationally linked to a private new land and it has become occupies a key position in Savin agricultural Egyptian where he currently represents more km 30% of the cultivated area in Egypt, in addition to the role played by Livestock in the development and increase the productivity and fertility of those lands.

The research aims to estimate production functions of red meat in farms produce red meat in new land of Nubaria province and determine the economic and technological features of these functions to identify the most important factors affecting the production of red meat of these farms so as to identify the extent of economic efficiency available in form production of red meat study area.

## 2.MATERIALS AND METHODS

The research depends on primary data obtained through the questionnaire to a stratified random sample of meat in new lands of Nubaria province during the summer of 2014 and the number of sample 75 farm represents about 5% of the total meat production farms in province. The sample was divided into the first two categories of 40 Farm represents farms that have 1-5 animal units , and the second of 35 farms represent with more than 5 animal units, has been dealing with each category separately, where there is a significant difference between the two categories of study sample shows in terms of average productivity of animal unit based on analysis of variance test in one direction where the percentage of (F) calculated about 47.2 which was significant at 0.01 level.

**Table (1): Average of independent variables under study in the first and second farmer category of sample research farms in the new land of Nubaria province**

Variable	Unit	Average	
		1 <sup>st</sup> category	2 <sup>nd</sup> category
No. of animal unit (X <sub>1</sub> )	Animal unit	2.8	7.5
Farm labor (X <sub>2</sub> )	Man/day	56	115
Veterinary medicines (X <sub>3</sub> )	pound	70	160
Amount of concentrated feed (X <sub>4</sub> )	ton	2.5	5.4
Amount of green fodder (X <sub>5</sub> )	ton	8.75	18
Amount of dry fodder (X <sub>6</sub> )	ton	2.14	6.5
Breeder age (X <sub>7</sub> )	year	39	32
Breeder education level (X <sub>8</sub> )	No. of education year	10	13

Source: Compiled and computed from sample research data.

There are many factors affecting the production of red meat, which may be difficult to restrict and measure the impact of each of them on the meat production, so it has been assumed that the most important factors affecting the specific red meat production in new lands of West Nubaria province are: number of animal units (X<sub>1</sub>), agricultural employment man / day (X<sub>2</sub>), the value of veterinary medicine ability pound (X<sub>3</sub>), the amount of concentrated feed (ton) (X<sub>4</sub>), the amount of green fodder (ton) (X<sub>5</sub>), the amount of dry feed (ton) (X<sub>6</sub>), producer

age (year) ( $X_7$ ) and education level estimated by the number of years spent in education ( $X_8$ ).

The study used Step-Wise Multi Regression to reach the best form of model estimate the parameters of the standard economic relations, has been estimated production functions using several mathematical formulas such as linear, double and a half logarithmic and squared so as to categories of the study sample

### 3. RESULTS AND DISCUSSION

#### 3.1. Red meat production functions in the farms of first farm category

Using regression analysis Stepwise to the discretion of the farms produce red meat production functions in the form of linear and double, half and logarithmic and squared for the first farm category with capacity of animal less than five units animal can be seen from the review of the results contained in Table (2) that the model-paced beats the other models both from the economic point of view or a statistical described by the following equation:

$$Y = 0.073 + 0.096 X_1 + 0.07X_4 + 0.004X_5$$
$$(4.20)** \quad (4.36)** \quad (3.22)** \quad (5.39)**$$
$$F = 154.31** \quad R^2 = 0.85$$

Where:

$Y$  = the estimated production capacity in tons of red meat and animal

$X_1$  = number of animal protean,  $X_4$  = the amount of concentrated feed to  $X_5$  = green fodder (ton).

Based on this model is evident that the most important variables that impact on the production of red meat farms in new land of Nubaria province with capacity for animal least five animal units are: (1) animal unit ( $X_1$ ), (2) estimated amount of concentrated feed (ton) ( $X_4$ ) (3) the amount of green fodder (ton) ( $X_5$ ).

The value of ( $t$ ) calculated for variables  $X_1$ ,  $X_4$ , and  $X_5$ , reached about 4:36, 3:22, 5:39, respectively at significant level 0.01. As the rate of determination coefficient ( $R^2$ ) was about 0.85, which means that the explanatory in previous model about 85% of the variation in total farm output of meat in the first farms category. As the value of ( $F$ ) calculated around 154.31, which means a significant effect of the explanatory variables in the previous model on the dependent variable on the total output of the red meat research in the sample when the probability level 0.01.

For review and analysis of economic derivatives of the above-mentioned production function is clear that the marginal productivity of the variables  $X_1$ ,  $X_4$ , and  $X_5$ , which represents the number of animal units, concentrated feed and green fodder drew about 0.096, , 0.07, and 0.004 tons of meat respectively. For average productive for these variables about 0.196, 0.22, and 0.063 tons, respectively. For production elasticity of the variable ( $x_1$ ) turned out to be of about 0.49, which means that a change of 10% in the number of animal units farm consequent change in the same direction amount of 4.9% of GDP farm . For production elasticity of meat for the variable ( $x_4$ ) amounted to about 0.32 This means that a change of 10% in the amount of concentrated feed results in a change in the same direction with about 3.2% in GDP farm of red meat, with regard to production elasticity of the variable ( $x_5$ ) amounted to about 0.063%, and this means that the change rate of 10% in the amount of green fodder result in a change in the same direction with about 0.63% of the total farm output of meat.

By measuring the economic efficiency of resources farm utilized in the production of red meat farms category of first study sample by assessing the proportion of marginal productivity value of these resources to the opportunity cost chance to know about the economic merit in the use of the mentioned resources under the rule of competitive conditions in the production of red meat of review results obtained and set out in Table No. (7)

that: (1) the proportion of marginal production value to the opportunity cost of a variable ( $X_1$ ) of about 7.28, which means higher than the value of marginal productivity on the opportunity cost meaning that producers can increase their profits from production meat through increasing the number of animal units until being equally valuable marginal productivity with the opportunity cost, (2) the proportion of production value of the marginal feed concentrates ( $X_4$ ) to the opportunity cost about 0.85%. This means that meat producers consume in the use of concentrated feed and must reduce the amounts used them even par value of marginal productivity with the opportunity cost. (3) the proportion of production about 0.48%. This means that meat producers consume in the use of green fodder and must reduce the amounts used them even par value of marginal productivity with the opportunity cost.

**Table (2): Economic merit in the use of agricultural resources in the first category farms first of research sample in new land of Nubaria province**

Function form	Independent variable	Average	Unit	Marginal production (ton)	VMP (pound)	Opportunity cost (pound)	VMP to op. cost
Linear	$X_1$	2.8	Animal unit	0.96	696	393,75	1.77
	$X_4$	2.5	ton	0.07	507.5	2500	0.203,
	$X_5$	8.75	ton	0.004	29	200	0.145

Source: Computed from search data sample.

### **3.2. Red meat production functions in the second farmer category of sample**

Using Stepwise regression analysis to the discretion of the farms that produce red meat, the production function was in double half and logarithmic and squared for the first of farm category with capacity of animal more than five animal units can be seen from the review of the results contained in Table (3) that the model-paced beats the other models both from the economic point of view or statistical. It is described by the following equation:

$$\begin{aligned}
 Y &= 0.55 + 0.11 X_1 + 0.0046 X_2 + 0.09 X_4 \\
 (2.86)^* &(12.65)** \quad (3.43)** \quad (4.27)** \\
 R^2 &= 0.76 \quad F = 135.60**
 \end{aligned}$$

Where:

$Y$  = the estimated production capacity in tons of red meat

$X_1$  = number of animal units

$X_2$  = farm labor (man / day)       $x_4$  = intensive fodder (ton)

Based on this model is evident that the most important explanatory variables impact on the production of red meat farms in new land of Nubaria province with animal capacity more than five animal units are: (1) number of animal units ( $X_1$ ), (2) farm labor ( $X_2$ ), (3) the amount of concentrated feed by ton ( $X_4$ )

The value of ( $t$ ) calculated for previous variables around 12.65, 3.43, 4.27, respectively with significant at 0.01 level. As the rate of the determination coefficient ( $R^2$ ) of about 0.76, which means that the explanatory in variables model investigate about 76% of the variation in total farm output of meat in the first category farms. As the value of ( $F$ ) calculated, it was about 135.6, which means a significant effect of the explanatory variables in the previous model on the dependent variable at 1% level.

And review and analysis of economic derivatives of the above-mentioned production function is clear that the marginal productivity of the variables  $X_1$ ,  $X_2$ ,  $X_4$ , which represents about 0.11, , 0.0046, and 0.09 tons

respectively of meat. Average production amounted for these variables were about 0.319, 0.02, and 0.44 tons respectively.

For production elasticity of variable ( $X_1$ ) turned out to be of about 0.34, which means that a 10% change in the number of farm animal units result in a change in the same direction in the amount of 3.4% of total gross farm meat. For the flexible production of the variable ( $x_2$ ) amounted to about 0.23. This means that the change amounted to 10% in the amount of farm labor consequent change in the same direction amount of 2.3% of GDP farm of meat, either with regard to production elasticity of the variable ( $x_4$ ) amounted to about 0.20 , this means that a 10% change in the amount of concentrated feed results in a change in the same direction the amount of 2% of the total farm output of red meat farms in second category of study sample .

By measuring the economic efficiency of farm resources utilized in the production of red meat farms category of second study sample by assessing the proportion of marginal productivity of these resources to the opportunity cost of to know about the economic merit in the use of the mentioned resources under the rule of competitive conditions in the production of red meat of review results obtained and listed in table (3) that: (1) the proportion of value marginal production to the opportunity cost of a variable number ( $X_1$ ) of about 8.34, which means higher than the value of marginal productivity on the opportunity cost meaning that producers can increase their profits from meat production through increase the number of animal units until being equally valuable marginal productivity with the opportunity cost , (2) that the percentage of the value of marginal production for labor farm ( $X_2$ ) to the opportunity cost of about 4.76 and this into outweigh the value of the marginal productivity on the opportunity cost which meaning that producers can increase their profits from the production of meat even par value of marginal productivity with the opportunity cost to increase the amount of farm labor. (3) The productivity ratio of the marginal feed concentrates ( $X_4$ ) to the opportunity cost of about 1.09, which means higher than the value of marginal productivity on the opportunity cost of any chance that producers they can increase their profits from the production of meat used to increase the amounts of concentrated feed even equal the value of the marginal productivity with the opportunity cost.

#### **4. CONCLUSION**

In general, it was clear from the results of the discretion of each of the average production and the proportion of marginal productivity value to the opportunity cost and contained tables (2, 3) outweigh the farms second category possessory farms first of farm category in terms of both average productivity or in terms of the efficient use of farm economic resources available, which means increased average productivity and high economic efficiency of the resources used to increase farm animal capacity.

**Table (3)- Economic merit in the use of agricultural resources in the second category farms of sample research farms in the new land of Nubaria province**

Item	Variable	Average	Unit	Marginal	Value of	Opportunity	Ratio of
				Production	marginal production	Costs (pound)(	output value for marginal opportunity cost
Linear	$X_1$	7.5	Animal unit	0.11	797.5	393.75	2.03
	$X_2$	115	Man/day	0.0046	33.3	50	0.67
	$X_4$	5.4	ton	0.09	652.5	2500	0.26

Source: Computed from search data sample.

**Table (4)-Average productivity of resources productivity in their respective categories of research sample at new land of Nubaria province**

Production resources	Average production for production resources (ton)	
	The first category	The first category
Animal Units (X <sub>1</sub> )	0.196	0.319
Farm Labor (X <sub>2</sub> )	-	0.02
Concentrated feed (X <sub>4</sub> )	0.22	0.44
Green fodder (X <sub>5</sub> )	0.063	-

Source: Computed from tables (2, 3).

**Table (5)- Value of the marginal productivity of the opportunity cost of resources productivity ratio in each of the two farm categories of research sample in new land of Nubaria province**

Production resources	Average production for production resources (ton)	
	The first category	The second category
Animal Units (X <sub>1</sub> )	7.28	8.34
Farm Labor (X <sub>2</sub> )	-	4.76
Concentrated feed (X <sub>4</sub> )	0.83	1.09
Green fodder (X <sub>5</sub> )	0.48	-

Source: Computed from tables (3, 4).

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## COTTON GROWERS' SATISFACTION WITH PUBLIC AND PRIVATE EXTENSION SERVICES: CASE STUDY OF MUZAFFARGARH DISTRICT OF PAKISTAN

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### ABSTRACT

Pakistan has tried many agricultural extension systems and approaches since its birth. In 1988, on the recommendation of National Commission on Agriculture formed by government to look into the poor performance of agriculture, privatization of agricultural extension was started. Currently, more than 500 private companies with public extension departments (multinational, national and generic) with public extension departments are actively engaged in providing extension services to farmers in addition to selling their products. In recent day's world, accountability is very important, without that you cannot evaluate the performance of any sector. Extension service providers should ensure the continuous satisfaction of farmers with the services being provided. In order to increase farmers' confidence and loyalty, extension feedback is becoming important day by day. Generally, evaluation of extension has been focused on farmers, such as behavioral change and also increase in output use, yield and income. Another important factor impacting the success or failure of extension programs may be efficiency and effectiveness with which extension personal deliver extension services. Present study, is aimed at analyzing the satisfaction of cotton growers with public and private extension services. In this regard, data was collected from 95 farmers using pre-tested questionnaire and using the mutli-stage random sampling technique from Muzaffargarrh district of Punjab province of Pakistan. Collected data were analyzed by using chi square test and frequency and percentages. Most of the farmers in the study area are getting extension services from private sector (pesticide companies). Study concluded that majority of the farmers were not fully satisfied with either the public or private extension services, however, farmers expressed partial satisfaction with private pesticide companies. Following these findings, resolute efforts are needed to improve quality of extension services both by private and public sector. Holistic participatory approaches are required to improve farmers understanding of technology, demand driven and farmers friendly strategies are recommended. Total service package should be applied by private companies rather than just pesticide use and disease identification services.

**Keywords:** Extension Services, random sampling, demand-driven, Punajb, Pakistan.

### INTRODUCTION

Agriculture occupies a key position in the economies of many developing countries, by considering its critical role of providing food security, provision of employment, revenue generation, earnings from export, and provision of raw materials for industrial development. So development of agriculture means economic development and human development as a large proportion of population is directly or indirectly earning their livelihood from agriculture. Majority of the population in Pakistan is also directly or indirectly linked to agriculture, almost 43% of labor force is employed in agriculture (GOP, 2014). To ensure a food and good living standard to such a huge population the development of agriculture is inevitable. Agriculture extension which brings information from laboratory to farmer (scientist to farmer) via extension agent has a vital role towards development of agriculture. Previously, agricultural extension was perceived as service to extend research-based knowledge to farmers in order to improve their lives. In developing countries, traditional view of agriculture extension was much focused on increasing production, improving yields, training farmers, and transferring

technology. Nowadays, understanding of extension services is beyond training to learning, technology transfer to learning, assisting farmers in forming groups, dealing market issues, and partner with service providers and other agencies (Nelson, 2009); in this way, making extension services much important for farming. Role of the input supplier as a technology transfer is under discussion as their main goal is business (selling of their own products), while on the other hand the fact is that majority of information providers are input supplier (Özçatalbaş, 2001; Özçatalbaş and Kutlar, 2003). Private sector input suppliers are also naturally present operational and commercial purposes. The extension may disagree with commercial purpose, input suppliers have an important role in the rural area. Input suppliers is also a major information provider in Pakistan for farmers. As a result, input suppliers is regarded as an information provider and therefore the process of providing information was regarded as a private extension in this study.

Approaches to agricultural extension worldwide continue to evolve. Since the Green Revolution and recognition of no more sustainability of training and visit (T&V) programs (Anderson, Feder, and Ganguly 2006; Moore 1984), with its focus on improving productivity via technology transfer, agricultural extension has adopted decentralized, participatory, and demand driven approaches in which accountability is geared towards the users (Birner et al. 2006; Birner and Anderson 2007; Davis 2008; Hall et al. 2000; Kokate et al. 2009; Sulaiman and Hall 2008; Swanson 2009). In Pakistan, Agricultural Extension Service was sole public funded service up to 1988; during this period government tried different models but all failed in achieving desired result of efficiency in production (Riaz, 2010). To provide effective extension services to farmers, Government of Pakistan has employed nearly 2,324 agricultural extension officer and 6518 field assistant. However this alone cannot help to ensure proper and effective delivery of services to farmers. The effectiveness of any agricultural extension services largely depends on its sustainability and farmers' access to services (Swanson and Rajalathi, 2010). Due to top down and supply driven approach nature of the services (same like many other developing countries), the services were ineffective. With failure of all public funded programs in 1988, a commission was formed by government in order to look in the poor performance of agriculture sector. Private sector was directed by the government to provide the total package of plant protection advisory services, consisting of guidance on agronomic, biological and chemical protection practices, in addition to selling their own products according to recommendation of the commission. Currently more than 500 pesticide companies are working and providing plant protection advisory services to farmers in addition to products selling (Ali et al, 2013).

With more than 85% small farms and 60% of farms comprising less than 2 hectare in the country (Ghafoor et al., 2010 and APCAS, 2010) there is an emerging need for stronger advisory structure that can further facilitate information access for diverse smallholder farmers. Increased productivity and efficiency of these farmers can ensure further progress in poverty and food security, which depends on improved and successful delivery of agricultural extension services. Cotton is very important cash crop contributing approximately 10% to GDP and 55% foreign exchange earning of the country. Cotton covers 15% of total cultivable area of the country and 1.3 million farmers cultivate cotton (out of total 5 Million) (GOP, 2014). Between 30 and 40 percent of the cotton is used for domestic consumption, the remaining is exported as raw cotton, yarn, cloth, and garments. Cotton production is stagnant in the country for many of the last years. Factors responsible for this stagnancy can be high temperature at flowering stage, soil and water problems, weather adversaries, improper production technologies and most importantly pest attack. Although Pakistan is the fourth largest producer of the raw cotton but country is still far behind in the productivity per unit area when compared with other major cotton producing countries. Despite public extension agents as well as lot of private pesticides companies providing services to cotton growers, the issues are prevailing.

In many developing countries agricultural advisory services are mainly provided by ministry of agriculture and free of cost due to large number of small farmers which cannot bear consultancy costs. On the other hand public agricultural service providers suffer difficulties like small budgets, rare career development opportunities, lack of transportation facilities to cover large number of farmers, delay in travel and daily payments, and dissatisfaction with promotion procedure (Ahmad et al., 2014 and Qamar, 2011), which further increase in their low performance.

Due to top-down and technology driven approach, without accountability to services recipients and in many cases focuses on large and medium farmers, extension services are usually unsatisfactory. In now a day's world, accountability is very important, without that you cannot evaluate the performance of any sector. Extension service providers should ensure the continuous satisfaction of farmers with the service being provided. In order to increase farmer's confidence and loyalty, extension feedback is becoming important day by day. But unfortunately, in many parts of the world extension staff is unsuccessful in fulfilling the needs of the farmers and impressing them. Many countries in the world has been moved from supply driven to demand driven extension approaches, but in Pakistan until now public as well as private extension agencies are using old techniques. Private extension agents mostly emphasize on extensive use of pesticide rather than judicious use of it (Ali et al., 2013). In a study by Mengal et al., (2012) it was found that public extension staff provide information about application of irrigation and private advice about use of plant protection measures, which shows that there is imbalance between services provision; farmers are not getting what they need but that what is being provided. In 1980s farmers were not satisfied with the performance of field staff of public extension system, that is why private extension was recommended to provide total services package but situation is not very different now a days. Studies show that dissatisfaction of farmers with both sectors prevails. Baloch and Thapa (2014) found that majority of date palm growers in Pakistan are overwhelmingly dissatisfied with services being provided by both sectors. Similarly, Abbas (2005) found that majority of farmers were not satisfied with performance of field staff of private sector.

### **Purpose and objectives of the study**

Mostly studied carried out on agricultural extension in Pakistan has been related to organizational aspects of extension. Despite the fact that world has moved from technology driven services to demand driven, and satisfaction of recipients is becoming more important for service providers. There is lack of studies discussing the issues like growers satisfaction with service being provided. While numerous studies have been conducted discussing farmer access services and suitability of extension services in other countries. Therefore it was deemed necessary to conduct a research covering cotton growers' satisfaction with services provided by both private pesticide companies and public extension agents.

### **Description of the study area**

The major cotton producing provinces in Pakistan are Punjab and Sindh. Approximately 80% of cotton is produced in Punjab and the rest in Sindh. Punjab is the largest province from population perspective and also holds a large portion in agriculture production. Punjab province comprises of 36 districts. The district of Muzaffargarh is located in southern Punjab province at almost the exact centre of Pakistan. The area in the district boundary is a flat, alluvial plain and is ideal for agriculture; cotton, wheat and sugarcane are the main crops grown in the district. Muzaffargarh district is surrounded with two rivers namely Indus and Chenab adding more fertile characteristics to the soil of the district, but these rivers are many times becoming the reason for flood during monsoon season. Muzaffargarh features an arid climate with very hot summers and mild winters. The city witnesses some of the most extreme weather in the country.

## MATERIALS AND METHODS

Muzaffargarh district was selected as study area; the selection of the area for study is because larger population of farmers cultivates cotton. Multi stage sampling procedure was employed in selection of cotton farmers for study. At first stage two administration areas out of four were selected. At second stage, 5 villages from each area were selected, and at last stage 10 cotton growers from each village were selected forming a total of one hundred respondents. Survey was conducted by face to face interview and using a pre-tested questionnaire. Farmers' satisfaction with advisory was ascertained by reference to level of stated agreement with 5 statements regarding their recent experience with the services. A standard Likert scale was used for each response whereby 1= 'very low' through 5= 'very high satisfaction' with different characteristics of services. Data was analyzed using chi square analysis of association between demographic characters and satisfaction with services, descriptive statistics, frequency, and percentage.

## RESULTS AND DISCUSSION

Data in Table 1 and 3 shows that mean age of the cotton farmers was 39.26 years. Analysis also shows that, 82 percent of farmers are less than are 50 years age. This shows that majority of the cotton farmers are in productive age range in the study area. Mean years of education is 3.34 which is very low. About 12 percent of the cotton farmers had no formal education, while the major part of respondent (40%) has education up to elementary level. This could be due to financial constraints which were probably hurdle in achieving further education. The mean farming experience was 17.72 years, analysis shows that, 29% farmers have farming experience in range of 1-10 years, 35% have 11-20 years, and 22% have 21-30 years. It could be said that, most of the farmers are not very old in the farming profession. Mean farm size in the study area is 3.8 ha, 73% of the respondents have a farm size less than 5 ha, which shows that majority of the cotton farmers are small farmers or have farm are less than sustainable level (considering 5 ha as sustainable farm size).

**Table.1 Socio-economic characteristics of the cotton farmers**

	Frequency	Percentage
Age		
20-35	41	43.2
36-50	41	43.1
51>	13	13.7
Total	95	100
Education		
Illiterate	12	12.6
Elementary	40	42.1
Higher secondary	31	33.5
University	12	12.6
Total	95	100
Farming experience		
1-10	29	30.5
11-20	35	31.6
21-30	22	22.0
31>	9	17.9
Total	95	100
Farm size		
1-5 hectare	73	76.8
5 ha>	22	23.2
Total	95	100

Results in Table 2 shows that cotton farmers were receiving advisory services from both public extension and private sector extension staff. If we compare percentage of farmers getting service solely from one source than private extension agents have more outreach to farmers than public. This could be due to the fact that public extension agents have low budget and resource problems, while on other hand private extension agents have targets to meet specific number of farmers everyday and also have transport and other resources. Almost 10% of the respondents are those who are not getting services or not approached by either public or private extension agents. Such types of farmers are those who have very small farm size or belong to uneducated category.

**Table 2. Distribution of farmers receiving advisory services from different sources**

Source	Frequency	Percentage
Public extension	3	3.2
Private	25	26.3
Both	58	61.1
other	9	9.5
Total	95	100

Results in the Table 3 show the relevance of the farmers' basic characteristics with satisfaction from extension services. Although age is very important factor influencing the farmer's attitude, in this study age was found to be insignificant. The possible explanation for this can be that the level of services being provided is very low, so there is no difference between the old and younger farmers satisfaction level. Education, another important factor shaping farmer attitude was close to significance. Farmers with high level of education were getting services and had higher level of satisfaction as compared to less educated or illiterate ones. Farming experience, farm size and income were found to be non-significant.

**Table 3. Chi square analysis of descriptive statistics and satisfaction with services**

Variable	Mean	S.D	Chi square		
			With Public	With Private	Decision
Age	39.26	9.68	.440	.558	Not significant
Education	3.34	1.55	.063	.059	Not significant
Farming experience	17.72	9.69	.509	.283	Not significant
Farm Size	3.8	6.56	.854	.572	Not significant

Table 4 shows the rank order of the each extension service being provided by both public and private extension agents. Results showed that, overall farmers are more inclined towards private services. But, at the same time, the level of satisfaction of farmers with both services does not show strong or very strong satisfaction. Farmers' level of satisfaction is medium with private while it is unsatisfied to medium with public. If we look on rank order, farmers have given highest score to identification of disease service of private and pesticide selection service of public extension agents. Farmers showed dissatisfaction with services like land preparation, planting techniques and fertilizer application rate being provided by private extension companies. While on the other hand farmers have dissatisfaction with almost all of the service of public extension.

**Table 4. Distribution of cotton farmers showing the rank-order of satisfaction with the services provided by the extension agents**

Service	Weighted mean square (WMS)	
	Public (rank)	Private (rank)
Overall satisfaction	2,63 (2)	3,10 (4)
Land preparation	2,32 (7)	2,34 (8)
Selection of seed	2,47 (6)	3,13 (3)
Planting techniques	2,27 (8)	2,76 (6)
herbicides	2,57 (4)	3,14 (2)
Fertilizer application rate	2,47 (5)	2,66 (7)
Identification of disease	2,60 (3)	3,20 (1)
Pesticides selection	2,75 (1)	3,08 (5)

## CONCLUSION

This study focused on the satisfaction of cotton grower with extension services provided by both public and private sector field staff in Muzaffargarh district. Specific objective of the study was satisfaction level of cotton growers with services.

1. Age, farming experience, and farm size were found to be no significant. No association was found between demographic characters of the respondents and satisfaction with services. Education was near to significance level.
2. Majority of the farmers are being approached by private extension field staff, while public extension field staff has less out reach.
3. Respondents showed medium level of satisfaction with private field staff, while dissatisfaction with public field staff.
4. Private field staff gain maximum score on identification of disease and public on pesticide selection.

## RECOMMENDATION

Keeping in view the results of the study following recommendation can be made;

1. Public extension field staff should increase its outreach to maximum farmers; government should provide enough resources and trainings to increase their access and competence.
2. Mostly very small farmers are being neglected by both sectors; it is deemed necessary for government to take steps to provide equal services to small farmers like others. At the same time a separate unit in both sectors which just deal with small farmers is recommended.
3. Private extension field staff has targets to achieve which influence the quality of services, as they advice more pesticide use and recommend usage of their own product rather than what is needed. Technical services should be kept aside from marketing and sales department. It has been seen that private are more concerned to sale of their products. Total service package which was recommended by 1988 commission should be adopted, beyond just plant protection and disease identification.

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## **ENVIRONMENTAL RISK PERCEPTIONS OF STUDENTS IN FACULTY OF AGRICULTURE IN TURKEY**

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### **ABSTRACT**

Various environmental problems are related with wrong risk perception about the environment as well as insufficient interest, behavior and information. The purpose of this study was to analysis environmental risk perception of students in faculty of agriculture in Turkey. Data were obtained in 20 – 22 April 2015 from face-to-face interviews of 73 students who join to Fifth National Student Congress on Agriculture in Adana Province. Environmental Risk Perception Scale developed by Slimak and Dietz (2006) was used in the study. The result of factor analysis showed that the scale consists of 8 factors explaining 74.20 % of total variance. The internal consistency coefficient Cronbach Alfa of the scale was 0.887 and KMO was 0.751. According to the students three most important environmental risk factor are respectively radiation, global warming and hazardous waste site. Students environmental risk perception was found to be above average show that awareness of student about environmental problems is high.

**Keywords:** Environmental risk perception, Students, Faculty of agriculture, Environmental education, Turkey

### **INTRODUCTION**

After the industrial revolution, environment, natural resources and natural processes were contaminated as human origin and nature was forced extreme as well over the ability to renew itself. This case caused deterioration that compensation is very difficult and time-consuming or impossible. In addition, changes in consumption structure of society in that process led to increasing the pressure on natural resources and caused changes in the agricultural systems. Neglecting of nature for economic development, it was led to the emergence of risk which may threaten human life such as depletion of natural resources, global warming, depletion of the ozone layer. (Altunoğlu and Atav, 2009; Kaya et al., 2012). People's behavior on environmental issues depends on how they perceive environmental risks. In recent years, society's perception of the environment and concerns on environmental issues have been changed. If the society' perception of environment and environmental risk are wrong, environmental protection efforts would also be wrong (Sam et al., 2010). Therefore, it is important that training of new generation who sensitive to environmental problems and perceived environmental risks right for production environment. In this context, the aim of this paper is to examine students' perceptions of environmental risk in agricultural faculties in Turkey.

### **MATERIALS AND METHODS**

Data were obtained in 20 – 22 April 2015 from face-to-face interviews of 73 students who join to Fifth National Student Congress on Agriculture in Adana Province. Environmental Risk Perception Scale developed by Slimak and Dietz (2006) was used in the study. This scale selected because it includes the key environmental issues that have been ongoing in the world and compatible with course which conducted in faculties of agriculture in Turkey (Altunoğlu and Atav, 2009; Slimak and Dietz, 2006).

Students' perception on sources of environmental risk was analyzed using descriptive statistics and factor analysis. The large numbers of variables were reduced in to smaller. This was done through factor analyses for sources of environmental risk. Factor analysis is a popular multivariate technique used to assess the variability of variables of a data-set (in our case, environmental risk sources variables) through linear combination of smaller number of latent variables, called factors. The extent of variation between variables in each factor is expressed by Eigenvalues. If there is a strong relationship between variables, the first few factors explain a high proportion of the total variance and the last factors contain very little additional information. In our analysis, factors whose Eigenvalues are greater than one were retained. Total variance accounted for environmental risk sources was observed to be 74.20 %. Varimax rotation was used to maximize the variance of the squared loadings for each factor, and thus polarizes loadings (either high or low) on factors for easy interpretation. To check the internal reliabilities, we calculated Cronbach's alpha. The Cronbach alpha values were found to be 0.887 which is acceptable. Kaiser–Meyer–Olkin (KMO) measures of sampling adequacy for sources of environmental risk scale gave a value of 0.751. This KMO values show that overall the scale is adequate for factor analysis due to large portion of communality (Alpar, 2011; Hair et al., 1994; Kalayci, 2008; Miran, 2002).

Multiple regression analysis was used to study in order to examine relationship between students' environmental risk perception and socioeconomic variables (Alpar, 2011; Hair et al., 1994; Kalayci, 2008). Regression model was established accordance with the following general form.

$$Y = \alpha_0 + \beta X_1 + \dots + \beta X_n + e_i$$

In equality;

Y: Perception of risk and risk management strategies (as the factor scores)

X<sub>i - n</sub>: Socioeconomic variables.

## RESULTS

### Characteristics of Students

General characteristics of students who data collected were presented in table 1. Students' grade point average was 2.75 and average age was 22.00 years old. All of students consisted of % 58.20 boys and % 41.80 girls. All of students' class consisted of % 13.70 first, % 27.40 second, % 34.20 third and % 19.20 fourth classes, % 5.50 also masters / PhD. students' learning departments are presented in table 1.

**Table 1: Characteristics of Students**

<b>Grade Point Average</b>		2.75
<b>Age (year)</b>		22.00
<b>Gender (%)</b>	Female	58.20
	Male	41.80
<b>Departments (%)</b>	Agricultural Economics	15.10
	Plant Protection	19.20
	Agricultural Structures and Irrigation	4.10
	Horticulture	20.50
	Agricultural Machinery and Technology Engineering	5.50
	Soil Science and Plant Nutrition	13.70
	Food Engineering	1.40
	Field Crops	11.00
	Animal Science	8.20
	Agricultural Biotechnology	1.40
<b>Class (%)</b>	First	13.70
	Second	27.40
	Third	34.20
	Fourth	19.20
	Masters / PhD	5.50

### Results of Statistical Analysis

Means, standard deviation and factor loading belong to Environmental Risk Perception Scale's items are given in table 1. Principal component factor analysis carried out using varimax rotation in order to determine factor structure of scale. Scale's the internal consistency coefficient Cronbach Alpha of the scale was 0.887 and KMO sample adequacy measure was 0.751. This values indicated that scale was appropriate and adequate for factor analysis. It must show a normal distribution of the measured property to use the parametric method. Bartlett Sphericity test is a multivariate technique used to check whether variables have a normal distribution (Alpar, 2011; Hair et al., 1994; Kalayci, 2008). Bartlett Sphericity test was significant in this study. (Chi - Square: 881.44, p <0.000). The result of factor analysis showed that the scale consists of 8 factors explaining 74.20 % of total variance. According to the students three most important environmental risk factor are respectively global warming, hazardous waste sites and radiation. Students environmental risk perception was found to be above average show that awareness of student about environmental problems is high (Table 1).

The factors 1 to 8 were labelled "ecological risks", "economy-induced risks", "agricultural origin risks," invasive species and human-induced risks", "water pollution risks", "entertainment and sporting fishing", "acid rain", and "GMO" respectively.

Factor 1, ecological risk, loads significantly from a variety of ecological variables like radiation, stratospheric ozone depletion, global warming and habitat. Risks arising from economic activities as mountain top mining, damming and destruction of wetlands variables indicates economy-induced risks in factor 2. Significant loadings of eutrophication, persistent and toxic organic pollutants, overgrazing and pesticides reflect role of agriculture in environmental pollution because that factor 3 called as agricultural origin risks. Factor 4 is called invasive species and human-induced risks because of the extremely high loadings of clear-cut logging of large tracts of

forests for pulp, paper, and wood products, sewage and invasive species variables. Factor 5 was labeled as water pollution risks because of the loadings petrol exploration and transport in sea adn Surface runoff (also known as nonpoint pollution) contaminated with agricultural chemicals and sediment variables. Factor 6, 7 ve 8 were labeled as entertainment and sporting fishing, acid rain, and GMO respectively. Because of the extremely high loadings sports and recreational fishing and hunting, acid rain, GMO vairables respectively.

**Table 1: Rotated Component Matrix**

Items	Mean	SD	Factors							
			1	2	3	4	5	6	7	8
Radiation: Release of radioactive materials associated with nuclear power generation.	4.750	0.465	<b>0.747</b>	-0.003	0.069	0.231	0.065	-0.086	0.204	0.046
The ozone hole caused by ozone-depleting substances like refrigerants (e.g.,freon) that reduces the protective ozone layer and leads to an increase in ultraviolet radiation from the sun. Also known as stratospheric ozone depletion.	4.640	0.562	<b>0.659</b>	0.179	0.386	0.172	0.191	0.134	0.123	-0.261
Global warming caused by excessive amounts of greenhouse gases like carbon dioxide and methane that may lead to weather extremes, such as temperature increases, flooding, sea level rise, extreme storms.	4.780	0.417	<b>0.659</b>	0.116	-0.028	0.364	0.006	0.279	0.306	-0.122
Worldwide human population growth.	4.260	0.882	<b>0.617</b>	0.100	0.179	-0.342	0.089	0.435	-0.201	0.059
Hazardous waste sites which may release toxic chemicals into streams and estuaries and landscapes.	4.780	0.449	<b>0.560</b>	0.225	-0.003	0.316	0.428	0.036	0.098	0.319
Destruction and fragmentation of wildlife habitat due to urbanization and suburban sprawl.	4.470	0.851	<b>0.559</b>	0.478	0.207	0.130	0.442	0.003	-0.215	-0.102
Mountain top mining:Atechnique that removes portions of mountain tops to reveal an ore seam (e.g., coal). The mined residue is then used as fill material that may alter the landscape.	3.780	0.961	-0.017	<b>0.792</b>	0.096	0.028	0.069	0.142	0.256	-0.118
The damming of rivers for electric power generation, flood control, navigation, and recreation.	3.560	1.105	0.191	<b>0.703</b>	0.206	0.125	-0.282	0.098	0.074	-0.088
Destruction and loss of wetlands by residential, commercial, industrial, agricultural, or recreational development.	4.420	0.815	0.478	<b>0.599</b>	0.162	0.189	0.196	0.037	-0.214	0.212
Entrainment and impingement of fish in water intake pipes at power plants and hydroelectric dams.	4.140	0.871	0.090	<b>0.442</b>	-0.058	0.034	0.400	0.427	0.072	0.386
Heavy metals like lead, zinc, and cadmium released into surface waters from mining operations and mercury released from the burning of coal.	4.180	0.752	0.081	0.003	<b>0.815</b>	0.190	-0.039	0.098	-0.036	0.259
Eutrophication: the overenrichment of waters due to nitrogen fertilizer runoff and nitrogen oxide deposition in watersheds. This may lead to algal blooms and depletion of dissolved oxygen in rivers and coastal waters.	4.010	0.920	0.263	0.225	<b>0.677</b>	0.109	0.007	0.250	0.317	0.056
Persistent and toxic organic pollutants (e.g., PCB's, DDT, dioxin, toluene, benzene) that are discharged into surface streams or into the air from chemical manufacturing plants. These chemicals are long-lived in the environment and can be transported great distances.	4.560	0.623	-0.070	0.319	<b>0.602</b>	0.391	0.310	0.035	0.065	-0.029
Overgrazing of range and pasture lands due to excessive numbers of livestock for a specific area.	3.780	1.057	0.237	0.424	<b>0.513</b>	-0.048	0.156	0.365	-0.173	-0.043

**Table 1: Rotated Component Matrix**

Items	Mean	SD	Factors							
			1	2	3	4	5	6	7	8
Pesticides: Insecticides used to treat insect pests; herbicides used to treat weeds; and rodenticides used to kill animal pests (e.g., gophers, prairie dogs).	4,320	0,743	0,251	0,346	<b>0,413</b>	0,037	0,328	0,316	0,342	-0,120
Clear-cut logging of large tracts of forests for pulp, paper, and wood products.	4,220	0,786	0,160	0,194	0,147	<b>0,795</b>	-0,105	0,032	-0,022	-0,045
Sewage: Untreated sewage dumped from cruise ships and treated sewage from waste water treatment plants discharged into streams.	4,560	0,707	0,188	-0,138	0,159	<b>0,696</b>	0,314	0,118	0,096	0,050
Invasive species: Plants like kudzu and cheat grass and animals like zebra mussels and sea lampreys.	4,160	0,866	0,241	0,149	0,234	<b>0,587</b>	0,135	0,383	0,210	-0,010
Drilling for oil from offshore drilling platforms along the coasts and on lands and the transportation of oil and petroleum products (e.g., pipelines, tank trucks, and supertankers) that may result in spills.	4,300	0,794	0,164	-0,110	0,092	0,063	<b>0,798</b>	0,003	0,226	-0,112
Surface runoff (also known as nonpoint pollution) contaminated with agricultural chemicals and sediment.	4,410	0,704	0,391	0,212	0,047	0,412	<b>0,485</b>	0,127	0,043	0,221
Sport fishing (e.g., fishing for bass, trout, catfish, deep sea and coastal fish) and sport hunting (e.g., hunting for deer, squirrels, waterfowl, and other wildlife).	3,490	1,226	0,070	0,207	0,067	0,203	0,187	<b>0,766</b>	-0,048	-0,053
Acid rain caused by the deposition of acid-producing sulfur dioxide into streams and on forests, usually from the burning of coal	4,560	0,623	0,182	0,146	0,100	0,121	0,225	0,017	<b>0,833</b>	0,115
The growing of genetically engineered crops (e.g., corn); also known as genetically modified organisms or GMOs.	3,990	1,074	-0,038	-0,127	0,178	-0,020	-0,057	-0,042	0,070	<b>0,870</b>
Variance % by			33,185	8,784	7,305	5,847	5,215	5,124	4,486	4,253

Current study results and a few study results about environmental risk perception were given together in the table 2 in order to make comparisons. Current study results, a few research results about environmental risk perception, data collection survey and top five ranking environmental risk are presented in the table 2.

When table 2 examine, it is seen that in the all of studies conducted in different times and with different samples, there are radiation and ozone depletion in the top five environmental risks. In the all of studies which reported in this study, there were radiation and ozone depletion in the top five environmental risks can be explained by the huge negative result of these risks may cause for human life. As the same way, chemical and biological risks in taking in the top five environmental risks could be explained by health problems caused by these risks. Another common result of studies is that important risk factor for people's perception are related to human life strongly.

**Table 2 : Results of A Few Studies About Environmental Risk Perception**

Researcher (s)	Data Collection Survey	Working Group	Top Five Ranking Environmental Risks
Current Study	Environmental Risk Perception Scale, 24 items	Agricultural engineer candidate 73 students, Turkey	1. Hazardous waste sites 2. Global warming 3. Radiation 4. Stratospheric ozone depletion. 5. Persistent and toxic organic pollutants 5. Sewage
Altunoğlu and Atav (2009)	Environmental Risk Perception Scale, 23 items	320 secondary school students, Turkey	1. Global warming 2. Radiation 3. Stratospheric ozone depletion 4. Hazardous waste sites 5. Sewage
Sayan (2013)	Environmental Risk Perception Scale, 24 items	Nurses candidate 778 student, Turkey	1. Radiation 2. Hazardous waste site 3. GMO 4. Sewage 5. Persistent and toxic organic pollutants
Slimak and Dietz (2006)	Environmental Risk Perception Scale, 24 items	University graduates, 614 People, USA	1. Hazardous waste site 2. Persistent and toxic organic pollutants 3. Sewage 4. Radiation 5. Heavy metals
Sam and ark. (2010)	Environmental Risk Perception Scale, 23 items	Faculty of Economics and Administrative Sciences, 424 students, Turkey	1. Radiation 2. Hazardous waste site 3. Sewage (4 and 5 are absent)

References: (Altunoğlu and Atay, 2009; Sam et al., 2010; Sayan, 2013; Slimak and Dietz, 2006)

#### **Relationship Between Students' socioeconomic Characteristics and Risk Perception**

In order to examine relationship between students' environmental risk perception and socioeconomic, multiple regression models carried out in this study. The regression coefficients and significant variables and models are presented in Table 3. Only two models which establish for economy-induced risks and GMO are significant at 0.10 level. Only one variable, age, is negatively related to economy-induced risks. This implies that students who younger are likely to perceive this risk source as significantly more than students who older. Sex of students is negatively related to GMO. This results shows that female students perceive risk related to GMO as highly important.

**Table 3. Relationship between risk perception and socioeconomic variables**

Socioeconomic Variables	Factors							
	1	2	3	4	5	6	7	8
	coef.	coef.	coef.	coef.	coef.	coef.	coef.	coef.
(Constant)	1.204	5.303	-2.141	0.670	1.101	1.547	-1.639	3.258
Sex*	-0.159	-0.104	-0.219	-0.237	-0.302	-0.249	-0.069	-0.835***
Age	-0.097	-0.215***	0.093	-0.025	-0.014	0.009	0.068	-0.110
GPA	0.308	-0.307	0.248	-0.010	-0.116	-0.411	0.066	0.039
Class**	0.109	0.191	-0.081	0.108	0.020	-0.082	-0.002	0.099
R <sup>2</sup>	0.063	0.144	0.043	0.023	0.229	0.070	0.014	0.217
P value	0.450	0.065***	0.641	0.855	0.791	0.384	0.941	0.008***

\* Measured as a dummy variable where 1 denotes female and 0 denotes male.

\*\* Measured as a dummy variable where 1 first class, 2 second class, 3 third class, 4 fourth class and 5 masters PhD

\*\*\*Variables and models significant at p < 0.10

## CONCLUSIONS

The purpose of this study was to analysis environmental risk perception of students in faculty of agriculture in Turkey. Data were obtained in 20 – 22 April 2015 from face-to-face interviews of 73 students who join to Fifth National Student Congress on Agriculture in Adana Province. Environmental Risk Perception Scale developed by Slimak and Dietz (2006) was used in the study. The result of factor analysis showed that the scale consists of 8 factors explaining 74.20 % of total variance. The internal consistency coefficient Cronbach Alfa of the scale was 0.887 and KMO was 0.751. In this study, it is aimed to determine how students perceive environmental risk based on research findings. According to the result the most important risk that the students perceive are radiation, stratospheric ozone depletion, global warming, worldwide human population growth and hazardous waste sites. Considering the first five ranks risks, it is seen that this risks directly affecting human life and they may cause terrible health problem for human. Accordingly, students have not seen themselves as a part of nature and it could be concluded that they perceive risk is important when it adversely affect the them.

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## **WATER DEFENSE BEHAVIOR OF EGYPTIAN FARMERS**

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### **PURPOSE**

Water is a major environmental component on which humans depend in farming, industry, and domestic activities. But many countries, including Egypt, are facing critical water situations (2;6,7) shortage of available water coupled with the pollution of limited water available are two facts contributing to the existing water situation. Water shortage has been the concern of researchers for decades (1,3,4,5,8,9). But water quality has been confined to dealing with water pollution behavior. The concern with protecting water from the widespread polluting human action is absent. The purpose of this paper is to assess water defense behavior among Egyptian farmers.

### **CONCEPTUAL FRAMEWORK**

Water defense behavior is conceptual as a four-dimensional concept. The dimensions are water defense knowledge, water defense attitudes, water defense practices, and water defense intervention. Those dimensions are briefly defined as follow.

- a. Water defense knowledge: Awareness of the variety of human acts that cause harm to water quality (perceiving threats).
- b. Water defense attitudes: disapproving human acts that cause harm to water quality (hating threats).
- c. Water defense practices: avoiding committing acts that cause harm to water quality (abandoning threats).
- d. Water defense intervention: taking an active role to prevent others from committing acts that cause harm to water quality (fighting threats).

### **Research Question and Design:**

The main concern is with water defense behavior. Irrigation water is running in open water streams. It has repeatedly been reported that rural people are discharging a variety of materials in water streams; thus decreasing the quality of water. A number of organization are currently engaged in activities to teach rural people to protect water streams. But no attempt was made to the actual behavior of people in this area. Water defense behavior is introduced here to refer to human acts directed toward protecting water in streams. The research question is; therefore, to identify the water defense behavior of farmers and to assess the relationships between certain independent variables and water defense behavior.

Four villages in Kafr- Elsheikh governorate were chosen as the site for the study. A random sample of 45 land holders was drawn from the list of land holders in each village. The total sample size is 180 farmers.

### **Data collection and Analysis:**

An interview schedule was prepared for use in data collection. Data were collected by personal interviews between trained interviewers and sample farmers in their homes or fields. Collected data were coded and analyzed. Measures of the dimensions of water defense behaviors are constructed as follows:

- a. Water defense knowledge is measured by a thirteen-item scale that has a reliability coefficient of .90 (coefficient Alpha)
- b. Water defense attitudes is measure by an eleven-item scale that has a reliability coefficient of .85.
- c. Water defense practices is measured by a thirteen-item scale that has a reliability coefficient of .91.
- d. Water defense intervention is measured by an eleven-item scale that has a reliability coefficient of .80.

Pearson correlation coefficient were computed to assess the bivariate relationships between eight independent variables and measure of water defense behavior.

## RESULTS

Table (1) presents the descriptive statistics of water defense behavior measures. Figures in the table show that respondents have moderate scores of water defense knowledge, water defense practices, and water defense intervention. But the scores of water defense attitudes are relatively high. Coefficients of relative variations indicate that respondents are less variable in water defense practices but more variable in water defense intervention. This means that farmers are similar in defending water from their own misconduct. But when it comes to defending water from the misconduct of others, they are more variable. Besides, water defense attitudes indicate that farmers claim greater feelings about water defense than they actually act to defend water.

Table (2) presents the bivariate correlation coefficients between the eight independent variables of age, educational level, level of living, size of land holding, farming status, mass media exposure, extension participation, and awareness with the water situation and the four dimensions of water defense behavior. Figures in the table show that the two independent variables of age and size of land holding are not correlated with any of the four water defense dimensions.

The sign of the correlation coefficient between farming statuses and the four water defense dimensions is negative. However, only two correlation coefficients are statistically significant. This indicates that farming status is inversely correlated with water defense knowledge and water defense intervention. This means that water defense knowledge and water defense intervention tend to decrease as dependence on farming increases. This may be interpreted to mean that full dependence on farming may press farmers to disregard water defense issues for practical concerns that are more crucial to them.

Extension participation is significantly correlated with water defense attitudes and water defense intervention, but not with water defense knowledge and water defense practices. This indicates that extension activities have little impact in developing water defense behavior.

The four independent variables of educational level, level of living, mass media exposure, and awareness with the water situation are significantly correlated with the four dimensions of water defense behavior. The magnitude of the correlation coefficients indicates that those four independent variables are correlated with water defense knowledge and water defense intervention more strongly.

## CONCLUSION

Making the best use of the limited water resources in Egypt may be approached through two parallel paths. The first path is using the right amount with little or no excess. This path has received much attention by agricultural extension and other organizations. The second path is keeping water resources close to its original good quality. This path is not getting the due attention. It has been repeatedly reported that rural people in general commit a variety of behavior that reduce water quality.

Past research concentrated on water polluting behavior. This means that concern is with the dark side of the subject. What seems urgently needed is shifting attention to the light side of the subject; namely, water protection behavior to save water quality. It is clear that the current behavior of farmers is far from protecting the water on which their living depends. Agricultural extension messages need to be broadened to encompass the four dimensions of water defense behavior specified in this study. Besides, efforts need to be exerted to reach full-time farmers because they seem to be the critical category with respect to water defense.

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**Table (1) Descriptive Statistics of Water Defense Measures**

Measure	No. of items	Range	Reliability	Mean	Coefficient of variation
Knowledge	13	13-39	.90	27.60	24.2
Attitudes	11	11-13	.85	27.78	24.8
Practices	13	13-52	.91	32.82	19.1
Intervention	11	11-44	.80	27.44	31.4

**Table (2) Pearson Correlation Coefficients Between Independent**

**Variables and Water Defense Measures**

Independent variables	Water Defense Measures			
	Knowledge	Attitudes	Practices	Intervention
Age	.044	-.054	-.009	-.025
Educational level	.542**	.243**	.328**	.478**
Level of living	.345**	.251**	.149*	.344**
Size of land holding	.011	.112	-.024	.001
Farming status	-.314**	-.101	-.212	-.235**
Mass media Exposure	.431**	.227**	.167*	.482**
Extension participation	.058	.158*	-.048	.274**
Awareness with water situation	.485**	.241**	.183*	.480**

\* Significant at .05 level

\*\* significant at .01 level

## SOME INFLUENTIAL FACTORS ON EGYPTIAN FARMERS' KNOWLEDGE ABOUT BIO – FERTILIZERS

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### ABSTRACT

This study aimed to assess the effect of extension participation and personal variables on types of knowledge gained by Egyptian farmers. Three experimented treatments were designed as using PowerPoint in extension meeting, holding an evening extension meeting, and doing an extension field. The subject matter of the three treatments are the same, namely, bio-fertilizers, where three types of knowledge were provided. Those were knowledge about benefits of bio-fertilizers, knowledge about methods of applying bio-fertilizers, and knowledge about precautions to be considered in using bio-fertilizers. The three extension education activities were implemented in three distinct locations. A total 240 farmers voluntarily joined the three treatments. An equal number of farmers were included as a control groups making a total sample size of 480 farmers. An interview schedule containing 97 knowledge items was prepared and used for data were collected at the end of each experimental treatment. Collected data were coded and analyzed using multiple linear regress on the findings of the study were

1- The three extension educational methods, combined, explained 58.8%, 55% and 51.1% of the variance in. Each of the treatments made significant unique contributions in the regression equations, the order of the three treatments was similar with PowerPoint extension meeting at the top, followed by the extension in field and evening meeting.

2- The five personal variables, combined explained 13%, 15.7% and 13.2% of the variance in knowledge about benefits knowledge about application, and knowledge about precautions; respectively with all variables making a significant unique attribution in all regression equations.

3-The eight independent variables, combined, explained 61%, 59% and 54% of the variance in knowledge about benefits knowledge about application, and knowledge about precautions; respectively with the three extension treatments making significant unique contribution. Whereas the two personal variables of social participation, and farming status only make significant unique contributions in all regression equations.

4- It could be concluded that the majority of explained variance was due to the extension treatments. But personal variables are of little relevance. This was taken to mean that all farmers are equally able to learn.

### INTRODUCTION

The agricultural extension education in Egypt has relied heavily on the extension meetings and extension fields for decades. Evaluation of the educational impact of those methods has been confined to the assessment of knowledge of participant farmers about the subject-matter provided. Extension meetings were concluded to enhance the knowledge of attendant farmers. That conclusion was reached sometimes on the basis of comparison with non-attendants as a control sample (Abu-Ghali, 2008; Eid 2012), but some other times the pretest and post test of attendant farmers was the basis of the conclusion (El-sayyed etal, 2007; Adbel-Aziz, 2007). Extension fields were also concluded to enhance the knowledge of the participant farmers as compared to non-participants (Marzaban, 1990, Sakr, 1991; Mansour, 1994; El-Hamouly. 1998; Abou-zaid, 2006; Abdel-Rahman and Ghanem, 2007; Amer, 2009; Salama, 2010;).

The mainstream extension research in Egypt has tended to lump all kinds of extension meetings together. This common practice disregards the possible impact of different meeting arrangements.

In an earlier paper, Abd-ella etal (2013), the current authors reported that evening extension meetings had higher knowledge impact than morning extension meetings, and that extension meetings provided by PowerPoint had higher knowledge impact than ordinary extension meetings. The point seemed to deserve more investigation.

Besides, extension meetings and extension fields were generally treated separately, no attempt to investigate the relative impact of the two methods was made.

In addition the role of individual farmer variables in gaining knowledge through participation in extension methods is still uninvestigated.

It seems important to incorporate extension meetings, extension fields, and individual variables in one study in order to identify the relative impact of each on farmers. Therefore, this study was conducted to answer the following question.

- 1- Does the knowledge impact of evening extension meetings, extension meetings with PowerPoint, and extension fields vary according to type of knowledge provided.
- 2- What is the relative impact of evening extension meetings, extension meetings with PowerPoint, and extension fields.
- 3- What are the roles extension methods used and individual traits have in explaining variance in knowledge among Egyptian farmers.

## **EXPERIMENTAL PROCEDURES**

The research reported here was designed and conducted according to the following steps

First: bio-fertilizers was chosen to be the subject of investigation. The subject-matter was prepared and categorized in three areas. Those were benefits, application, and precautions. A list 97 true/false statements was prepared to be used in data collection. The statements covered the three areas of the subject matter with 35 statements on benefits, 30 statements on application, and 32 statements on precaution.

Second: three experimental treatments were intended. Those were attending an evening extension meeting, attending an extension meeting with PowerPoint, and participation in an extension field. Each of the three experimental treatments was decided to the implement in a separate location. Eight villages in Kafr-Elshikh governorate were purposively chosen for the study. Four villages were allocated to extension meetings; two for evening meetings, and two for meetings with PowerPoint. The other four villages were located to extension fields. The total numbers of participating farmers were 100 in evening meetings, 100 in extension meetings with Power Point and forty in extension fields. Data were collected from participant farmers at the end of each treatment by personal interview with trained interviewers.

Third: A control sample of equal number was selected from the eight villages and interviewed. The total number of respondents is 480 farmers.

Fourth: collected data were coded and the following variables were included.

- a) Attending an evening extension meeting (Dummy variable)
- b) Attending an extension meeting with PowerPoint (Dummy variable)
- c) Participating in an extension field (Dummy variable)
- d) Size of land holding (in kirats)
- e) Size of animal holding (animal units)
- f) Farming status (full time = 2, part time = 1)
- g) Family size
- h) Social participation (number of organization joined)
- i) Knowledge about benefits (number of right responses)
- j) Knowledge about application (number of right responses)
- k) Knowledge about precautions (number of right responses)

Fifth: each of the three knowledge variables was used a dependent variables in three equations. The first equation included the three experimental treatments as independent variables (block 1). The second equation included the five personal variables as independent variables (block 2). And the third equation included all the eight independent variables (block 1 + block 2).

## **RESULTS AND DISCUSSION**

Findings of the study are presented below. Presentation is divided in four successive section

**1- The impacts of experimental treatments on knowledge:** table (1) present the result of the regression equations including experimental treatments as predictors of knowledge. Results in the table show that the three independent variables combined explain 58.8 %, 55% and 51.1% the variance in knowledge about benefits, knowledge about application, and knowledge about precautions; respectively. The mean score of knowledge about benefits for the control sample is 16.56 points. The attendance of an event extension meeting added 9.18

points; attendance of an extension meeting with PowerPoint added 6.6 points, and participating in an extension field added 12.86 points. This means that participation in extension fields ranks first in term of knowledge gain followed by attending an evening extension meeting. While attending an extension meeting with PowerPoint is the last. The case of knowledge about application, and knowledge about precautions convey comparable meanings, However, standardized partial regression coefficients put participating in an extension field in the second rank, this may be justified by the small size of 40 respondent as compared to the 100 respondents in each of the other treatments.

**2- The impact of individual variables on knowledge.** Table (2) presents the result of the regression equations including individual variables as predictors of knowledge. Result in the table show that the five individual variables of size of land holding, size of animal holding, farming status, family size and social participation, combined, explain 13%, 15.7%, and 13.2% of the variance in knowledge about benefits, knowledge about application, and knowledge about precautions, respectively. Each independent variable makes significant unique contributions in the three regression equations. Social participation and size of animal holding are the best predictors of all types of knowledge. The impact of those two variables are negative. It may be concluded that individual variables are of limited utility in explaining variance in knowledge.

**3- The impact of experimental treatments and individual variable together on knowledge:** Table (3) presents the results of the regression equations including experimental treatments and individual variables together as predictors of knowledge. Results in the table show that the two blocks of independent variables together explain about 61.4,59% and 54% of the variance in knowledge about benefits, knowledge about application, and knowledge about precaution, respectively. Standardized partial regression coefficients show that: each of the experimental treatments makes a significant contribution to each regression equation. Besides, social participation and farming status are the only two individual variables that make unique contributions in the three regression equations. The experimental treatment variables have greater beta values with participation in an extension field being the strongest predictor of all types of knowledge attendance of an evening extension meeting is the second strongest predictor of knowledge about benefits, and knowledge about application but it ranks third as a predictor of knowledge about precautions. Attending an extension meeting with PowerPoint is the second strongest predictor of knowledge about precautions but it ranks third in the other two types of knowledge. Social participation rank fourth as a predictor each type of knowledge. And farming status ranks fifth as a predictor of each of the three types of knowledge with the implication that part time farmers have slightly higher knowledge scores as compared to full time farmers. Those findings warrant the conclusion that individual variables are of little utility in explaining variance in knowledge, this may be interpreted to mean that Egyptian farmers have equal opportunity to gain knowledge from extension activities.

**4- The decomposition of explained variance in knowledge,** Result presented above show that the impacts of experimental treatment variables and personal variables are not completely separate. The percentages of explained variance in knowledge in the three above sections were used to decompose the explained variance in knowledge. Computed figures are presented in table (4). figures in table (4) show that experimental treatment variables add 48%, 43.3% and 40.8% to the explained variance in knowledge about benefits, knowledge about application, and knowledge about precaution, respectively after the individual variables. Those percentages are unique to the experimental treatments. Results also show that individual variables add 2.2%, 4% and 2.9% to the explained variance in knowledge about benefits, knowledge about application, and knowledge about precautions, respectively after the experimental treatment variables. These percentages are unique to the individual variables. According an estimated portion of the explained variance may not be due to either block of independent variables alone. Hence, it is considered to be shared by the two blocks of independent variables. That shared portion is estimated to be 8%, 11.7% and 10.3% of the variance in knowledge about benefits, knowledge about applications, and knowledge about precautions, respectively. This means that most of the impact of individual variables is shared by experimental treatment variables. But the largest portion of explained variance is due to experimental treatments alone. This is the case for all types of knowledge considered. This means that various types of knowledge do not require different agriculture extension methods at least as the three extension method considered are concerned.

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**Table (1) result of regression of knowledge on extension method variables**

Ext. Educ. Method	Partial regression coefficient					
	Benefits		Application		Precautions	
	B	Beta	B	Beta	B	Beta
Intercept	16.65		14.15		14.03	
Evening Meeting	9.18**	.483	7.14**	.483	7.36**	.426
Meeting with Power Point	6.68*	.351	5.18*	.324	6.16*	.357
Extension farm	12.68**	.458	10.30**	.436	10.52**	.424
R2	.588		.550		.511	
F	245.35**		209.53**		179.61**	

\*\* Significant at .01 level

**Table (2) results of regression of knowledge on Individual variables**

Variables	Beta		
	Benefits	Application	Precaution
Size of land holding	-.115**	-.150**	-.141**
Size of animal holding	.177**	.199**	.155**
Farming status	-.123**	-.115**	-.128**
Family size	-.093*	-.122**	-.089*
Social participation	.257**	.271**	.263**
R2	.130	.157	.132
F	15.31**	.19.17**	15.65**

\* Significant at .05 level

\*\* Significant at .01 level

**Table (3) results of regression of knowledge On extension method variables and individual**

**Variables together**

	Beta		
	Benefits	Application	Precautions
Evening Meeting	.424**	.420**	.362**
Meeting with Power Point	.377**	.325**	.376**
Extension farm	.472**	.451**	.444**
Size of land holding	-.015	-.053*	-.052*
Size of animal holding	.03	-.061*	.018
Farming statue	-.07*	-.066*	-.081**
Family size	.56	.31	.043
Social participation	.15**	.168**	.173**
R2	.61	.59	.54
F	88.7**	85.6**	67.42**

\* Significant at .05 level

\*\* Significant at .01 level

**Table (4) the decomposition of explained variance in Knowledge**

Explained by	Percentage of variance explained in		
	Benefits	Application	Precautions
- The block extension educational variable (1)	58.8	55.0	51.1
- The block personal variable (2)	13.0	15.7	13.2
- The two blocks of variables (3)	61.0	59.0	.540
- Added by E.E.V (3-2) 4	48.	43.3	40.8
- Added by personal variables (3-1)	2.2	04.0	02.9
Shared by the two blocks (3-(4+5)	8.8	11.7	10.3

## TECHNICAL EFFICIENCY OF RICE PRODUCTION IN THE NORTHERN AND ASHANTI REGIONS OF GHANA

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### ABSTRACT

The study examined the technical efficiency and its determinants of rice production in the Ashanti and the Northern regions of Ghana. The stochastic frontier Analysis was employed using a cross-sectional data of 300 rice farmers. The results show that rice farmers exhibit decreasing return to scale. The combined effects of operational and farm-specific factors influence technical efficiency although individual effects of some variables were not significant. The study showed that the rice farmers are 65% technically efficient, revealing that there is the possibility of increasing output by 35% using the same amount of inputs through the adoption of best farm practices by rice farmers so as to boost production.

**Keywords:** Efficiency, Rice production, Stochastic Frontier Analysis.

### INTRODUCTION

Productivity of the agriculture sector continues to be crucial for rapid economic growth as it plays a key role in Africa's development. In Africa, rice is the fastest growing food staple (Hegde and Hegde, 2013) and has become a commodity of strategic importance across most West African countries. Changing food preferences in the urban and rural areas coupled with high population growth rates and rapid urbanization increased rice consumption in sub-Saharan Africa by 5.6% per annum in the early 1990's - more than double the rate of population growth (Hegde and Hegde, 2013). Rice consists of about more than a third of cereal calories intake in West Africa as a whole (Hegde and Hegde, 2013).

The experience of Ghana over the years has not been different from the entire Region of West Africa. Agriculture activity continues to be the main source of household income in Ghana. Though rice is one of the main staple foods for Ghanaians, domestic rice production is still at an unsatisfactory level. It is estimated that Ghana spends about US\$100 million annually to import the total quantity of rice needed to meet more than half of Ghana's rice requirements (Alhassan, 2008). According to Buah et al. (2011), about 400,000 tonnes of rice on average is annually imported for consumption. Meanwhile, only 145,000 and 142,000 tonnes of rice were produced in 2004 and 2005 respectively in the country (MoFA, 2005 cited in Alhassan, 2008). This large import of rice is to supplement the total quantity produced in Ghana since domestic rice production fall short of the ever rising demand.

In 2009, a two year Emergency Rice Initiative project was set up to facilitate the production of rice in Ghana through attractive farmer access to certified seed of improved rice varieties, provision of subsidized fertilizer and knowledge on best rice production technologies in the major rice producing regions in Ghana (Buah et al., 2011). Rice has been explicitly identified in the Food and Agricultural Sector Development Policy (FASDEP) as an important food crop that should be given special attention for food self-sufficiency (MoFA, 2008). Also, Ghana's Ministry of Food and Agriculture (MoFA) and the Japan International Corporation Agency (JICA) are jointly implementing the 'Sustainable Development of Rain fed Lowland Rice Production' project in selected Districts in Ashanti and Northern Region

Despite initiatives taken by government to boost domestic rice production, farmers continue to harvest low yields (Abdulai and Huffman, 2000). The low rice productivity coupled with the increasing consumption of rice causes a supply gap between the total rice demanded and the total quantity produced domestically (MoFA, 2005). This low level of total quantity of rice produced in the country could be due to the inappropriate use of resources on the part of rice farmers in allocating inputs optimally to achieve the maximum level of output in their production. Other stochastic factors which are beyond the reach of the farmer also contribute to the low productivity of rice. Inefficient factors such as untimely harvesting, wrong fertilizer application, among others are all factors that can lead to low rice productivity. The study employs the stochastic frontier analysis (SFA) to address these problems.

## MATERIALS AND METHODS

### Data and Variable Description

The study was conducted in the Northern and Ashanti Regions of Ghana which are two of the major rice producing regions in Ghana and also have high concentration of rice farmers. The sample size for this study was 300 rice farmers. The multistage sampling technique was used. In the first stage, a purposive sampling technique was employed to select two Regions (Northern and Ashanti) out of the ten Regions in Ghana. In the second stage, one district was purposively selected from each region, whilst taken into consideration district with the high number of rice farmers. Based on this, the Tamale Metropolitan Area and Ejura Sekyeredumase Districts were selected in the Northern and Ashanti regions respectively. Lastly, a list of rice farmers was obtained from the District and Municipal Agricultural Directorate 150 rice farmers were randomly sampled for each District. Data collection was preceded by a pilot test of the questionnaire to validate the reliability and appropriateness of the questions and expected responses from the rice farmers. A revision of the questionnaire in the light of error detection was conducted and omissions highlighted from the pilot survey. Well-structured questionnaires were administered to the selected rice farmers to collect data on the output, input (list them as well...) and farmer-specific factors (such as age, gender, education level, Institutional factors such as training, FBO, Extension contact, access to credit and farm-specific factors such as method of planting, method of harvesting as well as data on output quantities and respective prices, quantity of inputs used.

Output is measured as the total quantity of rice in kilograms that rice farmers obtained in the last production year. **Labour** is measured in man-days<sup>3</sup> per hectare (ha). Family and hired labour are aggregated as labour variable because their productivity levels are assumed to be the same (Abdulai and Huffman, 2000). **Seed** refers to the total quantity of rice seeds cultivated measured in kilograms per hectare (kg/ha). It is expected to have a positive effect on total rice output. **Fertilizer** is defined as the quantity of chemical fertilizer applied on the rice farm in the last production year. Fertilizer is measured in kilograms per hectare (kg/ha). Fertilizer application (in optimal quantity) is expected to have a positive sign in both models. **Pesticide** is defined as the quantity of pesticide applied on the rice farm in the 2012 production year. Pesticide is measured in Liters applied per hectare (liters/ha). The summary statistics of these variables are presented in Table 1.

The following are variables in the inefficiency model. **Age** of the rice farmers is a continuous variable, measured in years and defined as the number of years since birth until the date of the survey. Age is expected to have either a positive or a negative effect on technical efficiency. **Years of rice farming** is also a continuous variable measured in the number of years a rice farmer has been in farming. This is expected to have a positive or a negative influence on technical efficiency. **Education** represents the levels of formal education of the decision maker. It is categorized as no school = 1; primary school level = 2; secondary school/middle school level = 3; senior secondary level/technical school level = 4 and tertiary level = 5. **Gender** is measured as dummy, where male farmers are assigned a value of 1 and 0 is for female. Thus since rice farming activities requires much physical strength, male who are regarded as stronger than female is used as the base. **Major occupation** is also dummied, has value of 1 if the rice farmer has rice farming as his/her major occupation and 0 for otherwise.

**Extension contact** is measured as dummy and has the value of 1 if the farmer has at least one contact with extension agents and 0 if otherwise. The expected sign could either be a negative or positive. It is expected to be negative when rice farmers have access to extension agents and put advice of extension personnel into good use to reduce inefficiency. On the other hand, if it is positive it implies rice farmers do not have access to extension contacts at all or have access but do not use information effectively leading to inefficiency. **Membership of FBO:** This is measured as dummy and have the value of 1 if the farmer belongs to an association and 0 if otherwise. Again, the expected sign could either be a negative or positive. It is expected to be negative when rice farmers have membership of Farmer Based Organization and put advice and shared experience from colleagues into good use to reduce technical inefficiency. On the other hand, it is negative if rice farmers do not have access to FBOs at all or are in such groups but do not use information acquired effectively. **Access to credit:** Also this is measured as dummy; farmers who had access to credit in the last production season are assigned a value of 1 and 0 for otherwise in the same way, the expected sign could either be a negative or positive. It is expected to be negative when rice farmers have access to credit and use it effectively by purchasing inputs in right quantities and at the right time which boost efficiency and production. On the other hand, the expected sign is positive if rice farmers do not have access to credit at all or have access to it but channel it into other unproductive ventures such as marriage, health, funerals etc.

**Method of planting:** This is also dummied as 1 if farmer uses transplanting and 0 if broadcasting method. The

<sup>3</sup>Man-days are computed according to the rule that one adult male, one adult female, and one child ( $\leq 18$  years) working for 1 day (8 hours) equal 1; 0.75; and 0.50 man-days, respectively. These ratios have also been used by Onumah *et al.* (2010), Battese *et al.* (1996) and Coelli and Battese (1996).

expected sign is either negative or positive. A negative sign implies that transplanting method reduces technical inefficiency as compared to broadcasting method in the study area while a positive sign implies otherwise. **Mode of harvesting and method of land preparation:** These are also measured as dummies; 1 for farmers who uses mechanized method (the use of tractors and combined harvesters) and 0 for manual. The expected signs are either negative or positive. A negative sign imply that using mechanized method to harvest or prepare the land before planting reduces technical inefficiency as compared to manual methods while a positive sign imply otherwise.

**Table 1: Summary Statistics of Variables in the Frontier and Inefficiency Models**

Variable	Item	Minimum	Maximum	Mean	SD
Output	Kilogram/Ha	125	6375	1247.09	867.739
Fertilizer	Kilogram/Ha	0	750	175.090	144.204
Dummy for Fertilizer	dummy	0	1	0.7833	0.4126
Pesticide	Litres/Ha	0	25	3.4761	3.2054
Dummy for Pesticide	dummy	0	1	0.72	0.4497
Seed	Kilogram/Ha	25	450	161.237	67.990
Labour	Man days/Ha	9.844	630	109.747	97.1231
Gender	dummy	0	1	0.7333	0.4430
Major occupation	dummy	0	1	0.7833	0.4127
Extension contact	dummy	0	1	0.4867	0.5007
Credit access	dummy	0	1	0.1633	0.3703
FBO	dummy	0	1	0.2867	0.4530
Seed variety	dummy	0	1	0.2133	0.4103
Planting method	dummy	0	1	0.4567	0.4990
Land Preparation	dummy	0	1	0.94	0.2379
Formal education	level	1	5	1.4333	0.8334
Farming years	Years	1	51	12.293	9.0295
Age	Years	18	82	42.387	12.742
Age squared	Years	324	6724	1963.57	1202.03
Harvesting method	dummy	0	1	0.01	0.9967
Region	dummy	0	1	0.5	0.5008

Source: Author's Computation, 2014.

For the **regional effects**, it is measured as dummy with the value of 1 if the farmer is in the Northern Region and 0 if in the Ashanti Region. Northern Region is assigned the value 1 as the reference point because it has a higher concentration of rice farmers and high rice production levels compared to Ashanti Region. Table 1 also illustrates the summary statistics of these exogenous variables.

### Data Analyses

Following Battese and Coelli (1995), the stochastic frontier production model specified (1) in cross-sectional data context was adopted for the study.

$$\ln Y_i = f(\ln X_i; \beta) + (\nu_i - u_i) \quad (1)$$

$Y_i$  denotes the output of the  $i^{\text{th}}$  firm,  $X_i$  is a vector of input quantities of the  $i^{\text{th}}$  firm, and  $\beta$  is a vector of unknown parameters to be estimated. This study adopts a model by Battese and Coelli (1995) which specifies that the  $u_i$ 's are non-negative random variables assumed to be distributed as truncation (at zero) of the normal

distribution with mean,  $Z_i\delta_i$  and constant variance  $\sigma_u^2$ , such that the technical inefficiency effect  $u_i$  is defined as;

$$u_i = Z_{mi}\delta_m + W_i \quad (2)$$

$W_i$  is defined by the truncation of the normal distribution with mean zero and variance,  $\sigma_u^2$ , such that the point of truncation is  $-Z_{mi}\delta_m$  i.e.  $W_i \geq -Z_{mi}\delta_m$ . These assumptions according to Battese and Coelli (1995) are consistent with  $u_i$  being a non-negative truncation of the  $N \sim (Z_{mi}\delta_m, \sigma_u^2)$  distribution.  $Z_{mi}$  is a (1 x m) vector of explanatory variables associated with technical inefficiency of production, which may include, socioeconomic characteristics, farm specified factors and institutional factors.  $\delta_m$  is a (m x 1) vector of unknown parameters to be estimated. If all the elements of the  $\delta_m$ -vector are zero, then there is no relationship between the technical inefficiency effects and the Z-variables.

The estimation of the production frontier assumes that the boundary of the production function is defined by the ‘best practices’ of the farmer. It therefore indicates the maximum potential output for a given set of inputs ( $X_i$ ) can be expressed as;

$$Y_i^* = f(X_i; \beta) \exp(v_i) \quad (3)$$

The technical efficiency of the  $i^{th}$  rice farmer, denoted by  $TE_i$ , is given as the ratio of the mean of production of a given farmer, given the farmer’s realized effect (observed output), to the corresponding mean of production given that the farmer’s effect was zero (Battese and Coelli, 1988). Thus the technical efficiency of the  $i^{th}$  firm is given by;

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(X_i; \beta) \exp(v_i - u_i)}{f(X_i; \beta) \exp(v_i)} = \exp(-u_i) \quad (4)$$

The above equation demonstrates that the difference between  $Y_i$  and  $Y_i^*$  is embedded in  $u_i$ . Thus the difference between the total output that is actually produced by the farmer and the total expected output is due to the inefficiency on the part of the farmer. The measure of  $TE_i$  has a value between zero and one. When  $TE_i$  equals to one, it implies that  $Y_i = Y_i^*$  and implies that the production lies on the frontier hence indicates a fully efficient farm and if assumed to be zero implies a fully inefficient firm. Considering the distributional assumption of the random errors, this study will employ the single-stage maximum likelihood estimation procedure (Kumbhakar et al., 1991; Reifschneider and Stevenson 1991; Huang and Liu 1994) for the estimation of the parameters of the farm-specific  $TE_i$  in terms of the parameterization is given as:  $\sigma^2 = \sigma_v^2 + \sigma_u^2$  and  $\gamma = \sigma_u^2 / \sigma^2 = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$  (Battese and Corra, 1977).

The parameter,  $\gamma$  is viewed to be bounded between zero and one. Thus, for  $0 < \gamma < 1$ , output variability is characterized by the presence of both technical inefficiency and stochastic errors. When  $\gamma$  is equal to one, it implies that output variability is solely due to technical inefficiency and hence the stochastic frontier model becomes irrelevant to this effect but rather the deterministic frontier model. On the other hand, if  $\gamma$  is zero, then technical inefficiencies are solely due to stochastic noise and hence the average response function (OLS) becomes a best representation of data.

To estimate the output elasticity of the farmers with respect to the various inputs, the study estimates a Transcendental logarithmic (Translog) production function where the total output of the rice farmer is used as the dependent variable and rice seeds, fertilizer, pesticides and labour (normalized by land size) as the explanatory variables. Though the Cobb Douglas production function is simple to use for stochastic frontier analysis, it restricts the returns to scale to take the same value across all farms and assumes that the elasticity of substitution has a value equal to one. The translog production function on the other hand is less restrictive by allowing some combination of cross and squared terms to improve upon the fitness of the model (Coelli, 1995). The translog production function has not been designed to capture cases of zero observation for some input variables. This implies that if the conventional translog production function is not modified to take into account of these zero cases, it might result in serious biased estimates. This study employs the stochastic frontier modified translog production function is specified in as in the case of Battese and Broca, (1997);

$$\ln Y_i = \beta_0 + \beta_0^* D_i + \sum_{n=1}^4 \beta_j \ln X_{ni} + \frac{1}{2} \sum_{n=1}^4 \sum_{m=1}^4 \beta_{nm} \ln X_{ni} \ln X_{mi} + (v_i - u_i) \quad (5)$$

The estimations of the stochastic production frontier and inefficiency model are based on the assumption underlying technical inefficiency and the functional form used. There is therefore the importance of testing hypotheses to ascertain the adequacy of the specified models; whether the Cobb Douglas or the translog production function best fits data, whether the exogenous variables influence efficiency and among others. The following are the various hypotheses tested in the technical efficiency model.

## **RESULTS AND DISCUSSIONS**

### **Statement of Hypotheses for the Frontier Model**

The following hypotheses were tested for the statistical validity of the dataset for the technical efficiency and inefficiency models. Also the appropriateness of the specified stochastic frontier production and inefficiency models are presented using the generalized likelihood ratio test.

**Table 2: Statement of Hypotheses for the Frontier Model**

Null hypothesis	Test statistic ( $\lambda$ )	Degree freedom	Critical value	Decision
1. $H_0: \beta_{ij} = 0$	59.6004	10	23.2	Rejected $H_0$
2. $H_0: \gamma = \delta_0 = \delta_1 = \delta_2 = \dots = \delta_{13} = 0$	83.6638 <sup>c</sup>	15	31.353*	Rejected $H_0$
3. $H_0: \gamma = 0$	12.9587 <sup>c</sup>	1	5.412*	Rejected $H_0$
4. $H_0: \delta_0 = \delta_1 = \delta_2 = \dots = \delta_{13} = 0$	70.9578	14	30.60	Rejected $H_0$
5. $H_0: \delta_1 = \delta_2 = \dots = \delta_{13} = 0$	70.7052	13	29.10	Rejected $H_0$
6. $H_0: \beta_2 = \beta_4 = 0$	19.1272	2	9.21	Rejected $H_0$
7. $H_0: \delta_{14} = 0$	35.506	1	6.63	Rejected $H_0$

<sup>c</sup> Value of test of one sided error. The correct value for the hypothesis of the one sided error (hypothesis involving  $\gamma$ ) is obtained from Table 1 of Kodde and Palm (1986, p. 1246), whilst the rest are obtained from chi-square table and are all significant at 1%.

The first null hypothesis relates to the adequacy test of the Cobb-Douglas functional form relative to the less restrictive functional form expressed by the translog functional form. Thus, it was tested whether or not the second order coefficients and the cross products of the translog are equal to zero. The rejection of the null hypothesis at 1% significance level means that the translog functional form is an adequate representation of the data. Onumah et al. (2010), Ghee-Thean et al. (2012) and Sharma and Leung (1999) rejected the Cobb Douglas functional form as well for the translog.

The second null hypothesis specifies that the technical inefficiency effects are absent in the model at every level, the rejection of this hypothesis means that rice farmers are not fully technically efficient and are therefore not operating on the frontier. It was rejected at 1% significant level in favour of the alternative hypothesis that there is technical inefficiency among rice farmers and this therefore justifies inclusion of inefficiency variables to the model to determine the extent to which they affect technical efficiency. The third hypothesis which specifies that inefficiency effects are non-stochastic was also rejected at 1% significant level. This justification is confirmed by the value of gamma ( $\gamma$ ) equal to 0.622, which is statistically different from zero and highly significant at 1%. Hence, the traditional average (OLS) function is not an adequate representation for the data. The fourth hypothesis that the inefficiency effects are half normally distributed thus the intercept term and the coefficients associated with socio-economic, farm specific characteristics and institutional factors in the technical inefficiency model are zero was also rejected at a significance level of 1%.

The rejection of the fifth null hypothesis that the technical inefficiencies are not affected by farm and farmer specific factors and institutional factors implies that the variables included in the inefficiency model have a mutual significant contribution in explaining technical inefficiency effects for rice farmers, though individually not all of them may be significant. This implies that the joint effects of these variables are statistically significant at 1% level. The sixth null hypothesis which specified that there is no intercept change in the production frontier model was rejected in favour of the alternative hypothesis. This implies that the parameter estimates of the stochastic frontier production frontier function would have been biased if the dummies for fertilizer and pesticides were not incorporated into the model to account for the zero observation in these inputs.

The seventh null hypothesis that there are no regional effects on technical efficiency was rejected. This means that there is location effect on the technical efficiency of the rice farmers in the two regions. Thus, it matters whether a rice farmer is located in the Northern or Ashanti Region because they are affected by different factors

since they are located in different ecological zones. This may be as result of the regional and environmental differences experienced by the two Regions. Also these differences may be attributed to the differences in services delivered to them by the extension agents and other government beneficial policies.

### **Frontier Model Estimation**

The estimated sigma squared ( $\sigma^2$ ) parameter in the stochastic production frontier function which indicates the fitness and the correctness of the specified distributional assumptions had a coefficient of 0.499 and was significantly different from zero at 1%. The estimated gamma ( $\gamma$ ) parameter (0.6224) was significant at 1% implying that, the production inefficiency effects are significant in determining the level and variability in rice farming in the study area. The gamma indicates the proportion of the variability in production efficiency explained by the inefficiency effects and so it being significant from zero means that both inefficiency effects and random effects contributes to the deviation of the observed production frontier from the potential.

All the inputs and the constant term were found to be positively significant as expected except the dummies (Table 3). Seed had the highest coefficient of 0.277 implying that a 1% increase in the quantity of seeds used on a hectare of land would increase output by 0.277 percent. Some of the square and cross terms were also found to be significant justifying the use of the translog instead of the Cobb-Douglas production function.

From the productivity analysis, all the input variables were positively responsive to the total quantity of rice harvested (output) and were all statistically significant. The estimated elasticities for fertilizer and labour (family and hired labour) were found to be statistically significant at 10% with positive coefficients of 0.139 and 0.133 respectively. This implies that output would increase by about 0.14% and 0.13% when there is a 1% increase in the quantity of fertilizer and labour respectively. This positive coefficient of fertilizer is in consonance with the result of Ghee-Thean et al. (2012) in measuring the technical efficiency of paddy farming in Malaysia using the stochastic frontier approach. Seed was also found to be positive and highly significant at 1% with coefficients of 0.28. Of all the inputs, seed was found to have the largest elasticity of 0.28% and this that output would increase by 0.28% when there is a 1% increase in the quantity of seed used by farmers. Pesticide was also found to be positively significant at 1% with a coefficient of 0.203. This implies that a 1% change in pesticides application would lead to a 0.20 change in the total output. The return to scale is estimated by the summation of all the partial elasticities of the various inputs. From the results, the return to scale is calculated to be 0.75 approximately. This means an increase in all the input variables by 1% would cause a 0.75% increase in the total quantity of rice harvested. This demonstrates a decreasing return to scale. This implies that rice farmers are operating on a large scale. The estimated returns to scale is similar to that of Adepoju (2008) with a returns of scale of 0.77 and Bravo-Ureta and Pinheiro (1997) who had 0.78 as returns to scale for both the OLS and MLE estimates though various were not scaled by land size in their estimations. Also, Chiang et al. (2004) and Ogundari and Ojo (2007) also had an estimate of 0.90 and 0.84 respectively (values less than one) which also depict decreasing returns to scale. However, Onumah and Acquah (2011) and Akinbode et al. (2011) had 1.12 and 1.29 respectively implying increasing returns to scale. Ghee-Thean et al. (2012) on the other hand had a negative returns to scale with an estimate of -0.105.

**Table 3: Output Elasticity Estimates**

Variable	Elasticity
Fertilizer/hectare	0.139*
Pesticide /hectare	0.203***
Seed /hectare	0.277***
Labour/hectare	0.133*
<b>Returns to scale</b>	<b>0.752</b>

Source: Author's field survey, 2014. \*, \*\*, and\*\*\* means statistically significant at levels of 10%, 5% and 1% respectively.

### **Technical Inefficiency Estimates**

The institutional factors, farm and farmer specific factors incorporated into the technical inefficiency model could affect the observed output negatively or positively and this is determined by the signs of the coefficients of these variables. The variables have negative (positive) influence of reducing (increasing) technical inefficiencies.

**Table 4: Maximum Likelihood Estimates of the Stochastic Production Frontier Model**

Variables	Parameters	Coefficients	S.E	t-ratio
Constant	$\beta_0$	1.1569***	0.4000	2.9011
LnFertilizer/hectare	$\beta_1$	0.1389*	0.0820	1.6931
Dummy for fertilizer	$\beta_2$	-0.0772	0.4246	-0.182
LnPesticide/hectare	$\beta_3$	0.2034***	0.0883	2.3042
Dummy for Pesticides	$\beta_4$	-0.4468***	0.1150	-3.3886
LnSeed/hectare	$\beta_5$	0.2774***	0.0566	4.9027
Lnlabour/hectare	$\beta_6$	0.1333**	0.0680	1.9612
0.5(LnFertilizer) <sup>2</sup>	$\beta_7$	0.0550*	0.0316	1.7386
0.5(LnPesticide) <sup>2</sup>	$\beta_8$	0.0528	0.0744	0.7101
0.5(Lnseed) <sup>2</sup>	$\beta_9$	-0.1404***	0.0494	-2.841
0.5(Ln Labour) <sup>2</sup>	$\beta_{10}$	-0.0673	0.0899	-0.7481
LnFertilizer*LnPest	$\beta_{11}$	-0.0211	0.0173	-1.2177
LnFertilizer*Lnseed	$\beta_{12}$	-0.0103	0.0279	-0.3704
LnFertilizer*LnLabour	$\beta_{13}$	-0.0070	0.0246	-0.2849
LnPest*Lnseed	$\beta_{14}$	0.0078	0.0627	0.1238
LnPest*LnLabour	$\beta_{15}$	0.0210	0.0640	0.3285
Lnseed*LnLabour	$\beta_{16}$	0.0974*	0.0476	1.7649
Sigma squared	$\sigma^2$	0.4985***	0.0818	6.0911
Gamma	$\gamma$	0.6224***	0.1302	4.780
Log-likelihood		-249.4551		

Source: Author's field survey, 2014 \* , \*\*, and\*\*\* means statistically significant at levels of 10%, 5% and 1% respectively.

With regards to major occupation of farmers, it was found to have a significantly (at 10%) negative effect on technical inefficiency. This implies that farmers with rice farming as their major occupation are more technically efficient than those who farm as a part-time job. This could be to the reason that farmers who have rice farming as their major occupation pool a greater proportion if not all their resources (money and time allocation) to support good farming activities unlike their counterpart who divide resources among their various jobs.

This is to say that farmers with rice farming as their major occupation are almost all the time attentive and put in much effort to recoup their monies invested in their farms as they derive the greater proportion of their incomes from the sales of the farm produce unlike the part-time rice farmers who have alternative source of income. This result is in conjunction with Onumah et al. (2010).

Planting method variable was also positively significant at 10% level. Two planting methods that were considered in the study: transplanting and broadcasting. The positive coefficient means that rice farmers who employs the broadcasting method of planting reduces technical inefficiencies rather than transplanting method. This could be due to the reason that transplanting method is time consuming and needs more labour to perform that task as compared to the broadcasting method which can be done with ease within the shortest possible time and thereby increasing technical efficiency. The coefficient of years in rice farming (experience) variable is negative but not significant. This implies that, rice farmers who have more years in the farming are more technically efficient than those with less numbers of years. Farmers with years of rice farming tend to be more experienced and may tend to learn and correct past mistakes by easily adopting new advanced technologies to help them improve their yield. The less experienced farmers find it difficult adopt new technologies since they have not being in the farming

business for long and are not aware of the essence of doing that, they are therefore bound to repeating the same mistakes over some years before detecting them, making them more technically inefficient. However, this relationship is weak. This finding is similar to the findings of Ogunniyi (2011). Notwithstanding, Onumah et al. (2010) found a contrary result

**Table 5: Maximum Likelihood Estimates of the Technical Inefficiency Frontier Model**

Variables	Parameter	Coefficient	S.E	t-ratio
Constant	$Z_0$	-2.5059***	1.4198	-1.7649
Gender	$Z_1$	-0.4331**	0.2192	-1.9754
Major occupation	$Z_2$	-0.2892***	0.1757	-1.6466
Extension contact	$Z_3$	-0.3809	0.1766	-0.2157
Credit access	$Z_4$	0.0610	0.2009	0.3037
Membership of FBO	$Z_5$	0.2166	0.1787	1.2122
Seed variety	$Z_6$	-0.7469	0.1877	-0.3970
Planting method	$Z_7$	0.3566***	0.2175	1.640
Land preparation method	$Z_8$	0.6935	0.4319	1.605
Education	$Z_{14}$	-0.0593	0.0849	-0.7793
Farming years(experience)	$Z_{10}$	-0.0162	0.0132	-1.2191
Age	$Z_{11}$	0.0768***	0.0463	1.6588
Harvesting method	$Z_{12}$	-4.1306***	2.5067	-1.6478
Regional effect	$Z_{13}$	-1.5300*	0.4306	3.5534

Source: Author's field survey, 2014 \* , \*\*, and\*\*\* means statistically significant at levels of 10%, 5% and 1% respectively.

The result of the age variable is positively significant at 10%. This means that older rice farmers are less technically efficient than the younger ones who are open-minded and willing to implement new production systems. This finding is in consonant with the findings of Abdulai and Huffman (1998), Onumah et al. (2010) but however not consistent with Coelli and Battese (1996) who revealed that young farmers tend to be more conservative and reluctant to adopting new technology and are therefore less technically efficient. The signs of the coefficients of the age and age squared variables were positive and negative respectively related to technical inefficiency and this proves the non- monotonic nature of the age variable.

Harvesting method was also found to be negatively significant at 10%. This implies the use of mechanized method of harvesting such as combined harvesters increases technical efficiency whereas the use of human power (manually) reduces technical efficiency. This is because the combine harvesters are faster and accurate than the use of knives and sickles. The variety of seeds used by rice farmers also has a negative effect on technical inefficiency. The negative coefficient implies that the farmers who grow the improved (high-yielding) variety are more technically efficient than those who grow the traditional variety. The same result was gotten by Okoruwa et al., (2009). This means that technical efficiency would improve when rice farmers adopts the high- yield variety of rice seeds.

Regional effect was negatively significant at 1% significant level implying that characteristics and locational differences increases technical inefficiency. This is justified by the rejection of the hypothesis that there is no regional effect at 1% significance. This means that farmers in the Northern Region tend to be less technically efficient than those in the Ashanti Region due to the differences in weather, climate and farmer practices. This could be as a result of the favourable weather conditions to rice farming in the Ashanti Region and also the good farm practices adopted by rice farmers in that Region.

## CONCLUSIONS

This study concluded that the Translog production functions best fits data and in addition, the traditional average response function was not an adequate representation of data. The mean technical efficiency levels indicated the rice farmers in the study are neither operating on the production frontier. Thus there is room for improvement as far as farmers' efficiency levels by increasing output by 36% through the adoption of best farm practices to boost economic efficiency level of rice farmer.

The joint effects of factors influencing technical inefficiency (gender, major occupation, age of farmer, harvesting and planting method and regional effect of the rice farmers) were found to be responsible in explaining the deviations in production of rice from the maximum level in the Northern and Ashanti Regions of Ghana even though some individual variables were not. Rice farmers in the study area exhibit decreasing returns to scale. Also the study showed that regional and location differences do have effect on technical efficiency. This is confirmed by the hypothesis test that there no regional effect that was rejected.

## RECOMMENDATIONS

Following the conclusions drawn, the study recommends that rice farmer should be educated and trained by the Ministry of Food and Agriculture (MoFA) through the work of the extension agents to constantly educate them on the use of the recommended quantity of inputs as they are experiencing decreasing returns to scale. This implies that farmers are operating on a large scale and so it is recommended that farmers reduce the quantity of inputs (fertilizer, seed, pesticide and labour) used on the farm because output would increase less than a proportionate increase in all inputs.

The study also recommends that rice farmers in the Northern and Ashanti Regions should be encouraged by the Government through the Ministry of Food and Agriculture (MoFA) to constantly encourage them adhere to the best practices of rice farming activities and good management skills which would improve their technical efficiency levels. This would help to increase the total rice output.

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The economic and social cohesion of regions in Poland

JEL Classification Code: C21, C67, R15, R30, R38

**ABSTRACT**

The processes of economic and social cohesion in regions take place at different paces, and their intensity within the social and economic sphere is not homogenous. The aim of this study is to assess economic and social cohesion within regions in Poland in 2005 and 2012. The analysis of intraregional cohesion was based on NUTS 5 (gmina-level)<sup>4</sup> statistical units. In order to formulate a synthetic indicator of the economic and social cohesion of gminas, the measure of growth was used, as it allows for including in one synthetic indicator a large number of variables covered by analysis.

The analyses carried out allowed for dividing the entities under examination into five main groups based on the average value and the standard deviation from the average. The analysis of economic and social cohesion of gminas in regions shows that there are significant differences in spatial distribution, and that they involve different directions of change. On the scale of the country, only 40.2% of gminas have shown to be cohesive in both aspects under analysis. Other gminas are characterised by the lack of strict consistency between the two aspects of cohesion analysed.

The highest level of balance, both in 2005 and in 2012, was demonstrated by the Western regions of Poland, while in the eastern part of the country the level of balance was the lowest. Implementing the polarisation and diffusion model in Poland gives rise to the risk that the differences in economic and social cohesion of regions will deepen even more.

**Keywords:** economic and social cohesion, region, gmina, integrated development.

**INTRODUCTION**

The economic and social cohesion of regions in Poland and the measures taken to implement it have gained special significance after the EU accession. For years, the EU has been debating the issue of social and economic cohesion of regions, mostly due to the constantly growing disparities between the regions and within individual regions themselves. The territorial perspective on social and economic cohesion was already emphasised in Article 2 of the Rome Treaty<sup>5</sup>. Similar provisions were included in other acts of primary EU legislation. As one of the goals for the policies of the EU “economic and social cohesion” was introduced in the first Delors package in the 1980s<sup>6</sup>, and since then the cohesion policy has been programmed against a long-time horizon.

An important provision for the European cohesion policy was made in the Treaty of Lisbon, which supplemented economic and social cohesion with territorial cohesion<sup>7</sup>. It emphasised that territorial cohesion should be achieved on all levels: that of the EU, of the individual countries, regions, and locally, in accordance with the subsidiarity principle and the main goal of cohesion policy. The purpose of cohesion policy is not just to eliminate geographical differences, but to ensure such mechanisms that would facilitate qualitative changes in economic, social, infrastructural and any other terms. Thus, the success of cohesion policy depends on whether territorial development is based on endogenous potential and on support from the Community dimension

<sup>4</sup> Polish system of local self-government is organized in three layers with 16 regions (voivodship) that correspond to the EU NUTS II level, 379 powiaty (middle stage) and 2479 gminas as the lowest level of local authorities. Entities at each layer are organizationally and financially independent. Especially neither voivodships nor powiaty have any decisive, control or supervisory power over gminas. Within the system a particular emphasis is laid on gmina as the most important device of decentralisation and reorientation on local needs. Since 1972, when it replaced the smaller gromada, the gmina has been the basic unit of administrative division, at the bottom level of the local self-government in Poland – administratively and financially independent having own sources of income, own development strategies, elective authorities.

<sup>5</sup> Treaty establishing the European Economic Community, Rome, as published in “Collection of Documents” 1957, No. 5, p. 950.

<sup>6</sup> Report by the Commission to the Council and Parliament on the financing of the Community budget COM(87) 101 final, Brussels Commission of the European Communities, 28.02. 2087.

<sup>7</sup> Protocol No. 28 on economic, social and territorial cohesion, to the Treaty of Lisbon.

(support of pro-growth projects that are significant on the local scale and lead to the integration of territories).

The development of regions in the context of cohesion policy should be considered in terms of the implementation of its goals, i.e. achieving economic, social and territorial cohesion. Under this approach, cohesion policy is significant in implementing sustainable development, which strives to achieve appropriate relationships between economic and social development in a given area. The goal of both cohesion policy and of the development of regions may be achieved with the help of integrated measures and the use of EU structural funds. The basic challenge for the regions is thus to choose their own projects aimed at pro-growth (infrastructural) investments and to develop effective coordination instruments in order to ensure an integrated approach to development.

The article at hand discusses the phenomenon of cohesion in social and economic terms among regions in Poland in 2005 and 2012, with particular emphasis on intra-regional cohesion.

The main objective of this study is to assess the economic and social cohesion of gminas in Poland and to identify those local structures that constitute serious barriers to the economic and social development of regions. We claim that the social phenomena in gminas are a more serious barrier to regional cohesion than economic ones.

In order to specify the economic and social cohesion of gminas in individual regions, we used the measure of growth; in order to specify the relationship between economic cohesion and social cohesion, we used the correlation coefficient.

The analysis of statistical data concerns the years of 2005 and 2012. The data was supplied by the CSO Local Data Bank. It concerned 2479 gminas, including 306 urban, 602 urban-rural, and 1571 rural gminas in 16 regions (voivodeships).

#### **Research methodology applied to intraregional economic and social cohesion (in terms of gminas)**

Cohesion may be analysed in terms of countries (cross-national cohesion), as well as units of lower order (domestic cohesion). Domestic cohesion may refer to statistical units of various size, NUTS 2, NUTS 3, NUTS 4 and NUTS 5; most analyses concern regions (NUTS 2). This study looks at the local dimension of economic and social cohesion in the individual regions of Poland. The assumption was that well-elaborated growth indicators in the above-mentioned aspects are a prerequisite for shaping the cohesion of the region.

The following indicators were selected to describe the economic development of gminas:

y<sub>1</sub> - share of unemployed persons in working age,

y<sub>2</sub> - share of investment expenditures in the overall expenditures of gminas,

y<sub>3</sub> - the number of working persons per 1000 residents in working age,

y<sub>4</sub> - the number of economic entities per 1000 residents in working age,

y<sub>5</sub> - gminas' own revenue per 1 resident.

The above factors positively influence economic growth, with the exception of y<sub>1</sub>, which affects growth in a negative way.

Social cohesion was characterised based on the following indicators:

x<sub>1</sub> - share of unemployed persons in working age,

x<sub>2</sub> - the age dependency ratio (i.e. the relation of people in pre- and post-working age to the people in working age),

x<sub>3</sub> - the social dependency ratio (i.e. the relation of people in post-working age to the people in working age),

x<sub>4</sub> - population density,

x<sub>5</sub> - the share of women in overall population,

x<sub>6</sub> - 3 years' migration balance per 1000 residents,

x<sub>7</sub> - 3 years' natural population change per 1000 residents,

x<sub>8</sub> - the share of social welfare expenditures in the overall expenditures of gminas.

Owing to the fact that the analysis of both economic and social cohesion was based on many variables, a synthetic variable was necessary. This study uses Hellwig's measure of growth (Hellwig 1972). In line with that method, there is a point in an n-dimensional space for a specific phenomenon for every gmina in Poland.

$$P_i(x_{ij}) \quad (i = 1, 2, \dots, 2479; \quad j = 1, 2, \dots, n)$$

where:

i - entity (gmina);      j - variable (feature); n - number of variables for a given phenomenon

In order to specify the location of that point in the n-dimensional space, it was necessary to eliminate the denominations of the individual variables in the first place, i.e. to standardise the variables.

Next, the growth standard was established. The growth standard is an abstract point  $P_0$  with the following coordinates:

$$z_{01}, z_{02}, \dots, z_{0n}$$

where:

$$z_{0j} = \max(z_{ij}) - \text{for stimulants}$$

or

$$z_{0j} = \min(z_{ij}) - \text{for de-stimulants}$$

This means that the coordinates for the growth standard are the maximum values for standardised variables where they act as stimulants for development, or minimum values for the standardised variables that act as de-stimulants.

The next stage for calculating the synthetic variable was to calculate the distance ( $c_{i0}$ ) between the entities under analysis ( $P_i$ ), in this case – gminas, and the standard ( $P_0$ ). The distance is calculated using the formula:

$$c_{i0} = \sqrt{\sum_{j=1}^n (z_{ij} - z_{0j})^2}$$

When the distance between the individual entities and the standard is calculated, a synthetic variable ( $d_i$ ) is established for each entity in line with the formula:

$$d_i = 1 - \frac{c_{i0}}{c_0}$$

where:

$$c_0 = \bar{c} + 2s_0$$

with:

$\bar{c}$  – the arithmetic mean of the distances between the entities and the standard,

$s_0$  - standard deviation for the distance between the individual entities and the standard.

Established in this way, the synthetic variable, also referred to as the measure of growth, defines the location of the individual entities with regard to benchmark i.e the hypothetical gmina with the highest (for stimulants) or lowest (for de-stimulants) values for the characteristics included in the analysis. It must be noted that the synthetic variables calculated in this way in two aspects were presented in relation to the average for the gminas under analysis, assumed as 100 for the years 2005 and 2012. Furthermore, the higher the value for the synthetic variable, the better the situation of a given gmina in terms of the aspect under analysis.

The analyses conducted allowed for dividing the population of gminas into five groups with a different level of economic and social development, on the basis of the average value of the synthetic indicator and the standard deviation from the average:

very low level  $x_i < \bar{x} - 0,9\delta_x$

low level  $\bar{x} - 0,3\delta_x > x_i \geq \bar{x} - 0,9\delta_x$

medium level  $\bar{x} + 0,3\delta_x > x_i \geq \bar{x} - 0,3\delta_x$

high level  $\bar{x} + 0,9\delta_x > x_i \geq \bar{x} + 0,3\delta_x$

very high level  $x_i \geq \bar{x} + 0,9\delta_x$

$\bar{x}$  - average,  $\delta_x$  - standard deviations

### Analysis of the results

Assessment of economic and social cohesion at the local level in individual regions

When comparing the position of gminas in the particular regions in 2005 and 2012 in terms of the level of economic and social cohesion, one may note that on the scale of regions there are considerable differences in the level and in the change of the level of economic and social development, with the differences much greater for social than for economic development (Table 1). Thus no “catch-up effect” took place (Williamson 1965), which would include higher growth rates of poorer areas over the richer ones. According to Williamson, there is an optimum point of regional inequalities, initially oriented towards the development of the strongest centres – which contributes to their initial growth. It is only after a longer period of diffusion and polarisation that the development of those centres entails the development of the entire region, which attenuates the disparities.

This may be explained by the fact that in the years under consideration, the resources from cohesion policy were used by richer gminas in the region. Those were in a better financial situation and thus it was easier for them to accept one of the important principles of cohesion policy, i.e. the principle of additionality.

**Table 1. The levels of economic and social development in regions**

Voivodeship	Level of economic development			Level of social development		
	level in 2011	changes between 2005 and 2011	changes – variability coefficient	level in 2011	changes between 2005 and 2011	changes – variability coefficient
Dolnośląskie	115.3	103.1	123.5	127.0	103.7	20.4
Kujawsko-pomorskie	94.9	98.9	95.5	105.3	104.8	219.3
Lubelskie	79.2	96.0	125.5	65.0	75.2	347.6
Lubuskie	108.2	98.8	119.0	111.5	108.1	220.5
Łódzkie	102.4	96.4	86.9	87.4	88.1	267.0
Małopolskie	95.8	103.0	104.3	106.5	104.1	220.4
Mazowieckie	95.3	97.5	116.3	93.7	97.5	229.5
Opolskie	101.4	100.5	102.5	115.1	110.2	213.4
Podkarpackie	86.9	98.3	112.2	99.0	102.7	208.6
Podlaskie	88.5	99.8	112.0	42.6	55.9	524.4
Pomorskie	115.0	107.1	146.8	122.1	117.9	182.8
Śląskie	119.0	99.9	101.7	130.0	112.2	185.4
Świętokrzyskie	85.0	99.4	111.2	73.9	80.4	329.6
Warmińsko-mazurskie	93.2	99.6	113.6	97.0	103.4	226.5
Wielkopolskie	111.6	101.3	108.0	118.8	112.5	210.0
Zachodniopomorskie	115.7	103.8	111.3	109.5	109.8	209.5

Source: own calculations based on the CSO Local Data Bank.

The significant differences in the levels of economic and social cohesion among the individual regions are demonstrated by the coefficient of variation (Table 1). The current economic and social cohesion of regions in Poland is influenced by a higher level of development of urban gminas than rural and urban-rural entities. In individual regions, urban gminas have much higher economic and social development indicators and a lower level of developmental inequalities. This may be interpreted on the basis of selected theories of regional and local development, including the theory of growth poles and the attraction model. It seems that the region does not develop in economic and social terms to the same extent in its entire area – its development is correlated

mainly with the demographic and infrastructural potential (Kołodziejczyk 2014).

The next stage in the analysis was the comparison of the adopted classification of gminas in terms of the level of economic and social cohesion in regions, on the assumption that economic cohesion is an important factor in social development, which is manifested by the high value of the correlation coefficient between economic and social cohesion (Pearson correlation:  $r=0.62$ ).

Analysing the spatial differentiation of gminas in regions in terms of the level of economic and social cohesion, one may note that in 2012, a significantly higher level of both economic and social cohesion was manifested in western voivodeships in Poland.

Subsequently, the analysis concerned the issue of whether the economic development of gminas in the particular regions is equivalent to their social development; in other words, whether the level of development of a gmina in the aspects under consideration is consistent, whether a given gmina in the region is in the same developmental group. Analysing this phenomenon, one may note the significant differences in spatial distribution, marked by differing directions of change. In 2012, only approximately 40.2% of the gminas analysed showed consistency in the level of development in the two aspects under analysis (considering all development levels, from 1 to 5). Very high economic and social cohesion is manifested by 162 gminas, 60.4% of which are urban gminas; they constitute 32% of all urban gminas in Poland. The largest group (361) are gminas with low cohesion in both aspects under analysis. There were 294 rural gminas here (81.4% of the designated group of gminas and 18.7% of their overall number). The smallest group was that of gminas with a very low level of cohesion in both aspects – only 48 gminas. In the group with the medium level of cohesion there were 310 gminas; the most numerous were urban-rural gminas, 24.7% of their total number in Poland.

Other gminas are characterised by the lack of strict consistency between the two aspects of cohesion analysed. They are characterized by very high territorial cohesion and high or average economic cohesion, or vice versa. These are not very advantageous circumstances for shaping the process of the economic development of gminas, as limited cohesion in one aspect limits the possibilities to take advantage of the potential in another one.

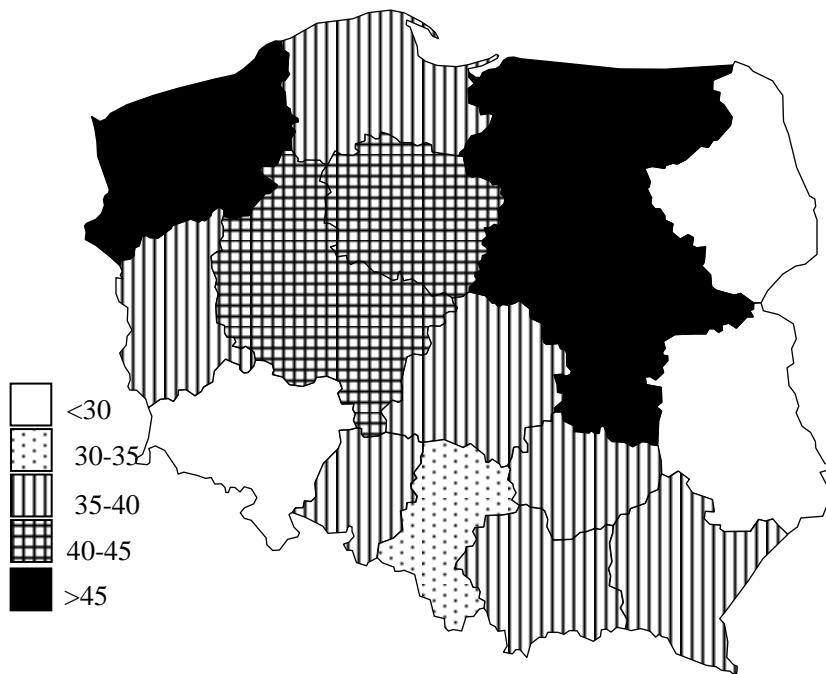
**Table 2. The economic and social cohesion of gminas in Poland, 2012**

	Economic cohesion						
	Cohesion scale	very low	Low	average	high	very high	total
Social cohesion	Very low	48	277	36	6	3	370
	Low	13	361	111	11	6	502
	Average	6	304	310	86	37	743
	High	2	88	186	116	92	484
	Very high		7	84	127	162	380
	Total	69	1037	727	346	300	2479

Source: Local Data Bank – own calculation

When evaluating the level of economic and social cohesion of gminas in the regions, we may state that the greatest balance both in 2005 and in 2012 was observed in regions (Zachodniopomorskie, Warmińsko-Mazurskie and Mazowieckie), while in the Dolnośląskie, Lubuskie and Podlaskie voivodeships it was the lowest. Within that period, the level of economic development in comparison to the average decreased in 10 regions, and the decrease varied in scale – 0.6% in the Warmińsko-Mazurskie voivodeship and 3.6% in the Łódzkie voivodeship. The situation was different in terms of the level of social cohesion, as the decrease occurred in 5 regions only, but it was greater. In the case of the Podlaskie voivodeship, it was about 40%. This followed from the smaller natural population change and a higher balance of migration. There are also increasing differences in the level of economic and social development in regions between different types of gminas, especially between rural gminas. The varied degree of change in the level of development of gminas may follow from a concentration of measures – mainly in the area of infrastructure – in some types of gminas (e.g. rural ones).

Figure 1. The share of gminas in the region with consistent levels of economic and social development (2012)



Source: Local Data Bank – own calculation

However, the analysis of the variability coefficient confirms that intraregional variability is lower for economic than for social cohesion. Nearly all regions show an increase in the inequalities in economic and social terms. For economic cohesion, the inequalities increased the most in the Pomorskie voivodeship (by 46.8%) and in the Lubelskie voivodeship (by 25.5%), while the highest decrease in inequalities was recorded in the Łódzkie voivodeship (by 13.1%). The highest increase in social inequalities was observed in the Podlaskie (by 424%) and Lubelskie voivodeship (by 247%).

## CONCLUSIONS

The above discussion leads to the following conclusions:

- There are marked differences in terms of the level of economic and social cohesion in the individual regions in Poland. Urban and urban-rural gminas have shown a higher level than rural gminas in both aspects under analysis.
- The increasing values of variability coefficients in both aspects of cohesion suggest that from the perspective of the features taken into consideration, between 2005 and 2012 the differences between gminas in regions became greater, which means a lesser degree of intra-regional cohesion.
- In 2012, only 40.2% of gminas under analysis manifested cohesion in both aspects under analysis, which mostly involved the western regions of Poland. In comparison to 2005, one may state that a larger shift to groups of gminas with the highest level of cohesion was observed in social cohesion. Thus, one may claim that the process of intraregional cohesion improvement is not homogenous.
- The results of mathematical and statistical analyses (the high correlation coefficient) confirm the adopted assumption that there is a significant dependence between the two aspects of cohesion.
- Implementing the polarisation and diffusion model in Poland gives rise to the risk that differences in terms of economic and social cohesion of regions will deepen even more.

Overall, one may claim that no catch-up effect may be observed, meaning that gminas with a lower level of development do not seem to be catching up on better-developed gminas, which may indicate that on a local scale, economic and social cohesion is achieved too slowly within a region. This is an especially disturbing symptom in a country that benefits from cohesion policy, as its funds are spent precisely on decreasing the differences between regions and within regions (between gminas).

The observation of those socio-economic phenomena in those years confirms that groups of gminas determined on the basis of the level of economic and social cohesion require a separate cohesion policy that would facilitate a better utilisation of the existing and potential local resources, in line with the strategic objectives of the region.

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## **YIELD AND PRICE RISK OF COMMONLY GROWN AGRICULTURAL PRODUCTS IN ADANA PROVINCE OF TURKEY**

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### **ABSTRACT**

In this paper, it is aimed to analyze the yield and price risk of commonly grown agricultural products in Adana province of Turkey by using “Variation Measurement” and “Random Variation Measurement” methods. In this study, the yield and price (the price in the hands of farmers) series are used covering 1994 - 2013 period for cotton seed, oilseed sunflower, soybeans, melons and watermelons. Research data was obtained from Turkey Statistical Institution and Food, Agriculture and Livestock Ministry the Provincial Directorate of Adana. To eliminate the effect of inflation on the price series are expressed in 2013 prices by using the PPI (1994 = 100). In order to attain the set objectives, coefficient of variation and random coefficient of variation are calculated and interpreted for seed cotton, oilseed sunflower, soybeans, melons and watermelons. In order to determine a suitable trend equation, Cumulative Sum of Forecast Error Method was used. Many functions type (linear, exponential, quadratic) tried and quadratic functions was judged to be appropriate for the studied product. According to the calculated coefficient of variation, yield risk is maximum for seed cotton (28.94%), at least for melon (10.17%), price risk is maximum for watermelon (26.63%), at least for soybean (13.37%) and gross income risk is maximum for sunflower (31.18%), the least for melon (20.97%) in Adana Province. All of the random variation coefficient was calculated lower than coefficient of variation. This case indicated that if farmers aware of technical and economic developments, they would taking rational decision and minimized yield and price risk. According to research results, the contracted production, futures markets, farmer organizations, collecting information about the input and output markets from a variety of sources and agricultural insurance as risk management tools could be advised to farmers.

**Keywords:** Yield and Price risk, Variation Measurements, Turkey

### **INTRODUCTION**

Agricultural activities are carried out largely under the influence of natural conditions (Ceyhan, 2003). Farmers don't estimate their yield and income due to fluctuations in the factors they can not control such as rains, temperature, disease, frost, wind, flood and so on. As a result of input-output price change, there are income fluctuation and important differences in agriculture year after year. As a result of this, farmers are forced to take risky decisions (Hoag, 2009). It will be useful that analysis of the risks faced by farmers and their weight and determining of farmers' attitudes toward risk. Therefore when planning in crop and livestock production, it is quite necessary that analysis of risks involved in agricultural production and understanding farmers' risk behaviors (Ceyhan, 2003).

In 2013, Soybean, oilseed sunflowers, cotton, melon and watermelon, 66.15%, 7.30%, 9.42%, 6.96% and 19.94% of total production of Turkey was grown in Adana, respectively. In this study, coefficient of variation and random coefficient of variation is calculated and interpreted for seed cotton, oilseed sunflower, soybeans, melons and watermelons.

### **MATERIALS AND METHODS**

Research data was obtained from Turkey Statistical Institution and Food, Agriculture and Livestock Ministry the Provincial Directorate of Adana. To eliminate the effect of inflation on the price of the series are expressed in 2013 prices by using the PPI (1994 = 100) (Anonim 2015). In order to attain the set objectives, coefficient of variation and random coefficient of variation are calculated and interpreted for seed cotton, sunflower, soybeans, melons and watermelons. In order to determine a suitable trend equation, Cumulative Sum of Forecast Error Method was used. Many functions type (linear, exponential, quadratic) tried and quadratic functions is judged to be appropriate for the studied product (Gündüz and Esengün, 2004; Çetin and Esengün, 2013; Kip, 1975).

## RESULTS AND DISCUSSION

In order to see yield fluctuation of some important agricultural products, Coefficient of Variation and Random Coefficient of Variation (RCV) calculated and presented in table 1. Coefficient of variation calculated %28.94 for seeded cotton, %27.20 for oilseed sunflower, %20.85 for soybean, %17.41 for watermelon and %10.17 for melons. Coefficient of variation for seeded cotton is higher than other products. It is implies that the possibility of fluctuations in seeded cotton production is higher than other products. All of random coefficient of variation calculated lower than coefficient of variations. It is implies that if farmers aware of economic and technical development, they could take retional measures against fluctuations.

**Table 1. Variation Measurement and Random Variation Measurement Related to Yield Series (1994 - 2013)**

Product	Standard Deviation ( $\sigma$ )	Standard Deviation of Regression ( $\sigma_y$ )	Period Average (kg / da) ( $\bar{Y}$ )	Coefficient of Variation (CV) %	Random Coefficient of Variation (RCV) %
Seeded Cotton	116.92	107.72	404.05	28.94	26.66
Oilseed Sunflower	53.87	47.03	198.05	27.20	23.75
Soybean	70.99	61.71	340.40	20.85	18.13
Watermelon	840.77	806.04	4.828.59	17.41	16.69
Melons	408.78	213.86	4.020.30	10.17	5.32
<b>Trend Equations</b>					
Seeded Cotton	$Y = 204.955 + 20.379 * t - 0.104 * t^2$				
Oilseed Sunflower	$Y = 114.864 + 7.872 * t + 0.04 * t^2$				
Soybean	$Y = 190.846 + 22.154 * t - 0.579 * t^2$				
Watermelon	$Y = 3725.709 + 49.835 * t + 4.039 * t^2$				
Melons	$Y = 3599.582 + 47.579 * t - 0.550 * t^2$				

In order to see price fluctuation of some important agricultural products, coefficient of Variation and Random Coefficient of Variation (RCV) calculated and presented in table 2. Coefficient of variation calculated %23.66 for seeded cotton, %23.26 for Oilseed sunflower, %13.37 for soybean, 26.63% for watermelon and 22.83% for melons. Coefficient of variation for seeded cotton is higher than other products. It is implies that the possibility of fluctuations in seeded cotton production is higher than other products. All of random coefficient of variation calculated lower than coefficient of variations. It is implies that if farmers aware of economic and technical development, they could take retional measures against fluctuations.

**Table 2. Variation Measurement and Random Variation Measurement Related to Price Series (1994 - 2013)**

Product	Standard Deviation ( $\sigma$ )	Standard Deviation of Regression ( $\sigma_y$ )	Period Average (kg / da) ( $\bar{Y}$ )	Coefficient of Variation (CV) %	Random Coefficient of Variation (RCV) %
Seeded Cotton	0.36	0.29	1.50	23.66	19.43
Oilseed Sunflower	0.32	0.16	1.37	23.26	11.78
Soybean	0.13	0.08	0.96	13.37	7.82
Watermelon	0.15	0.10	0.56	26.63	17.15
Melons	0.17	0.13	0.76	22.83	16.94
<b>Trend Equations</b>					
Seeded Cotton	$Y = 2.358 - 0.160 * t + 0.006 * t^2$				
Oilseed Sunflower	$Y = 0.897 + 0.117 * t - 0.006 * t^2$				
Soybean	$Y = 1.162 - 0.053 * t + 0.002 * t^2$				
Watermelon	$Y = 0.699 - 0.010 * t + 0.0001 * t^2$				
Melons	$Y = 0.938 - 0.007 * t + 0.0000001 * t^2$				

Gross income is a function of price and yield variables. Therefore it is more important fluctuations observed in gross income. In order to see gross income fluctuation of some important agricultural products, Coefficient of Variation and Random Coefficient of Variation (RCV) calculated and presented in table 1. Coefficient of variation calculated %24.77 for seeded cotton, %31.18 for Oilseed sunflower, %23.05 for soybean, %23.00 for watermelon and %20.97 for melons. Coefficient of variation for oilseed sunflower is higher than other products. It is implies that the possibility of fluctuations in oilseed sunflower production is higher than other products. All of random coefficient of variation calculated lower than coefficient of variations. It is implies that if farmers aware of economic and technical development, they could take retional measures against fluctuations.

**Table 3. Variation Measurement and Random Variation Measurement Related to Gross Income Series (1994 - 2013)**

Product	Standard Deviation ( $\sigma$ )	Standard Deviation of Regression ( $\sigma_y$ )	Period Average (kg / da) ( $\bar{Y}$ )	Coefficient of Variation (CV) %	Random Coefficient of Variation (RCV) %
<b>Seeded Cotton</b>	144.39	95.09	582.91	24.77	16.31
<b>Oilseed Sunflower</b>	83.24	45.44	266.96	31.18	17.02
<b>Soybean</b>	74.94	58.80	325.12	23.05	18.09
<b>Watermelon</b>	599.98	54.45	2.608.17	23.00	2.09
<b>Melons</b>	638.43	382.22	3.044.67	20.97	12.55
<b>Trend Equations</b>					
<b>Seeded Cotton</b>	$Y = 567.073 - 21.102 * t + 1.654 * t^2$				
<b>Oilseed Sunflower</b>	$Y = 136.870 + 23.441 * t - 0.809 * t^2$				
<b>Soybean</b>	$Y = 245.117 - 3.519 * t + 0.300 * t^2$				
<b>Watermelon</b>	$Y = 2.535.161 + 28.303 * t - 1.562 * t^2$				
<b>Melons</b>	$Y = 3.318.917 + 37.151 * t - 4.630 * t^2$				

## CONCLUSION

In this paper, it is aimed to analyze the yield and price risk of commonly grown agricultural products in Adana province of Turkey, by using “Variation Measurement” and “Random Variation Measurement” methods. in this study, the yield and price (the price in the hands of farmers) series are used covering 1994 - 2013 period for cotton seed, sunflower, soybeans, melons and watermelons. According to the calculated coefficient of variation, yield risk is maximum for seed cotton (28.94%), at least for melon (10.17%), price risk is maximum for watermelon (26.63%), at least for soybean (13.37%) and gross income risk is maximum for sunflower (31.18%), the least for melon (20.97%) in Adana Province. All of the random variation coefficient was calculated lower than coefficient of variation. This case indicated that if farmers aware of technical and economic developments, they would taking rational decision and minimized yield and price risk. According to research results, the contracted production, futures markets, farmer organizations, collecting information about the input and output markets from a variety of sources and agricultural insurance as risk management tools could be advised to farmers.

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## POLISH INTERNATIONAL TRADE OF HORTICULTURE PRODUCTS WITH TURKEY

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### ABSTRACT

Turkey is among the largest suppliers of fruit, vegetables and their products to Poland and EU. It is the fifth, after Spain, Italy, Germany, and the Netherlands, supplier of horticultural products to Poland. In the Polish import from Turkey, processed fruit and vegetables, citrus fruit and nuts dominate, and in the export – homogenized vegetables, dried mixed nuts, concentrated apple juice, and frozen vegetables.

The balance of international trade with horticultural products between Poland and Turkey is constantly negative. In 2012-2014 the value of the export of fruit, vegetables, their preparations, to the Turkish market was on average 3.2 million USD, and the value of import 166.4 million USD.

For Polish and EU importers, apart from the Customs Union between the EU-28 and Turkey (with regard to processed agricultural products), and the gradual liquidation of customs barriers in trading fresh fruit and vegetables, what also matters are the high diversity of Turkish products, the ban on GMO cultivations, and also the domestic system of monitoring food safety operating in Turkey.

The study presents changes in the export and import of fruit, vegetables and their preparations, between Poland and Turkey in 2006-2014 in comparison to deliveries from other countries, with particular focus on the 2006-2008 and 2012-2014 trienniums.

**Keywords:** international trade, Turkey, Poland, fruit, vegetables

### INTRODUCTION

Turkey is the main trade partner of Poland, from the region of the Middle East and Asia. It is among the largest suppliers of fruit, vegetables and preparations to Poland. From the accession of Poland to the EU in May 2004, Poland is bound by contracts concluded between the European Union and Turkey, including the Customs Union contract signed in 1996. The free trade contract covers industrial products and processed agricultural products (agricultural raw materials are covered by additional agreements).

### MATERIALS AND METHODS

The analysis was based on data from the bases of the Polish Ministry of Finance (MF) and the United Nations (UN Comtrade), and also the Turkish Statistical Institute (Turkstat). An important source were the web portals agra-net.com, fresh-market.pl, as well as the information included on the webpages of the Ministry of Economy and the Department of Promotion of Trade and Investments of the Republic of Poland Embassy in Ankara.

A descriptive method, comparative analyses, economic indicators were used in the study.

### PRODUCTION

Turkey is among the largest fruit and vegetable producers. In 2012-2014, vegetable harvest in Turkey was on average 28.3 million tons, and fresh fruit 17.8 million tons. Vegetable production in the EU-28 was 61.6 million tons then, and fruit 37.4 million tons. The total production of fruit and vegetables in Turkey was nearly 5-times higher than in Poland.

**Table 1. The production of fruit and vegetables in the EU-28, Poland and Turkey**

Specification	Fresh fruit			fresh vegetables		
	2012	2013	2014*	2012	2013	2014*
EU-28	36.5	37.8	38.0	36.5	37.8	38.0
including: Poland	3.8	4.1	4.2	3.8	4.1	4.2
Turkey	18.0	18.2	17.1	18.0	18.2	17.1

\*non-final data

Source: IERiGŻ-PIB, turkstat.gov.tr

Owing to different soil and climate conditions, the structure of horticultural cultivations in Poland and Turkey is

very diverse. In Poland, there is high production of apples, strawberries, raspberries, currants, and cherries, and among vegetables: cabbage, tomatoes, cucumbers, carrots, and onions. Turkey is the world leader in the production of apricots, cherries, hazelnuts and figs. It is also a large producer of watermelons, melons, grapes, strawberries, apples, citrus fruit (oranges, lemons, grapefruits), plums, olives, tomatoes, cucumbers, eggplants, and onions.

The structure of particular cultivations and distribution of harvest are also different. That is particularly visible for apples. Poland and Turkey are in the world forefront of apple producers (along with China, USA and India). The greatest share in the Turkish apple production belongs to the Red Delicious (47%) and Golden Delicious (29%) varieties, and also the local Amasaya variety (9%). Granny Smith, Gala and Jonagold are of smaller importance. In Poland the most popular are Idared (21%), Champion (14%) and Golden Delicious (10%), and also Gala, Gloster, and Jonagored. The ecological apple cultivation in Turkey applies to ca 5% of production, while in Poland it does not exceed 1% (Fruit Juice Supply Chain....2013).

In 2012-2014 in Turkey, 3-4% of the apple production went for export, ca 15% for processing and over 80% for direct consumption. In Poland the export applied to over 1/3 of the production, nearly 50% went for processing and ca 20% for consumption inside the country (in recent years the average apple consumption per 1 inhabitant in Turkey reached almost 30 kg annually, and in Poland it was definitely lower and ranged between 13-15 kg).

**Table 2. The area, production and export of apples in Poland and Turkey**

Specification	2006	2007	2008	2009	2010	2011	2012	2013	2014*
<b>Turkey</b>									
The area (thousand ha)	163	158	158	163	165	167	175	-	-
The production (million tons)	2002	2458	2504	2782	2600	2680	2889	3129	2480
The export (thousand tons)	25	10	20	60	81	87	69	125	112
The share of export in the production (%)	1	0	1	2	3	3	2	4	5
<b>Poland</b>									
The area (thousand ha)	162	176	172	174	170	184	195	193	176
Production	2305	1040	2831	2626	1878	2493	2877	3085	3195
Export	398	450	407	777	725	534	958	1230	1062
The share of export in the production (%)	17	43	14	30	39	21	33	40	33

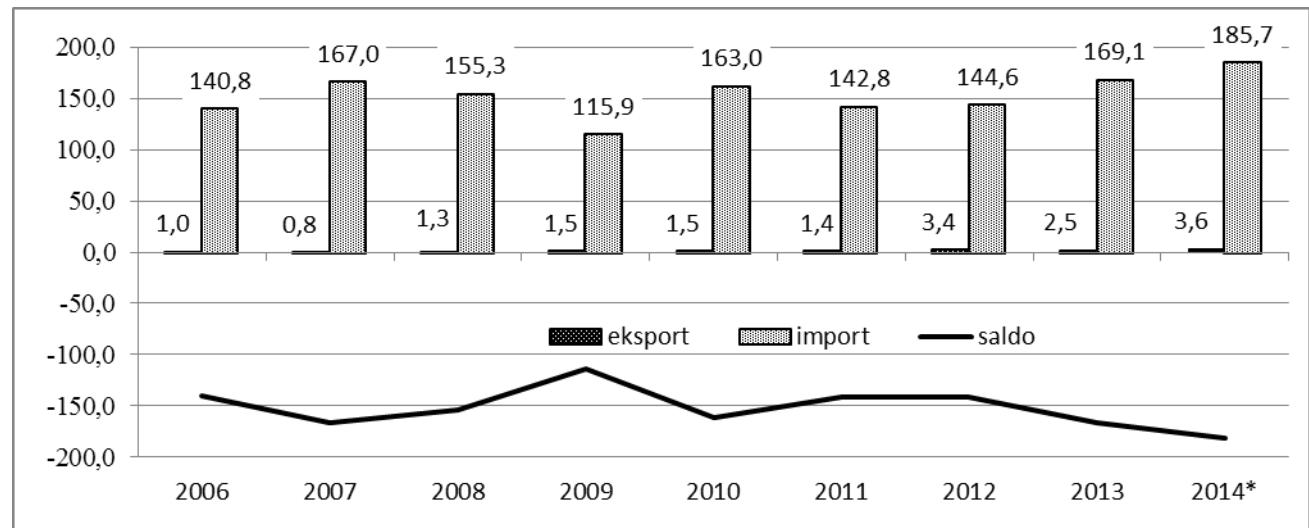
\*non-final data

Source: Central Statistical Office (GUS). Turkish Statistical Institute,

#### INTERNATIONAL TRADE

The balance of international trade with horticultural products between Poland and Turkey is constantly negative. In 2012-2014 the value of the Polish export of fruit, vegetables, their preparations, to Turkey was on average 3.2 million USD, as compared to 1.1 million USD in 2006-2008, and the value of import accordingly: 166.4 million USD and 154.4 million USD. The average annual dynamics of the growth in the export value in 2006-2014 reached 17%, and import 3.5%.

**Figure 1. Polish foreign trade with horticulture products with Turkey (million USD)**



\*2014 non-final data

Source: Ministry of Finance

In the export of horticultural products to Turkey, processed products dominated, whose share increased from 91 to 96%. In 2012-2014 the greatest share in the export belonged to homogenized vegetables (33% of the sales value), dried mixed nuts (18%), concentrated apple juice (10%), and frozen vegetables (8%).

**Table 3. Polish export of horticultural products to Turkey**

Specification	000 tons			million USD		
	2006-08	2009-11	2012-14*	2006-08	2009-11	2012-14*
Fresh fruit	0.0	0.0	0.2	0.1	0.1	0.1
Processed fruit	0.3	0.5	0.5	0.6	1.1	1.3
Processed vegetables	0.1	0.3	0.9	0.	0.3	1.8
Total	0.4	0.8	1.8	1.1	1.5	3.2

\*2014 non-final data

Source: Ministry of Finance

The chances for growth in the export of Polish horticultural products to the Turkish market, especially fresh products, are not too large. Although within the structure of food consumption in Turkey fruit and vegetables dominate (with the share of ca 23%), but they are mostly domestic products. In addition, Turkey is regarded as a self-sufficient country in terms of agricultural-food products.

However, in the years to come, changes of consumer patterns may occur. Over 66% of Turkish people are below 40, more open to European influences. According to UN forecasts (World Population ... 2013) the number of people in the country will systematically increase and in 2040 it will reach almost 92 million.

The share of Turkey in the total value of horticultural products imported to Poland dropped from 7% in 2006-2008 to 6% in 2012-2014. In the import from Turkey, processed fruit dominate. Their share in the total value of the import of horticultural products increased from 45 to 68%. Fresh vegetables became more important (from 4 to 6%) while fresh fruit became less (from 49 to 24%). At the decrease in the volume and growth in the value, the share of vegetable preparations did not change (2%).

The most important in the Polish import from Turkey were canned mixed nuts, whose import increased from 6.7 thousand tons in 2006-2008 to 10.3 thousand tons in 2012-2014, and their value was 64% higher and amounted to 88.6 million USD. It was, respectively, 35 and 53% of the value of the import of Turkish horticultural products. Turkey has been the largest supplier of mixed nuts to Poland for years. However, the country share in the total value of the import of the preparations dropped from 80 to 71% (while deliveries of mixed nuts from Germany, the Netherlands, Spain and GB increased).

**Table 4. Polish import of horticultural products from Turkey**

Specification	000 tons			million USD		
	2006-08	2009-11	2012-14*	2006-08	2009-11	2012-14*
<b>Fresh fruit</b>	<b>39.9</b>	<b>40.0</b>	<b>39.8</b>	<b>76.0</b>	<b>38.8</b>	<b>40.6</b>
grapefruits	12.6	12.1	15.4	9.4	9.6	11.4
lemons	10.5	18.7	12.2	11.7	16.8	12.9
hazelnuts	5.7	0.4	0.4	43.8	2.5	3.2
grapes	3.4	2.9	3.4	3.5	3.0	3.7
watermelons	3.9	1.3	3.0	1.7	0.8	1.7
<b>Fresh vegetables</b>	<b>4.8</b>	<b>10.9</b>	<b>8.5</b>	<b>5.4</b>	<b>12.5</b>	<b>9.2</b>
tomatoes	2.9	7.2	5.1	3.9	9.6	6.6
onion	1.3	2.4	2.5	0.8	1.6	1.5
cucumbers	0.5	0.9	0.8	0.5	1.0	0.9
<b>Processed fruit</b>	<b>14.5</b>	<b>22.7</b>	<b>19.6</b>	<b>70.0</b>	<b>86.3</b>	<b>113.4</b>
canned fruit	6.7	7.2	10.4	54.3	55.4	89.0
- mixed nuts	6.4	7.1	10.3	54.0	55.3	88.6
dried fruit	5.1	4.8	5.5	10.1	12.3	14.6
- dried grapes	2.7	2.9	3.2	4.1	5.2	6.6
- dried apricots	2.4	1.9	2.3	5.9	7.0	7.7
fruit juices	2.2	10.1	3.0	3.9	16.7	7.3
- concentrated apple juice	2.2	9.3	2.4	3.8	14.2	4.1
frozen fruit	0.3	0.4	0.4	0.5	0.8	0.9
<b>Processed vegetables</b>	<b>3.1</b>	<b>2.7</b>	<b>1.7</b>	<b>3.0</b>	<b>3.0</b>	<b>3.3</b>
dried vegetables	0.0	0.1	0.5	0.1	0.5	1.9
frozen vegetables	0.7	0.2	0.2	0.9	0.3	0.2
<b>TOTAL</b>	<b>62.3</b>	<b>76.3</b>	<b>69.5</b>	<b>154.4</b>	<b>140.6</b>	<b>166.4</b>

\*2014 non-final data

Source: Ministry of Finance

The value of import of dried fruit from Turkey increased by 45% to 14.6 million USD. Poland imported mainly dried apricots (increase in the share from 4 to 5% of the total value of the horticultural product import) and dried grapes (increase from 3 to 4%). Turkey is the second in the world, after the USA, producer of raisins and their largest exporter (in the 2014/2015 season, the production of raisins in Turkey was 310 thousand tons, and export 235 thousand tons). In deliveries to Poland, Turkey comes second after Iran (the share of Turkey increased from 16% of the import volume in 2006-2008 to 22% in 2012-2014, while of Iran decreased from 43 to 27%).

The share of fruit juices in the value of the import of horticultural products from Turkey increased from 3 to 4% (the highest, at the level of 17% was in 2010, as a result of an high import of apple juice after low harvest of apples in Poland).

The import of vegetable preparations dropped from 3.1 to 1.7 thousand tons and the value of their import, as a result of the price increase, grew from 3.0 to 3.3 million USD. Poland imported dried vegetables from Turkey (mainly tomatoes) and frozen vegetables (frozen paprika and tomatoes).

The average import of fresh fruit in all examined periods was ca 40 thousand tons, and the value of the import decreased from 76 million USD in 2006-2008 to 40.6 million USD in 2012-2014. Such a large decrease resulted from the drop in the share of hazelnuts in the fresh fruit import (from 58 to 8%). The share of apricots and

strawberries was also lower. While the importance of grapefruits, lemons, grapes, watermelons, tangerines, and oranges grew. In 2012-2014 Turkey was the largest supplier of grapefruits to the Polish market and the third (after Spain and Argentina) supplier of lemons.

The import of fresh vegetables increased from 4.8 to 8.5 thousand tons and the import value increased by 70% to 9.2 million USD. In the import of vegetables, the most important are tomatoes, onions and cucumbers. In 2012-2014 Turkey (with the share of 4% in the total import volume) was the fourth supplier of tomatoes to Poland (after Spain, Morocco, the Netherlands and Germany) and the fifth supplier of cucumbers (after Spain, Germany, the Netherlands, Romania, and Hungary). Turkish tomatoes come to Poland mainly from December to March, and cucumbers, from November to February.

In the years to come, further growth in the import from Turkey, of fresh fruit and vegetables and their products, is expected. That will be fostered by gradual removal of custom barriers (in May 2015 decisions were taken on suspending the concession for importing watermelons and tomato products from Turkey to the EU).

For importers from Poland and other EU countries, the proximity of the market with a broad assortment of fresh fruit and vegetables, the quality of products, introducing by Turkey a ban on GMO crops, as well as food safety monitoring supervised by Turkish phytosanitary services are important.

## CONCLUSIONS

The perspective of the accession of Turkey to the EU, the expected increase in the number of inhabitants and the removal of customs restrictions give the chances for the increase in commercial turnover of horticultural products between Poland and Turkey.

Due to the food self-sufficiency, fixed consumer patterns and strong accustomization to domestic products, there are small chances to increase the export of fresh fruit and vegetables to Turkey. The chances to increase the export of processed fruit and vegetables are bigger.

The import of both fresh fruit and vegetables, and also fruit and vegetable products from Turkey may be expected to grow significantly in the years to come.

As a large producer and exporter of horticultural products, Turkey is a serious competitor of Poland on the international market (especially as an exporter of strawberries, cherries, concentrated apple juice, and frozen food).

The import of fruit, vegetables and preparations from Turkey is not a threat to the Polish horticultural sector. It applies mainly to products from other climate zones or is a supplement to the offer in the periods of shortages of domestic goods on the market.

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## ECOLOGICAL AGRICULTURE IN POLAND

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### ABSTRACT

The development of ecological agriculture, and more broadly, sustainable agriculture, is one of the priorities adopted for implementation by the European Union in the perspective to 2020. Due to lower productivity of land than in conventional farms, ecological cultivations must be and are supported with subsidies from the EU funds. In Poland, after joining the EU, growth in the number of ecological farms and areas of ecological cultivations is noticed. The article presents the scale and pace of the development in Poland in the period after the accession, as compared to the development of ecological agriculture in other EU countries. The ways of controlling the development of ecological agriculture and its financing were specified, as well as the main problems hindering the development. The analysis was prepared mainly on the basis of the data from the Yearbooks of the Central Statistical Office in Poland and the Reports on the condition of ecological agriculture in Poland prepared by the Inspection of the Commercial Quality of the Agricultural-Food Articles (IJHARS). This is an institution conducting in Poland the inspection of the development of ecological agriculture. The literature concerning the development of ecological agriculture in Poland was also used. Vertical and horizontal methods of comparisons and expert evaluations were used.

The analysis shows that the share of ecological cultivation areas in the overall area of arable lands (ca 4%) in Poland is still smaller than the average in the EU, and the main problems in the development of ecological agriculture are: lower, despite subsidies, income of ecological farms than farms with cultivations thru conventional methods, too few ecological processing plants (which determines the poor offer of organic food products), excessive bureaucracy with regard to inspections of ecological farms, a small degree of self-organization of ecological producers and still low ecological awareness of Polish consumers. The system of supervision and control over the development of ecological farms in Poland is positively assessed by the European Commission.

**Keywords:** ecological agriculture, development, control, support, problems

### INTRODUCTION

The development of industrial agriculture, resulting in the multiplication of crops and productivity of farm animals, resulted in, at the same time, intensification of negative phenomena in the form of: degradation of soil, reduction of water resources, deterioration of biodiversity or excessive energy consumption (Prandek, Floriańczyk 2014). Therefore, in many countries of the world (mostly in economically developed), activities are taken towards stopping the degradation of natural environment, which is to make the rural areas into attractive and appreciated places of life for more and more families (Kowalski, Grochowska, Nosecka ed. 2014) and, at the same time, be the guarantee of sustainable development of agriculture. The actions stimulating the pro-environmental methods of production foster balancing the operations of farms in the ecological sphere, and also to a large extent, in the economic sphere, since the growth of environmental qualities may be an additional stream of income flowing to rural areas. The problem in the development of ecological agriculture are, of course, prices of agricultural and food products relatively high in relation to the produced in the system of industrial agriculture. The segment of the market of ecological products, of high nutritional and health qualities, will however still grow along with the growth in the ecological-health awareness of consumers. Thus presently, it is impossible to speak of the growth in pressure on the qualitative dimension of food production in relation to the quantitative dimension (Wilkin 2009). The qualitative dimension includes the manner of production of foodstuffs (using technologies friendly to the natural environment, supporting the natural productivity of land and limiting the use of mineral fertilizers, plant pesticides and stimulants in animal production).

In the EU countries, ecological balancing of economy, including the agricultural-food sector, was clearly determined in the Lisbon Strategy (EC, 2010b) and the present Strategy "Europe 2020" foreseeing smart and sustainable development fostering social incorporation (EC, 2010a). In the ecological aspect, the Strategy

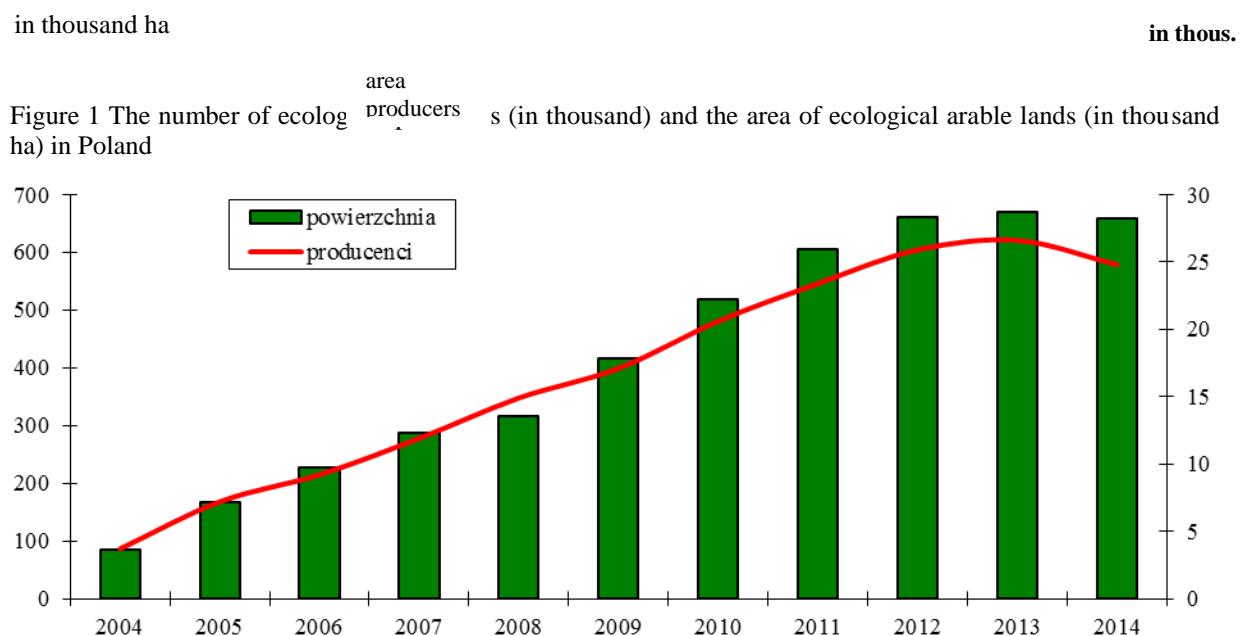
emphasizes the importance of protection of the resources of soil and waters by conducting reasonable management of fertilizers and plant pesticides, protection of soil against erosion, acidification, reduction in the content of organic matter and contamination with heavy metals. The development requires intensifying the scientific-research studies concerning agriculture, including biotechnology, and increasing the scope of their implementation to agricultural and processing entities, at the growth in financial support for such activities. In Poland, the support for the development of ecological production is co-financed from the EU structural funds and is executed from funds allocated for the implementation of the Rural Development Program.

## MATERIAL AND RESEARCH METHODS

In the study, statistical data was used, from the Yearbooks of the Central Statistical Office of Poland (GUS), EU Messages and Information concerning the development of ecological production in the Community and the Reports on the condition of ecological agriculture in Poland prepared by the Inspection of the Commercial Quality of the Agricultural-Food Articles (IJHARS). This is the institution conducting in Poland the inspection and supervision over the development of ecological agriculture. The results of the tests conducted in IERiGŻ-PIB in Warsaw of the productivity and profitability of ecological farms in Poland were also used. In the analysis, vertical and horizontal methods of comparisons and expert evaluations were used.

## THE DEVELOPMENT OF ECOLOGICAL AGRICULTURE IN POLAND

Introducing EU subsidies and coming into force of EU regulations concerning ecological agriculture resulted in the dynamic growth, from 2004 (the first year of Poland in the EU), in the number of ecological farms in Poland, as well as the ecological cultivation areas. In 2014 the number of ecological farms (after the completed period of conversion and during the conversion) and the area of arable land of the farms was 25.4 thousand and ca 658 thousand ha respectively. As compared to 2004, it was over seven times more (fig. 1).

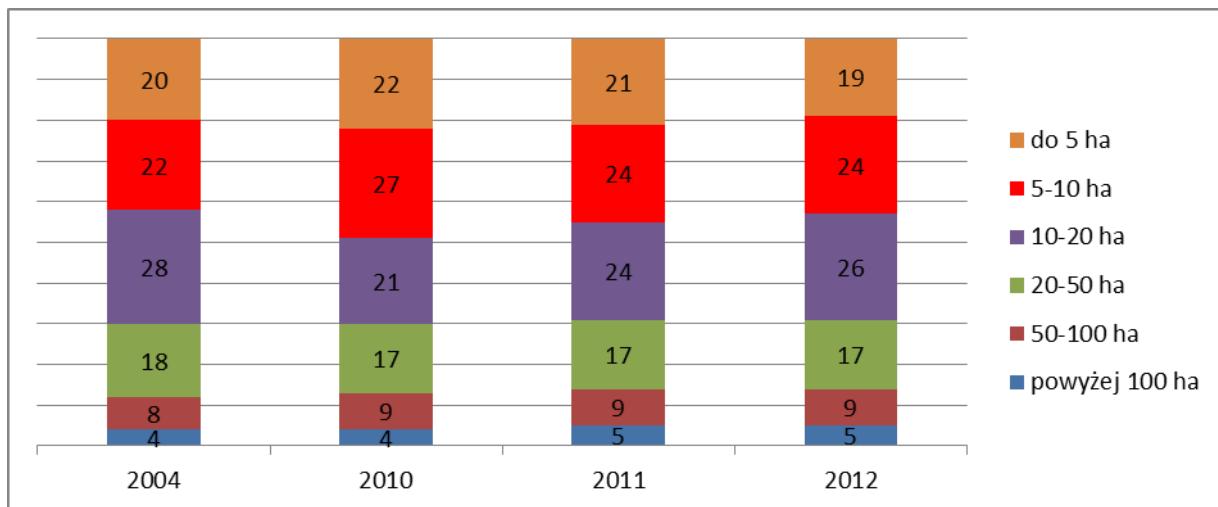


Source: IJHRS reports on the condition of ecological agriculture in Poland

The average annual growth rate in the number of ecological producers in 2004-2014 was 14.1%, and of ecological cultivation areas 15.2%. Ecological producers in Poland deal mainly with plant production. In 2012 (the last available data) 76.5% of the total number of ecological farms had plant production only; 23.5% of farms had both, plant and animal production. The largest area of ecological arable lands are meadows and pastures (35.3% of the ecological area in 2012). The second place belonged to plant cultivations for feed (33.7%). Areas under corn took up 18.6% of ecological arable lands, and orchards and berry plantations took up 8.9%. Other crops (vegetables, leguminous plants, industrial plants, potatoes, and other crops) made 3.5%.

In Poland, mainly farms smaller in terms of area deal with ecological production. In 2006 the share of ecological farms with the area up to 10 ha in the overall number of ecological farms was 32%, in 2010 - 49%, and in 2012 ca 43%. The share of ecological farms of the area of 50-100 ha in all years after the accession did not exceed 10%, and of the area over 100 ha – 5% (fig. 2).

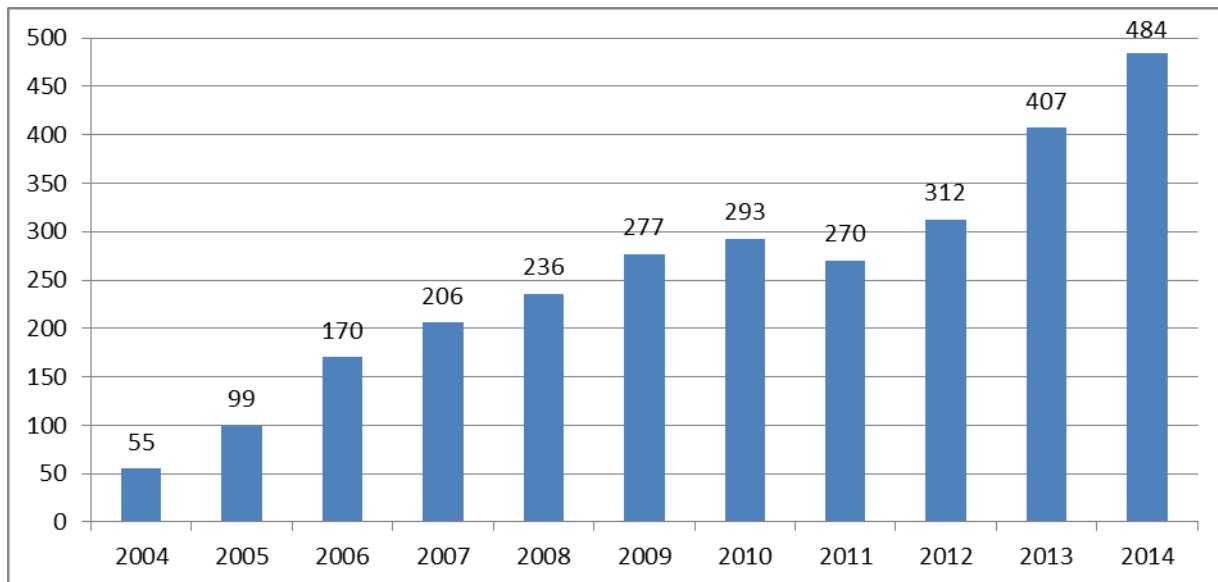
Figure 2 The structure of ecological farms in Poland according to size in %



Source: IJHARS reports on the condition of ecological agriculture in Poland and the Statistical Yearbooks GUS

In Poland the number of units processing ecological products dynamically increases. In 2004 the number of such companies was 55, and in 2014 as much as 484 (fig. 3). The majority of ecological processing plants deal with processing fruit and vegetables (32% of the total number in 2012). 24% dealt with grain mill products and 7% with processing meat.

Figure 3 The number of ecological processing plants in Poland



Source: IJHARS reports

In recent years the growth in the number of ecological processing plants is greater than in the first years of Poland in the EU. However, the rate of growth of the area and the number of ecological crop producers are smaller recently. In 2014 the number of producers and the ecological crop area dropped even in relation to the previous year (tab. 1). It was caused by taking back the certificates of ecological agriculture from producers not complying with the requirements of such agriculture.

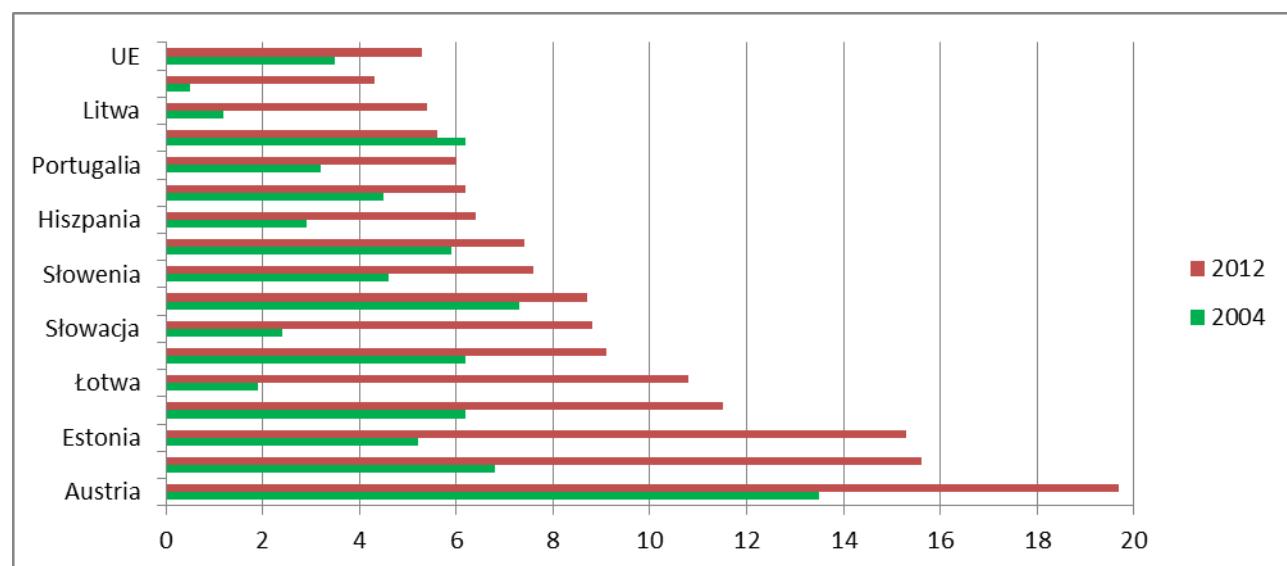
**Table 1 The area of ecological crops and the number of ecological producers and processing plants in Poland**

Years	The area of ecological crops in thousand ha	The number of ecological producers in thousand	The area as compared to the previous year in %	The number of producers as compared to the previous year in %	The number of processing plants	The number of processing plants as compared to the previous year in %
2004	83.7	3.7	-	-	55	-
2005	166.3	7.2	82.6	3.5	99	44
2006	228.1	9.2	61.8	2.0	170	71
2007	287.5	11.9	59.4	2.7	206	36
2008	314.9	14.9	27.4	3.0	236	30
2009	416.2	17.1	101.3	2.2	277	41
2010	519.1	20.6	102.9	3.5	293	16
2011	605.5	23.4	86.4	2.8	270	-23
2012	661.7	25.9	56.2	2.5	312	42
2013	670.0	26.6	8.3	0.7	407	95
2014	657.9	24.8	-12.1	-1.8	484	77

Source: Statistical Yearbooks GUS and IJHARS reports

Among EU countries the number of ecological farms larger than in Poland in 2012 was only in Spain and Italy (25.9, 30.5 and 43.9 thousand farms respectively). While the area of ecological crops larger than in Poland was in Spain, Italy, Germany, and France. The share of the ecological cultivation area in the overall arable land area is still relatively low (4.3%) in Poland. In 2012 the ratio was lower only in France, Ireland, the Netherlands, Hungary, Great Britain, and Romania (fig. 4).

**Figure 4 The share of ecological farm area in the total area of arable lands in selected EU countries in 2004 and 2012.**



Source: Statistical Yearbooks GUS

At the same time, growth in the share of ecological area in the overall area of UR (3.8 percentage points) was relatively high in Poland in 2012 as compared to 2004. The ratio increased more in Austria, Sweden, and among the new EU member states – in Estonia, Lithuania, Latvia, the Czech Republic, and Slovakia. In Poland, apart from Bulgaria and Romania, the average area of ecological farms is the smallest.

As in Poland, in most EU countries, the biggest share in the ecological crop area belongs to meadows and pastures, plants meant for feeds and orchards. That is because ecological farms function mainly in the regions with the extensive system of breeding farm animals (mainly cattle and sheep). The importance of ecological crops is small in areas and countries with the dominance of intensive methods of production. Among EU countries, it applies mainly

to the Netherlands.

Almost in all EU-15 countries, the number of ecological processing plants is definitely larger than in Poland. While in all new member states of the Community, the number of such processing plants is smaller than in Poland. In Poland the share of food produced by ecological methods in the total turnover of the food market is 0.1% and it is one of the lowest ratios in the EU (in Denmark and Austria the share is 5-7%) (Nowogórzka 2012).

#### **The system of control and supervision over the development of ecological agriculture in Poland**

In Poland, as in the most EU countries, a control system based on private certifying units, recognized and supervised by designated state authorities, was adopted. Supervision over verifying units and over ecological production is done in Poland by the Inspection of the Commercial Quality of the Agricultural-Food Articles (IJHARS). The Inspection cooperates with:

- Commercial Inspection – with regard to introducing to the retail market, agricultural and food products,
- Veterinary Inspection – with regard to fodder,
- The State Inspection for Plant Protection and Seed Production – with regard to vegetative multiplying material and seeds for the purposes of cultivation,
- Polish Accreditation Center – the authority accrediting certifying units.

The condition for a certifying unit to start operations with regard to inspecting ecological agriculture is to have authorization of the Ministry of Agriculture and Rural Development to perform inspection, and issue and revoke certificates in ecological agriculture. IJHARS, among others, authorizes producers to import the products of ecological agriculture from third states not mentioned on the list of the European Commission, examines the requests for permission for using the provided for in the law deviations from the rules of ecological production, carries out examinations for ecological agriculture inspectors, and also audits and inspections of certifying units. Certifying bodies (10 entities) perform inspections at ecological producers thru the mediation of people entered in the register of ecological agriculture inspectors kept by the IJHARS Main Inspector. At the end of 2012 there were over 500 ecological agriculture inspectors in the register.

In Poland, there is a relatively high number of permits for using deviations from the rules of ecological production. It applies mainly to keeping cattle tethered. However, the number of applications for deviations submitted by ecological producers systematically decreases, which proves of the growing degree of adjustment of ecological farms to the requirements of ecological production. The consent for deviations is granted by provincial IJHARS inspectors, after getting familiar with a certifying unit opinion.

The import of ecological products may be done by ecological producers controlled by the certifying units in regard to the import of such products from the states outside the Community. In 2012 the most permits concerned the import of ecological products from: Sri Lanka (import of 13.8 thousand tons), Belarus (17 thousand tons) and Chile (33.7 thousand tons). From Turkey, 200 tons of frozen strawberries were brought (tab. 2).

**Table 2 The import of ecological products to Poland in tons**

Countries	2011	2012
Ukraine	6880	3900
China	310	4800
Peru	135	50
USA	300	-
Brazil	16	-
Chile	200	33700
Belarus	12000	17000
Turkey	200	200
Sri Lanka	3500	13800
Serbia	400	600
Indonesia	-	20

Source: A IJHARS report

The expanded system of supervision over the development of ecological production enables effective control of the proper (consistent with the EU requirements) running of ecological farms in Poland. It is confirmed by the results of audits performed by the European Commission. However, at the same time, as the survey tests conducted in 2011

in a group of 200 ecological farms show, the expanded control system, a great deal of legal regulations and a complicated language of documents, are seen by the producers as hindrances for ecological cultivations (Nowogródzka and Szarek 2012).

### The support system for ecological production

In Poland, the development of ecological agriculture is supported from the funds of the Rural Development Program financed from the European Agricultural Fund for Rural Development and co-financed from the state budget. Ecological producers get financial support under several operations, i.e. Participation of farmers in a food quality system, the Agri-environmental Program or the "Ecological Agriculture" Package. The "Ecological Agriculture" Package includes 12 possible variants for implementation, i.e. agricultural cultivations, permanent grasslands, vegetable cultivations, herb cultivations, orchards and berry cultivations, and other orchards and berry cultivations (in breakdown into farms with compliance certificates and being in the period of switching).

Payments under the "Ecological Agriculture" package are implemented per 1 ha and vary from 428 PLN/ha (ca 100 EUR) for farms having permanent grasslands (in the period of conversion and after conversion) to 1882 PLN/ha (orchards and berry cultivations in the conversion period) (tab. 3). The 100% rate is obtained by the producers with the area of 0.1-50 ha, 75% – with the area of 50-100 ha and 60% with the area over 100 ha. The amount of payment was determined accounting for the lost income (smaller crops), additional labor expenditures of the farmer, larger fuel consumption and the cost of using natural fertilizers, but, at the same time, lower direct costs due to smaller outlays on the purchase of production means.

The rules and amount of support for ecological farms did not change in the EU and Poland in the new budget perspective 2014-2020.

**Table 3 Rates of subsidies for ecological farms in PLN/ha**

Specification	in the conversion period	after the conversion
Agricultural cultivations	966	792
Vegetable cultivations	1557	1310
Herb cultivations	1325	1325
Orchards	1882	1501
Extensive orchards	790	660
Fodder cultivations on arable grounds	787	559
Permanent grasslands	428	428

Source: RDP 2014-2020

Without subsidies and support, the development of ecological agriculture would not be possible. As the research based on data of the Polish FADN (Floriańczyk, Prandecki 2014) shows, the productivity of land in ecological farms in Poland is on average 30% smaller than in conventional farms. At the same time, despite large financial support, incomes obtained by "ecological" producers were in 2012-2013 lower than obtained by those with "traditional" farms. However, to a large extent, it resulted from a relatively large share in the total number of ecological farms, of farms being in conversion, where production is lower than in farms after transition.

### The problems of the development of ecological agriculture in Poland

The main problem of ecological agriculture is the relatively low productivity of land and the permanent dependence of ecological farms on external sources of financing. Acquisition of subsidies involves the necessity to comply with strictly defined requirements concerning ecological farming and overcome obstacles related to excessive (according to farms) bureaucracy in running production and obtaining payments.

The problem in increasing the number of ecological farms involved in the production of supplies meant for direct consumption or constituting raw materials for ecological processing plants, is still low demand for organic food products in Poland. It results from the relatively low income of Polish consumers, as compared to most EU-15 countries. The results of research conducted by Źakowska-Biemans and others (2012) show that for over 50% of Polish consumers, organic food is too expensive. What limits the demand is still a poor commercial offer of ecological products (they are mainly cereal products, juices, processed fruit and vegetables, and herbal products), a poorly developed network of distribution channels and points of ecological product sale, and still low ecological awareness of Polish consumers. The relatively little diverse commercial offer of organic food products results from still too few ecological farms. It also causes the necessity to locate part of non-processed ecological products in conventional processing plants, causing the reduction in potentially feasible incomes of producers. The problem is also the lack of cooperation of ecological producers with regard to forming large, qualitatively uniform batches of products, sold to processing plants, and mainly to retail networks. Cooperation and self-organization of ecological

producers (groups and organizations of producers) not only strengthens the position of the producers toward other market participants, but also makes it possible to improve the income situation of the members of groups and organizations due to the EU support and the possibility to reduce the costs of sales by increasing in the supply concentration.

### The end and conclusions

The development of ecological agriculture is related to the necessity to protect the natural environment, and, on the other hand, with the growing demand for products safe for the health of consumers. It is also the method and possibility to activate the regions with relatively large resources of workforce and a relatively low level of income of agricultural producers. It is about both, the possibility to get subsidies from the EU funds and the development of the so-called agritourism (offering ecological products, safe for health). Thus the development of ecological agriculture fosters the so-called social incorporation, which is one of the important goals adopted for implementation by EU in the perspective to 2020.

Maintaining the dynamic development of ecological agriculture in Poland, after the accession to the EU, requires mainly: simplifying administrative and bureaucratic procedures related to running ecological farms and obtaining subsidies, extensive actions promoting the consumption of ecological products, improving the product distribution system, enriching the supply offer, and dynamizing the process of formation of ecological processing plants. Self-organization of the producers is very important, to reduce the costs of sales, improve the position toward other market participants, but also get support for creating and functioning of the groups of producers recognized by the EU law. The development of ecological agriculture, and more broadly, sustainable, requires greater involvement of scientific institutions in using modern, environmentally friendly production methods, but also the calculation of profitability of using particular solutions.

Any significant increase in the importance of ecological products in the general supply of food articles in Poland would require the growth in the income of Polish consumers, which is dependent on the general condition of the economy.

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## CURRENT SITUATION IN DAIRY INDUSTRY AND FEED EFFICIENCY OF PROFESSIONAL DAIRY FARMS OF TURKEY

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### ABSTRACT

Nowadays controlling and monitoring feed efficiency (FE) has become more common benchmark for profitability of milk production relative to dry matter (DM) intake. Therefore, the study examined the current situation of Turkish dairy farms and their feed efficiency. Data were collected from purposively selected 5 professional dairy cattle farms, Food and Agriculture Organization (FAO), Ministry of Food, Agriculture and Livestock, Turkish Statistics Institute (TURKSTAT) and obtained from previously conducted surveys. Partial productivity measures and data envelopment analysis (DEA) were used to measure firm level productivity and efficiency. Research results showed that dairy is a small scale family operation in Turkey. However, the numbers of commercial dairy farms has tended to increase. Research results also showed that utilization of feeds by the dairy cow, especially DM and fiber digestibility was not efficient. Still, Turkish dairy farms tended to measure their efficiency level by using conventional methods, resulting in efficiency loss for dairy farms. Based on the results of the Data Envelopment Analysis (DEA), the technical efficiency scores of sample professional dairy farms was 0.88, indicating that same amount of milk could be produced even if they reduced their dry matter intake or animal numbers by 12 %. The study suggested that high digestible feeds has to be used in the dairy cattle rations, particle size in the diet must be always monitored because forage and concentrate feeds should not be selected by cows and reduce average days in milk (DIM) in dairy herds may help to maximize dairy efficiency. Understanding of efficiency mechanism will enable management decisions on the dairy operation to be implemented that will further improve or enhance FE in Turkey's dairy farms.

**Keywords:** Dairy cattle, feed efficiency, technical efficiency, productivity, efficiency, stochastic frontier analysis, data envelopment analysis.

### 1. INTRODUCTION

Efficient use of resources is an important economic component for all dairy operations. On dairy operations feeds are the most magnificence item in production cost. Efficient conversion of feeds into milk affects the profitability of dairy operations. Feed efficiency (FE) is a new term that its popularity has been improving all around the world for the dairy industry. FE is becoming a more common benchmark for profitability of milk production relative to dry matter (DM) intake. The definition of FE is amount of milk produced per amount of DM consumed. FE can also be used in Beef, fish and poultry industries as a benchmark for profitability. Not only profitability in production but also environmental efficiency will be affected by increasing cow's feed efficiency, because increased FE of cow will be caused to fewer nutrient and less manure production. This is also important point of dairies for manure management. FE is not common measures in Turkey. Forages, concentrate feeds and additives are becoming more expensive in the market. That is why; many dairy farms have concentrated on feed conversion capabilities into milk of dairy farms, which affects the dairy farm's bottom line in economic conditions.

Milk producers need land, labor, livestock, feed, capital and managerial talent, etc. as an input in order to produce milk and its nutritional components such as milk fat and milk protein as an output. Not at the desired price of raw milk and continuous increase in the price of inputs used in production causes milk producers to be willing to make them more efficient and effective production level to have a sustainable profitability. The biggest challenge faced by dairy farmers is determination of most appropriate inputs and the optimum levels of them in order to achieve effective production frontier. In general, milk producers compare their farm productivity and efficiency level by benchmarking the amount of milk produced or cost of it with same scale of farms. However, this method measures productivity and effectiveness as partial and may cause significant errors. Actions and evaluation taken by the result of this method may affect to other parts of production activities (Fraser and Hone, 2001).

In real life, missing or incorrect decisions are made because of using partial productivity measurements for the process of production in dairy operations. However, new measurement approaches and methods have been developing since past in order to resolve the shortcomings of partial measurement technics. Those methods are not used in dairy operations as often as academically. These methods have a great importance to make a decision in all operations. The request of resolving this deficiency between application and theoretical approaches became a source of inspiration of this study. Applying of this kind of measurement methods where competition is highly intense will provide a huge benefit to companies working in dairy business and increase the resource use efficiency in Turkish economy. The literature related to efficiency measurements in Turkey are independent of each other is

moving in two directions. First of them is mostly the translation of the foreign resources that explain the theoretical frame of the efficiency measurements (Ulucan (2002), Eroğlu and Atasoy (2006), Behdioğlu and Özcan (2009)). In the other direction, there are academic studies which measure the efficiency in dairy farms (Nizam (2006), Topçu (2008), Gündüz (2011)). However, the literature related efficiency and its application to the dairy sector has been limited. Especially, feed efficiency in dairy farm still has not been clear in Turkey. Due to fill this information gap, the study intended to outline the Turkish dairy sector focusing on feed efficiency and to explore the feed efficiency of Turkish professional dairy farms by using farm level data in Turkey.

## 2. MATERIALS AND METHODS

Data were collected from World Agriculture and food Organization (FAO), Turkish Ministry of Food, Agriculture and Livestock, and Turkey Statistical Institute (TUIK) in order to reveal the current situation of Turkey. Other data such as numbers of lactating cow, cost of feeds, dry matter intake, milk yield, milk fat to calculate the feed efficiency and technical efficiency were collected through the survey from 5 dairy herds located in Malatya, Gaziantep, Elazığ and Kahramanmaraş which have Holstein genetics, fed total mix ration, were milked in milking parlors, had computerized record keeping systems.

An average dairy milk yield per lactating cow was calculated by dividing bulk milk tank average by the number of lactating cows contributing milk to the tank. Research data were summarized by using descriptive statistics before calculating feed efficiency. Feed efficiency was calculated using data collected from each herd assuming 3.5% fat corrected milk production. Data envelopment analyses were used to evaluate of technical efficiency of each farms. Daily milk yields, number of lactating cows, dry matter intake were used as a data in data envelopment analyses input oriented model. The results obtained from data envelopment analyses were compared to traditional measurement methods to increase validity. The results for the feed efficiency also compared with the average values that were declared at Tri-State Dairy Nutrition Conference by Pierre (2008). Technical efficiency values of each herd were estimated by using DEAP 2.1 software which was developed by Coelli (1997).

Fat corrected milk (FCM) was used for calculating of FE in order to put all dairy cows on an energy output equivalent for production. Use of 3.5% FCM is necessary for comparison between cows at different lactation, age, production, etc. The following formula was used to convert to FCM yield (Hutjens, 2010).

$$3.5\% \text{ FCM} = (0.4324 \times \text{milk kg}) + (16.216 \times \text{milk fat kg})$$

When milk is not corrected for fat content, the conversion of DM into milk should be referred to as dairy efficiency (DE) (Linn et al., 2007).

## 3. RESULTS AND DISCUSSION

### 3.1. Overview of the Turkish Dairy Sector

The number of dairy farms compared to other countries is very high in Turkey. However, based on the number of dairy cows there are numerous small scale operations in Turkey. The number of dairy cows and farms are presented in Table 1.

Based on the statistics announced by TURKSTAT, there have been 14.4 million cattle in Turkey. Year-based animal numbers of Turkey are depicted in Table 2 and the presence of bovine and ovine animals in the world are presented in Table 3.

FAO estimates that the world's total milk production has increased 2% compared to the previous year and total production has been 754 tons in 2012 (Table 3). Turkey increased the cow's milk production 15.8% compared to the prior year. According to the data of 2014, Turkey is in 8 ranks in the world with production of 16 million tons of milk (Table 4).

**Table 1: Development of the number of dairy farms in Turkey (TMFAL, 2014)**

Heads	2011		2012		2013	
	Number of dairy farms	%	Number of dairy farms	%	Number of dairy farms	%
1 – 5	1.047.778	60,05	811.778	59,00	701.907	56,11
6 – 9	363.683	20,85	293.399	21,00	252.776	20,11
10 – 19	234.714	13,45	198.117	14,00	190.009	15,19
20 – 49	74.920	4,29	60.570	4,00	85.910	6,87
50 – 99	17.496	1,00	14.228	1,00	16.204	1,30
100 – 199	4.500	0,26	2.798	> 1,00	3.141	0,25
200 – 499	1.765	0,10	1.119	> 1,00	783	0,06
500 +	-	-	-	-	217	0,02
Total	1.744.859	100	1.382.009	100	1.250.947	100

**Table 2: Development of the animal numbers in Turkey (1000) (TURKSTAT, 2014)**

Years	Cattle	Sheep	Hair Goat	Angora Goat	Buffalo
1990	11.377	40.553	9.698	1.279	371
1995	11.789	33.791	8.397	714	255
2000	10.761	28.492	6.828	373	146
2005	13.526	25.304	6.285	233	105
2009	10.724	21.750	4.981	147	87
2010	11.370	23.090	6.141	153	85
2011	12.386	25.032	7.126	151	98
2012	13.915	27.425	8.199	158	107
2013	14.415	29.284	9.059	166	118

**Table 3: The World milk production (million), (FAO, 2014)**

	2006	2007	2008	2009	2010	2011	2012
Cattle	561.7	573.8	585.1	586.2	597.6	612.7	625.7
Sheep	9.2	9.1	8.9	9.4	9.8	9.9	10.1
Goat	15.1	15.9	16.1	16.4	17.2	17.6	17.8
Buffalo	81	84.2	85.1	88.3	92.2	95.6	97.4
Others	1.8	2.1	2.5	2.0	2.4	3.1	2.9
Total *	668.8	685.1	697.7	702.3	719.2	738.9	753.9

**Table 4: Leading countries for production of cow's milk in the world (CNIEL, PZ, FAO, IDF, 2014)**

Countries	Milk Production (Million tons)	(%)
EU	152,0	0,0
USA	90,9	2,1
India *	60,1	4,7
China	37,4	2,4
Brazil	33,7	2,0
Russia	31,9	0,9
New Zealand	20,6	8,5
Turkey	16,0	15,8
Pakistan	13,9	3,8
Argentina	11,7	1,2
Mexico	11,3	2,1
Ukraine	10,1	2,6

\* Estimation

### 3.1.1. General Characteristics of Sample Dairy Farms

Examined dairy farms in the study were large-scale and market-orientated operations. Three of them were producing almost the same amount of milk. The number of animals varied between 54 and 105 and the amount of dry matter consumed for the production of milk was different from each other in these three farms. One of the sample farms was quite large organization and approximately 24 tons milk produced per day with 823 lactating animals. The last farm was producing 3120 kg milk with 128 lactating animals consumed 3 tons of dry matter per day (Table 5).

**Table 5: Feed and technical efficiency scores for sample dairy farms**

Dairy farms	Lactating cows (head)	DMI (kg/day)	Milk yield* (kg/day)	Average milk yield (head/kg/day)	FE	TE
1	823	19.587	23.724	28.8	1.21	1.00
2	128	3.000	3.120	24.3	1.03	0.85
3	105	1.963	1.985	18.9	1.01	0.83
4	71	1.519	1.633	23.0	1.07	0.88
5	54	1.117	1.096	20.2	0.98	0.81

\* Fat Corrected Milk (FCM)

### 3.1.2. Feed Efficiency in Sample Dairy Farms

Feed efficiency was amount of milk produced per amount of dry matter consumed. Pierre (2008) showed the optimal feed efficiency rates for dairy cattle in Tri State Dairy Conference (Table 6). Most of the dairy operations in the world has tried to control feed cost and maximizing profitability by reaching these values of efficiency.

**Table 6: Target FE per cow (St. Pierre, 2008)**

Milk Yield (Kg)	FE
25.0	1.25
29.5	1.38
34.1	1.49
36.4	1.54
38.6	1.58
40.9	1.63

Feed and technical efficiency measurement result for sample dairy farms showed that use of feeds by the dairy cow, especially DM and fiber digestibility was not efficient. DEA results stated that the average technical efficiency of these farms was 0.88, indicating that same amount of milk could be produced even if by dry matter intake or animal numbers were reduced by 12%.

#### 4. CONCLUSION

Under the light of the research findings, it was clear that feed efficiency of the Turkish dairy farms was unsatisfactory level even if they were very commercial and large scale. Since energy density in lactating cows' diet is directly related to feed efficiency, dairy farms should balance and control the energy density in diet. Recommendation of the study are presented the below.

- Forages have a large effect on FE, because of their digestibility and nutrient composition are variable. Using high digestible forages may increase the feed efficiency.
- Days in milk (DIM) are important for FE. In early lactation, dry matter intake is lower than mid and late lactation. Cows in early lactation metabolize their body fat and use as energy for milk production. When calculating FE, this artificial increase should be considered.
- Age and lactation number may influence the FE. As usually, in first lactating cows are still growing so divert nutrients to growth. Because of needing energy for growth, their FE is lower than other lactating animals. This nuance should be considered when planning this kind of things.
- Stress is another factor that changes the value of FE. Animals have to be in optimal comfort conditions. Heat and cold stress reduce the FE. Dairy farms should pay attention the cold and heat stress.
- Body condition score may impact on FE. Cows which have a higher body condition score has lower FE values. Because, nutrients are kept as a fat on body. Therefore, the dairy farm managers should pay attention when selecting the cows.
- Pregnancy is other factor that affects FE. Fetus requires extra nutrients for growth. This should be considered when determining the diet.
- Acidosis will reduce the FE, because Fiber digesting microbes are affected from lower pH level of rumen. So, acidosis should be controlled.
- Feed additives such as yeast, buffers increase the fiber digestion. Especially, adding additives to cow's diet will increase the FE when cows are in heat stressed.

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## TARIMIN TÜRKİYE EKONOMISİNDE YERİ

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### ÖZET

Tarım, bir yaşam biçimini olmakla birlikte, yurt içi gıda gereksinimini karşılama, sanayi sektörüne girdi temin etme, sanayi ürünlerine talep oluşturma, milli gelir, ihracat geliri ve istihdam sağlama yönüyle ülke ekonomisine değişik yollardan katkı sağlayan önemli bir sektördür. Çeşitli iklim koşullarına sahip olan Türkiye her türlü tarım ürününün yetişmesine olanak sağlayan ender ülkeler arasında yer almaktadır. Tarım, genel bir ifadeyle insanların toprağı işleyerek ekme ve dikme yoluyla ondan ürün elde etme faaliyeti olarak tanımlanmaktadır, bitkisel üretmeye ek olarak; hayvansal üretim, ormancılık, balıkçılık ve tarım teknolojileri faaliyetlerini de kapsamaktadır. 2014 yılı TÜİK verilerine göre gayri safi yurt içi hasıla (GSYH) içinde tarım sektörünün payı %7,1(cari fiyatlarla) olup, toplam istihdamın %21,3'ü tarım sektöründe istihdam edilmektedir. Aynı yılın verilerine göre 77,7 milyon olan Türkiye nüfusunun yaklaşık %20'si tarımsal alanda yaşamaktadır. Göründüğü gibi nüfusun ve istihdamın önemli bir bölümünü hala tarım sektöründe yer almaktadır. Bu da tarımın her ne kadar GSYH içindeki payı düşük olsa da, ekonomi içinde önemli bir yere sahip olduğunu göstermektedir. Nitekim tarımın GSYH içindeki payının düşük olması sanayi ve hizmetler sektörlerindeki payın yükseldiği anlamına da gelmektedir. Tarım tüm dünya ülkelerinde olduğu gibi Türkiye için de stratejik öneme sahip hassas ve bir o kadar da ekonomik büyümeye ve gelişmenin kilit noktasını oluşturan bir sektördür. Mutlak suretle korunması ve desteklenmesi gereken sektörün ekonomiye olan katkılarını artırmak için tarım ve sanayi sektörlerinde uygulanan politikaların uyum içerisinde olması, birikim ve yatırımların doğru yapılması gerekmektedir. Bu önemden dolayı bu derlemede tarımın Türkiye ekonomisindeki yeri yıllar itibarıyle incelenerek, tarımın ekonomideki yerinin tespit edilmesi ve bu alanda ki karar alıcıların doğru karar almalarına yardımcı olacak bilgilerin üretilmesi amaçlanmaktadır.

**Anahtar Kelimeler:** Tarım, Türkiye'de Tarım, Türkiye Ekonomisi, Ekonomi

### 1.GİRİŞ

Türkiye genel olarak dağlık bir arazi yapısına sahip olup, arazilerin %55,9'u 1.000 m'nin üzerinde yükseltiye ve %62,5'i %15'ten daha fazla eğime sahiptir. Türkiye'nin arazi yapısı ve buna bağlı olarak değişen iklim özellikleri farklı coğrafi bölgelerin oluşmasını sağlamıştır (TOBB, 2013). Bu nedenle, Türkiye toprakları tarih boyunca birçok uygarlığa ev sahipliği yapmış, iklim özellikleri sayesinde tarımsal faaliyetin yoğun bir şekilde yapılmasına olanak tanımıştır. Bitkisel ve hayvansal üretim dallarından oluşan tarım; yapısı gereği işgücüne büyük ölçüde ihtiyaç duymakta, ülkemizde çalışan nüfusun %21,3'üne istihdam sağlamaktadır (TÜİK, 2015).

Tarım sektörünün ekonomideki yerini TÜİK tarafından üretim yöntemiyle hesaplanan Tarımsal GSYH belirlemektedir. GSYH mal ve hizmet üretiminde ekonomik büyümeye ve gelişmenin temel ölçüsü olarak ele alınmaktadır. Tarımla ilgili mal ve hizmet üretimi de, ekonominin tarım sektörü açısından büyümeye ve gelişme performansını ortaya koymaktadır (Ege, 2011). Birçok yönden farklı katkıları bulunan tarımın, Türkiye ekonomisindeki yeri, farklı dönemlerde farklılık göstermektedir. Nitekim Cumhuriyetin kurulduğu dönemde daha fazla olan tarımın GSYH'deki payı, 1930'luk yılların başından itibaren sanayi sektörüne ağırlık verilmesiyle düşmeye başlamıştır. 1968 yılında GSYH içinde tarımın payı %39,8 (cari fiyatlarla) iken, bu oran sanayinin ülkemizde öncelikli sektör olması ve gelişmenin bu yönde gerçekleşmesiyle, 1970 yılında %37,1 olmuştur. 1980 yılında 25,8, 1990 yılında %17, 2000'de %10, 2010 yılında %8,4 ve 2014 yılında ise %7,1 düzeyine gerilemiştir (TÜİK, 2015). Türkiye'de tarım sektörünün GSYH'deki payının giderek azalması, sanayileşme ve hizmetler sektörlerinde gelişmeye daha çok önem verilmesinin bir sonucu olarak karşımıza çıkmaktadır. Başka bir deyişle, Türkiye'de sanayi ve hizmet sektörlerinde yaratılan değer artışı tarımdan daha fazla olmuştur. Dolayısıyla oransal olarak gerçekleşen bu düşüş nispi bir düşüşten ibarettir.

Tarım sadece fiziksel ve biyolojik çıktı üreten bir sektör olmayıp, küçük aile işletmeleri, büyük şirket çiftlikleri, kredi ve diğer girdi sağlayan şirketler, işleme sanayi işletmeleri, taşıma firmaları, toptancılar, lokantalar, oteller ve perakendeciler gibi çok sayıda kesimin içinde rol aldığı bir sektördür. Bu bağlamda tarım sektörünün sanayi ve hizmetler sektörü ile kıyaslanması doğru değildir. Her bir sektörün, ayrı olarak ve birbirleriyle olan ilişkileri açısından incelenmesi gerekmektedir (Ege, 2011).

Türkiye'de tarım sektörü büyük bir potansiyele sahip olup, kalkınmaya değişik yollardan katkı yapmakta, sağladığı faydalara ülke ekonomisinde önemli bir yer almaktadır. Bu önemden dolayı çalışmada, tarımın Türkiye ekonomisinde yerinin belirlenmesi amacıyla katkıda bulunduğu başlıca konulara deñinmiş, tarımın ekonomideki konumu yıllar itibarıyle incelenmiştir.

## **2.MATERYAL METOD**

Nüfusun önemli bir kısmının kırsalda yaşadığı Türkiye'de, ekonomiyi büyütmede, sektörel çeşitlendirmeyi oluşturmada, istihdam sağlamada ve yerel kaynakları daha etkin bir şekilde değerlendirmede tarım önemli bir rol oynamaktadır. Bu çalışma, tarımın Türkiye ekonomisindeki yerinin ne durumda olduğunu tespit etmek ve mevcut durumu değerlendirmek amacıyla yapılmıştır. Tarımın Türkiye ekonomisindeki yeri incelenirken, nüfus durumu ve istihdam sağlaması, yurt içi gıda ihtiyacını karşılaması, milli gelire katkısı, sanayi sektörüne girdi temin etmesi ve dış ticarete katkısı yıllar itibarıyle incelenmiştir. Çalışma literatüre dayalı olup, konu ile ilgili çeşitli kuruluşların (TÜİK, GTHB) yayınlarından, makale, dergi ve internet kaynaklarından yararlanılmıştır. Yararlanılan kaynaklar konu ile ilgilerine göre sınıflandırılmıştır.

## **3.TÜRKİYE'DE TARIMIN YAPISI VE EKONOMIDEKİ YERİ**

Türkiye toplam arazi varlığının %24,5'i I,II ve III. sınıf topraklardan oluşmaktadır. Bu kaliteli üç sınıf toprak içinde tarım topraklarının payı, %90'dır. Türkiye'nin 77,9 milyon hektar olan toprak varlığının 26,3 milyon hektarını tarım arazileri oluşturmaktadır. Türkiye'de özel mülkiyete dayalı küçük aile işletmelerinin hakim olduğu bir tarımsal yapı mevcuttur. İşlenen arazilerdeki genişlemeye birelikte, işletme sayısında artma olmuş, ortalama işletme arazisi 60 dekara ulaşmıştır. Miras ve arazi hukukunda yapılacak düzenlemelerle ortalama işletme arazisinin daha da artması beklenmektedir (TOBB, 2013).

Bir ülkenin genel ekonomik yapısı içerisinde tarım sektörünün yeri birçok kıstas ile belirlenebilir. Ancak genel itibarıyle; sektörün milli gelire katkısı, ülkenin gıda ürünlerinde kendine yeterliliği, buna bağlı olarak ihracat ve ithalatta gösterdiği özellikler, sanayi sektörüne girdi sağlaması, istihdamdaki payı, talep yaratma gücü, diğer sektörler açısından önemi vb. etkenler göz önüne alınarak değerlendirilmektedir (Günaydin, 2006).

### **3.1. Tarım Sektöründe Nüfus ve İstihdam**

Türkiye toplam nüfusu artmasına rağmen (77,7 milyon kişi) tarımla uğraşan nüfusun azalması ve yıllar itibarıyle düşüş göstererek 2012 yılında %22,7 oranına düşmesi kırsaldan şehirlere göçün bir göstergesidir. 2014 yılı verilerine göre ise bu oran %8,2'ye gerilemiştir. Ancak, bu gerileme sadece göç kaynaklı olmayıp, Türkiye'de 6 Aralık 2012 tarihinde Resmi Gazete'de yayınlanarak yürürlüğe giren; "14 ilde Büyükşehir Belediyesi ve Yirmi Altı İlçe Kurulması ile Bazı Kanun ve Kanun Hükmünde Kararnamelerde Değişiklik Yapılmasına Dair Kanun" nedeniyle kırsal nüfusun şehirli nüfus içinde yer almaya başlamasından kaynaklanmaktadır. 2012 yılında nüfusun %22,7'si kırsalda yaşıyor iken, 2013 yılı itibarıyle, kanun ile birlikte bu oran % 8,7'ye düşmüştür. TÜİK 2014 yılı verilerine bakıldığına ise, Türkiye nüfusunun %8,2'si (6.410 kişi) kırsal alanda yaşamaktadır. Oysaki kır nüfusu halen yerinde durmakta, kırda yaşamına ve üretimine devam etmektedir. 2013 yılından itibaren Türkiye'de kır nüfusunun azalmasının nedeni yürürlüğe giren kanundan kaynaklanmakta olup, idari bir tanımlamadan ibarettir (Çizelge 1).

Tarım her şeyden önce bir yaşam biçimini olup, Türkiye nüfusunun önemli bir bölümünün geçim kaynağını oluşturmaktadır. Türkiye'de tarımsal istihdamın toplam istihdamındaki payı 1950'li yıllarda itibaren önemli miktarda düşüş göstermiş, 1955 yılında % 77,4 olan pay, 1980'de %50,6'ya düşmüştür. Kırsaldan şehirlere göçlerin yaşanması nedeniyle de kırsal bölgede nüfus daha da azalmış ve bu bağlamda, tarımın istihdamdaki payı 2000 yılında %47,8'e, 2003'te %34,3'e (Miran, 2005), 2005'te %25,5'e gerilemiştir. Tarım sektörünün son dönemlerine baktığımızda ise, 2007 yılında %22,5'e düşen tarımsal istihdamın toplam istihdam içerisindeki payı 2008 yılı mali krizinin ardından 2009 yılı itibarıyle % 23,1'e yükselmiştir. 2010 ve 2011 yılı için bu rakam % 23,3, 2012 yılında % 22,1, 2013 yılında % 21,2 olarak gerçekleşmiştir. 2005-2014 yılları arasında tarım sektöründe istihdam oranında %9 artış olmasına rağmen, istihdam payı %4,4 oranında azalarak 2014 yılında %21,1 olmuştur (Çizelge 2). Bu azalışın temel nedenleri arasında; tarım sektöründe makineleşmeye bağlı olarak işgücü talebinin azalması, sanayi ve hizmetler sektörünün işgücü ihtiyacının artması, kırsalda hızlı nüfus artışı, ekilebilir toprakların parçalanması ve tarım sektöründe geçim imkânlarının daralması yer almaktadır (Avşar ve Üstün, 2014). Tarımda sermaye birikimi ve teknoloji kullanımındaki artışla birlikte bu oranın daha da düşeceği tahmin edilmektedir.

**Çizelge 1. Türkiye Nüfusu (Bin Kişi) ve Tarımsal Nüfusun Payı (%)**

Yıllar	Türkiye Nüfusu	Tarım Nüfusu	Tarım Nüfusunun Payı %
1935	16.158	12.355	76,5
1945	18.790	14.103	75,1
1955	24.065	17.137	71,2
1965	31.391	20.586	65,6
1975	40.348	23.479	58,2
1985	50.664	24.992	47,0
1990	56.473	23.147	41,0
2000	67.804	23.798	35,1
2007	70.586	20.838	29,5
2008	71.517	17.905	25,0
2009	72.561	17.754	24,5
2010	73.723	17.501	23,7
2011	74.724	17.339	23,2
2012	75.627	17.179	22,7
2013	76.668	6.633	8,7
2014	77.696	6.410	8,2

Kaynak: TÜİK

**Çizelge 2. İstihdam Edilenlerin Yıllara Göre İktisadi Faaliyet Kolları ve Dağılımı (Bin Kişi)**

Yıllar	Toplam	Tarım	Tarım İstihdam Payı (%)	Sanayi	Sanayi İstihdam Payı (%)	İnşaat	İnşaat İstihdam Payı (%)	Hizmetler	Hizmetler İstihdam Payı (%)
2005	19.633	5.014	25,5	4.241	21,6	1.097	5,6	9.281	47,3
2006	19.933	4.653	23,3	4.362	21,9	1.192	6,0	9.726	48,8
2007	20.209	4.546	22,5	4.403	21,8	1.231	6,1	10.029	49,6
2008	20.604	4.621	22,4	4.537	22,0	1.238	6,0	10.208	49,5
2009	20.615	4.752	23,1	4.179	20,3	1.305	6,3	10.380	50,4
2010	21.858	5.084	23,3	4.615	21,1	1.434	6,6	10.725	49,1
2011	23.266	5.412	23,3	4.842	20,8	1.680	7,2	11.332	48,7
2012	23.937	5.301	22,1	4.903	20,5	1.717	7,2	12.016	50,2
2013	24.601	5.204	21,2	5.101	20,7	1.768	7,2	12.528	50,9
2014	25.933	5.470	21,1	5.316	20,5	1.912	7,4	13.235	51,0

Kaynak: TÜİK

### **3.2. Tarımın GSYH İçindeki Yeri**

GSYH, bir ülkede yerleşiklerin sahip oldukları üretim faktörleri ile belli bir yılda ürettikleri tüm nihai mal ve hizmetlerin toplam piyasa değerini ifade etmektedir (Eruygur, 2010). Ulusal ekonomi gelişikçe, GSYH'yi oluşturan tüm üretim kesimlerinde farklı oranlarda olmakla birlikte, bir ürün artışı olmaktadır. Tarım özellikleri gereği, gelişme hızı diğer üretim kesimlerine oranla daha düşük olan bir sektördür. Ancak, ülkenin gelişme hızını belirleyici özelliklere sahip olduğundan önem taşımaktadır (Kıral ve Akder, 2005).

Türkiye GSYH içinde tarım sektörüne ait veriler Çizelge 3'te verilmiştir. Tarımın GSYHındaki payı 1999 yılında cari fiyatlarla %10,5 iken; bu oran giderek azalmış ve 2014 yılında %7,1 düzeyine inmiştir. Tarımsal GSYH'deki gerileme, tarım dışı GSYH'nin artış hızına bağlı olarak gerçekleşmektedir. Bu da, gelişen ekonomilerin özelliği olarak ekonomimizin gelişliğini göstermektedir. Ayrıca, GSYH içindeki oransal azalmaya rağmen, tarımdan elde edilen gelir 1999-2014 yılları arasında 11 kat artarak 2014 yılında 125 milyar TL civarına ulaşmıştır. Bunun başlıca nedeni ise, tarımsal üretimde fiyatların ve tarımsal üretim değerlerinin diğer sektörlerden sağlanan fiyat ve üretim değeri açısından daha düşük seviyelerde seyretmesidir. Başka bir deyişle, tarımın GSYH'deki payının giderek düşmesi sanayi ve hizmet sektörlerinin gelişmesinin göreceli olarak daha hızlı gerçekleşmesinden kaynaklanmaktadır.

**Çizelge 3. Cari Fiyatlarla GSYH ve Sektörlerin Payı (%)**

Yıllar	Tarım (Milyon TL)	Gelişme Hızı (%)	Türkiye (Milyon TL)	Gelişme Hızı (%)	Tarımın Payı (%)	Sanayi Payı %	Hizmetler Payı %	Ariçilik Hzm. Payı %	Vergi- Süb. Payı %
1999	10.976	25,3	104.596	49,0	10,5	30,2	57,1	6,8	9,0
2000	16.816	53,2	166.658	59,3	10,1	27,9	55,6	4,4	10,8
2001	21.235	26,3	240.224	44,1	8,8	26,8	58,5	5,3	11,1
2002	36.056	69,8	350.476	45,9	10,3	25,2	55,0	2,6	12,1
2003	45.135	25,2	454.781	29,8	9,9	24,9	54,2	1,9	12,9
2004	52.994	17,4	559.033	22,9	9,5	24,7	54,3	1,7	13,2
2005	60.710	14,6	648.932	16,1	9,4	24,7	54,1	1,4	13,3
2006	62.659	3,2	758.391	16,9	8,3	24,8	55,0	1,4	13,2
2007	64.327	2,7	843.178	11,2	7,6	24,8	57,0	1,5	12,1
2008	72.270	12,3	950.534	12,7	7,6	24,4	57,9	1,6	11,7
2009	78.770	9,0	952.559	0,2	8,3	22,9	59,6	2,3	11,5
2010	92.733	17,7	1.098.799	15,4	8,4	23,6	57,2	1,8	12,5
2011	103.628	11,7	1.297.713	18,1	8,0	24,4	56,3	1,3	12,7
2012	111.682	7,8	1.416.798	9,2	7,9	23,8	57,5	1,5	12,4
2013	115.658	3,6	1.567.289	10,5	7,4	23,6	57,6	1,6	13,0
2014	125.018	8,1	1.749.782	11,6	7,1	24,1	57,7	1,4	12,5

Kaynak: GTHB, TÜİK.

### **3.3. Toplum Beslenmesine Katkısı**

Toplumu oluşturan bireylerin sağlıklı gelişmesi ve üretmeye katkıda bulunabilmesi için yeterli ve dengeli beslenmesi gerekmektedir. Dolayısıyla, toplum sağlığı ve sosyo-ekonomik gelişmenin sağlanması toplum beslenmesi ile yakından ilgilidir. Beslenmenin yeterli ve dengeli olabilmesi için; insanlar, gıda maddelerini satın alabilecek yeterli gelire sahip olmalı ve aynı zamanda satın alabilecekleri gıda maddeleri yeterli düzeyde bulunmalıdır. Dünyada birçok ülke, nüfusunu besleyecek yeterli gıda maddesi sağlayamadığı için açlık sorunu yaşamaktadır (Kıral ve Akder, 2005). Temel ihtiyaç olarak tarım ürünlerinin giderek artan ve çeşitli talebinin yeterli ve güvenilir şekilde karşılanabilmesi tüm dünya ülkeleri gibi, Türkiye için de hayatı bir önem taşımaktadır. Hızlı nüfus artışı, ticaretin büyümesi, kişi başı gelir artışı ve tüketim alışkanlıklarındaki değişim ile birlikte, kişi başı tüketim artmaktadır bu da; tarımsal üretimin istikrarlı biçimde artmasını gerekli kılmaktadır.

Türkiye'de hayvansal ve bitkisel ürünler, ülke beslenmesinde önemli bir yere sahiptir. Tarım sektörü içinde önemli bir yer alan bitkisel üretim (tarla, sebze ve meyve) 2014 yılında yaklaşık 24 milyon ha alanda yapılmakta olup (Çizelge 4), 107 milyon ton üretim gerçekleştirilmiştir. Bu üretimin yaklaşık 62 milyon tonu, yani yarısından fazlası tarla bitkilerinden oluşmakta, onu sebze ve meyve üretimleri takip etmektedir.

#### **Çizelge 4 Türkiye'de Tarım Alanları**

Tarım Alanı	1990		2002		2012		2013		2014	
	(Bin ha)	%	(Bin ha)	%	(Bin ha)	%	(Bin ha)	%	(Bin ha)	%
Tarla Bitkileri	18.868	67,7	17.935	67,5	15.464	65	15.613	65,6	15.789	66
Nadas	5.324	19,1	5.040	19	4.286	18	4.147	17,4	4.108	17,2
Sebze	635	2,3	930	3,5	827	3,5	808	3,4	804	3,4
Meyve	3.029	10,9	2.674	10,1	3.201	13,5	3.232	13,6	3.238	13,5
Toplam	27.856	100	26.579	100	23.782	100	23.800	100	23.939	100

Kaynak: GTHB

Tek yıllık ürünlerden oluşan tarla tarımında yıllar itibarıyle iniş ve çıkışlar bulunmaktadır, meyve ve sebze tarımında giderek artan bir üretim söz konusudur(Çizelge 5).

#### **Çizelge 5. Bitkisel Üretim Miktarları (Bin Ton)**

Ürünler	2009	2010	2011	2012	2013	2014
Tarla	55.801	63.236	64.459	61.212	66.174	61.769
Meyve	16.389	16.386	16.993	17.811	17.995	16.876
Sebze	26.780	25.997	27.547	27.820	28.448	28.570
Toplam	98.970	105.619	108.999	106.843	112.617	107.215

Kaynak: GTHB

Genel anlamda taze tüketim, taze olarak sanayide işleme, depolama ve nakliyede çok dikkat edilmesi gereken bir ürün grubu olan meyve ve sebzeler, birim alanda verim ve kalitenin artması ile hasat sonrası altyapının gelişmesi sonucunda iç tüketim ve ihracatta artış sağlamıştır (TOBB, 2013).

Önemli besin kaynaklarından bir diğeri de hayvansal kaynaklı ürünlerdir. Hayvansal ürünlerin üretim değerleri incelendiğinde, yıllar itibarıyle kırmızı et başta olmak üzere, tavuk eti ve süt üretiminin arttığı görülmektedir (Çizelge 6). Et üretimindeki artışın sağlanmasında bilinçli bir sığır yetiştiriciliğinin yapılmaya başlanması, süt artışının sağlanmasında ise, yüksek ve verimli ırkların artması önemli ölçüde rol oynamaktadır.

#### **Çizelge 6. Hayvansal Üretim Miktarları**

Ürünler	Kırmızı et (Ton)	Süt (Ton)	Tavuk eti (Ton)	Tavuk yumurtası (Bin adet)	Bal (Ton)	Yaş İpek kozası (Ton)	Yapağı (Ton)	Kıl (Ton)	Tiftik (Ton)
2009	412.621	12.542.186	1.293.315	13.832.726	82.003	136	40.270	2.002	174
2010	780.718	13.543.674	1.444.059	11.840.396	81.115	126	42.823	2.607	200
2011	776.915	15.056.211	1.613.309	12.954.686	94.245	151	46.586	3.062	194
2012	915.844	17.401.262	1.723.919	14.910.774	89.162	134	51.180	3.570	200
2013	996.125	18.223.712	1.758.363	16.496.751	94.694	121	54.784	4.902	260
2014	1.008.272	18.498.630	1.894.669	17.145.389	102.486	80	58.351	5.460	280

Kaynak: TÜİK

### **3.4. Dış Ticaret Katkısı ve Önemi**

Türkiye'nin Dış Ticaret Dengesi sadece 1945 yılında fazlalık vermiş ve ihracatın ithalatı karşılama oranı % 173,2 olmuştur. Genel itibarıyle dış ticaret açığı yıldan yıla giderek büyümüştür. 1994 yılında alınan 5 Nisan kararları ile Türk Lirası değerinin yabancı paralar karşısında önemli oranda düşürülmüş (devalüasyon), ithalatı kısıtlayıp, ihracatı teşvik ettiğinden 1994'de dış ticaret açığı kapanmaya başlamış, 1994'ten sonra tekrar yükselmeye başlamıştır (Kıral ve Akder, 2005). Daha sonraki yıllarda farklılık arz etmekle birlikte dış ticaret açığının büyüdüğü görülmektedir (Çizelge 7). Dış ticaret açığının yüksek olması, gelir, istihdam ve fiyatlarında yaptığı değişim yoluyla ülke ekonomisini etkilemektedir.

Çizelge 7'de de görüldüğü gibi toplam dış ticaret açısından Türkiye döviz kaybederken tarım ürünleri ticareti bazı yıllarda fazlalık vermektedir, bazı yıllarda ise kuraklık, kriz vd. etmenlerin etkisiyle tarımsal hammadde ithalatı, ihracatın üstünde gerçekleşerek döviz kaybına sebep olmaktadır. Tüketicim alışkanlıklarının değişmesi, eğitim ve gelir artışında gözlenen farklılıklar tarım ürünleri ithalatımızda artışlara neden olan etmenler arasındadır ve son yıllarda Türkiye tarım ürünleri ithalatı ihracatından fazla olmaya başlamıştır. İthal edilen tarımsal ürünlerin başında; buğday, mısır, pıriç, yağlı tohumlar, pamuk, canlı hayvan ve et gelmektedir. Tarım ürünlerinde hammadde ithalatı genellikle, buğdayda kaliteli hammadde sorunu ve içinde işleme rejimi kapsamında; pıriç ve yağlı tohumlarda ise üretim açığı nedeniyle yapılmaktadır (Ege, 2011). Türkiye; Avrupa Birliği Ülkeleri ve Amerika Birleşik Devletleri başta olmak üzere birçok ülkeye fındık, kuru incir, çekirdeksiz kuru üzüm, Antep fistığı, kuru kayısı, tütün, zeytinyağı, pamuk, baklagil, yaş meyve-sebze ihracatı yapmaktadır. Türkiye bu ürünlerin ihracatında dünyanın onde gelen ülkeleri arasında yer almaktadır.

2000-2014 yılları arasında tarım ürünleri ihracatının toplam ihracat içindeki payı incelendiğinde %2 oranında, toplam ithalat içindeki payının ise, %0,3 oranında gerilediği görülmektedir. 2014 yılında tarım sektörü ihracatının toplam ihracat içindeki payı yaklaşık 6,4 milyar dolar ile %4, ithalat içindeki payı ise 8,7 milyar dolar ile %3,6 olarak gerçekleşmiştir(Çizelge 7).

**Çizelge 7. Tarımsal ve Genel Ticaret (Milyon \$)**

Yıllar	İhracat	İthalat	Dış Ticaret Dengesi	İhracatın İthalatı Karşılıma Oranı	Tarım Ürünleri İhracatı	Tarım Ürünleri İthalatı	Tarım Ürünleri Dış Ticaret Dengesi
2000	27.775	54.503	-26.728	51,0	1.684	2.125	-441
2001	31.334	41.399	-10.065	75,7	2.006	1.410	596
2002	36.059	51.554	-15.495	69,9	1.806	1.704	102
2003	47.253	69.340	-22.087	68,1	2.201	2.538	-337
2004	63.167	97.540	-34.373	64,8	2.645	2.765	-120
2005	73.476	116.774	-43.298	62,9	3.468	2.826	642
2006	85.535	139.576	-54.041	61,3	3.611	2.935	676
2007	107.272	170.063	-62.791	63,1	3.883	4.672	-789
2008	132.027	201.964	-69.937	65,4	4.177	6.433	-2.256
2009	102.143	140.928	-38.785	72,5	4.536	4.625	-89
2010	113.883	185.544	-71.661	61,4	5.091	6.490	-1.399
2011	134.907	240.842	-105.935	56,0	5.353	8.944	-3.591
2012	152.462	236.545	-84.083	64,5	5.379	7.503	-2.124
2013	151.803	251.661	-99.858	60,3	5.912	7.776	-1.864
2014	157.610	242.177	-84.567	65,1	6.376	8.658	-2.282

Kaynak: TÜİK

### 3.5. Sanayiye Girdi Temin Etmesi

Tarım sektörü tarıma dayalı sanayilerin gelişmesinde önemli sektörlerden birisidir. Hem tarıma dayalı sanayilere hammadde sağlamakta hem de diğer sektörlerde üretilen mal ve hizmetlere talep oluşturarak ekonomiye katkıda bulunmaktadır. Tarım ürünlerinin hammadde olarak ithalatı da, tarımsal sanayi açısından atıl kapasitenin değerlendirilmesine katkıda bulunmaktadır. Böylece ürünler işlenmekte ve işlenen ürünlerin ihracatıyla da katma değer oluşturulmaktadır (Ege, 2011). Dolayısıyla, tarım ve sanayi sektörleri birbirlerini etkileyen yani etkileşim içerisinde olan sektörlerdir. Sektörlerin etkileşim derecesi ise bu sektörlerdeki gelişmeye paralel olarak artmaktadır (Kıral ve Akder, 2005).

TÜİK 2014 yılı verilerine göre, Türkiye'nin GSYH'si harcama yönünden ele alındığında; yaklaşık % 69'unu tüketim harcamaları, tüketim harcamalarının ise yaklaşık %26'sını gıda harcamaları oluşturmaktadır. Bu durumda gıda harcamaları, tüm harcamalar içinde %18'lik ( $0,69 * 0,26 = 0,18$ ) bir orana sahiptir. TÜİK, yıllık sanayi ve hizmet istatistikleri, 2013 verilerine göre, imalat sanayinin üretim değeri olarak %11,6'sını gıda imalatı oluşturmaktadır. Tekstil ve giyim imalatları da dahil edildiğinde bu oran % 29'a ulaşmaktadır (TÜİK, 2015). İmalat sanayinin kullandığı tarımsal hammaddeinin ne kadarının Türkiye'de üretilen hammaddeyle karşılandığı önem taşımakta olup, bu oran ne denli büyük olursa, tarımın ilgili sanayi kolundaki değeri de o denli büyük olmaktadır.

Gıda sanayinin alt sektörlerinin ağırlığına bakıldığında %38 ile tahıl ve nişasta mamuller üretiminin ilk sırada yer aldığı görülmektedir. Bunu %15 ile süt ve mamulleri ve %14 ile mezbaha ürünleri takip etmektedir. Meyve sebze işleme sanayi %9'luk bir pay almaktadır. Yurt içi üretimin önemli bir bölümü bu dört sektör tarafından kullanılmakta, toplam üretim değeri içinde %76 pay almaktadır. Ancak, tahıl üretim ve kalitesi bazı yıllarda düşük olabilmekte, bu durumda sanayi hammadde ithalat yoluyla karşılanmaktadır. Bitkisel yağ sanayisinde ise daha çok ithal hammadde kullanılmaktadır. Fakat bu alt sektörün üretim değeri içindeki payı %6'dır. Yem sanayi hammadde olarak bazı ürünler ithal edilmektedir (Çizelge 8).

**Çizelge 8. Gıda Sanayi Alt Sektörleri Üretim Değeri (2005)**

Alt Sektörler	Üretim Değeri(Milyar TL)	Alt Sektör payları (%)
Mezbaha ürünleri	1.078.098	14
Süt ve mamulleri	1.107.771	15
Su ürünleri	109.090	1
Tahıl ve nişasta mamulleri	2.885.010	38
Meyve sebze işleme sanayi	691.075	9
Bitkisel yağ sanayi	439.899	6
Şeker ve şekerli mamulleri	859.685	11
Yem	325.501	4
Toplam	7.496.129	100

Kaynak: Ege, 2011.

Sanayinin bir diğer dalı olarak gübre, tarım ilaçları ve tarımsal mekanizasyon sanayi, tarıma hammadde ve ekipman sağlamakta, aynı zamanda gübre ve tarım ilaçları imalat sanayine katkıda bulunmaktadır. Başka bir ifadeyle sanayi tarım sektörüne girdi temin etmekte ve tarım, sanayi ürünleri için talep oluşturmaktadır.

### 4. SONUÇ

Tarım, artan gıda ürünleri talebini karşılama, tarım ürünleri ihracatı yoluyla döviz geliri elde etme, tarımdaki emeğin tarım-dışına transferi, sermaye oluşumuna vergi ya da yatırılabilir fon fazlası yoluyla katkı yapma, gelişme yoluyla diğer sektörler üzerinde uyarıcı etki yaratma, sanayiye girdi temin etme, istihdam sağlama, yaşam biçimini ve kültürel miras olma gibi katkılarda ülkenin sosyal ve ekonomik yönden gelişimini sağlayan bir sektördür.

Türkiye nüfusunun önemli bir kısmı kırsal alanlarda yaşamaktır, kırsal alandaki nüfusun ise büyük bir kısmı tarım sektöründe istihdam edilmektedir. Türkiye'nin içinde bulunduğu işsizlik göz önüne alındığında tarımın genel istihdama yaptığı sosyal ve ekonomik katkı göz önüne alınmalıdır. Ancak, kırsal alanda hayat koşullarının zorlaşması, yoksulluk, kaynaklara ulaşımda yaşanan kısıtlılıklar, kırsal nüfusun göç ederek azalmasına neden olmuştur. Kırsal alanda, tarıma dayalı sanayiye ağırlık verilmesi ve mesleki eğitim uygulama programları ile göçün engellenmesi ya da azaltılması mümkün olabilecektir.

Tarım sektörünün hizmet üretimine ve ekonomin diğer sektörlerine olan katkısı tarımın genel ekonomi içindeki önemini ortaya koymaktadır. Ülke nüfusunun önemli bir bölümünü kırsal alanda yaşayıp, tarımda istihdam edilmektedir. Tarımda istihdam eden kişi sayısı 2005-2014 yılları arasında artış gösterirken, tarımın genel istihdam içindeki payı düşmüştür. Tarım sektörü, özellikle gereği, gelişme hızı diğer üretim kesimlerine oranla daha düşük olduğundan, toplam GSMH içindeki payı, diğer sektörlerle kıyasla oldukça düşüktür ve yıllar itibarıyle giderek azalmıştır. Nitekim 1999 yılında GSMH içinde tarımın payı %10,5 iken, 2014 yılında bu oran %7,1'e düşmüştür. GSMH içinde ve toplam istihdam içinde tarımın payının düşük olması gelişmekte olan ekonomilerin bir özelliği olarak karşımıza çıkmakta, Türkiye ekonomisinin, diğer sektörlerde artan istihdam ve GSMH içindeki payı sayesinde, gelişme eğiliminde olduğunu göstermektedir.

Tarım sektöründe yaşanan gelişmelerle birlikte tarımsal üretim ve verimlilik artmış olsa da, tam anlamıyla yeterli bir gelişmeden bahsetmek mümkün değildir. Tarımsal ürünlerin ithalatı, ihracatından fazla olup, ithalat giderek artma eğilimindedir. Bu durum ise, ülke üretiminin yeterli olmadığını ve üretimi artırmayı yeni yasal düzenlemelere ihtiyaç duyduğunu göstermektedir. Ayrıca genel ve tarımsal dış ticaret açığı artmakta, bu da çözüm gerektiren bir sorun olarak karşımıza çıkmaktadır.

Tarım sektörünün doğal koşullara bağlı olması, risk ve belirsizliği artırmakta, tarımın arz ve talep esnekliğinin fazla olmayışi ve üretim periyodunun diğer sektörlerle göre uzun olması, tarıma dayalı sanayilere yönelik ve tarımsal desteklemeleri gerekli kilmaktadır. Özellikle, ekonomik ve sosyal açıdan kırsal alanın kalkınmasında öncü olan bitkisel üretmeye yönelik politika ve destek uygulamalarının tutarlılığı önem arz etmektedir. Tarım, diğer sektörleri etkileyen ve diğer sektörlerden de etkilenen bir yapıya sahiptir. Bu nedenle her bir sektör için uygulanan yasal düzenleme, birbirile uyum içerisinde olmalıdır. Hassas yapısı gereği tarım, ekonomiye olan katkılarını artırmak ve sürdürilebilirliğini sağlamak açısından, doğru yaklaşım larla korunmaya ve desteklenmeye ihtiyaç duymaktadır.

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## DETERMINANTS OF EGYPT'S FOREIGN TRADE WITH ARAB COUNTRIES USING THE GRAVITY MODEL

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### ABSTRACT

The main objective of this paper is to determine the factors that affect Egypt's bilateral trade flows to the Arab markets. Based on the panel data, the gravity model approach has been used to estimate Egypt's total trade, exports, and imports with the Arab countries through annual data covering the period 2000 to 2013 for 19 Arab countries. The gravity model in its random effects panel data was investigated. The results show that Egypt's GDP, importer's GDP, Egypt's population, importer's population, and distance are the main factors affecting Egypt's total trade and exports to Arab markets. In case of imports, only Egypt's GDP, importer's GDP, and Egypt's population are the main factors.

**Keywords:** Egypt, Arab markets, Gravity Model, Panel Data, Trade.

### 1. INTRODUCTION

Arab countries play an important role in Egypt's economic and trade policy. There are geographical proximity and common culture between Egypt and the other Arab countries [1]. From this point, Egypt tries to increase the prospects of cooperation and overcome obstacles to increase trade exchange with other Arab countries. This contributes to increase trade cooperation and set up joint investment projects to achieve sustainable development for all Arab countries. As it is also intended the natural and human resources to achieve economic welfare. Therefore increasing trade exchange and pushing Egypt's exports into the Arab markets depends primarily on Egypt's ability to achieve comparative and competitive advantages. The Egyptian market is considered one of the emerging and promising markets in Africa and the Middle East.

The foreign trade sector has an important part in the Egyptian economy, where the percentage of trade openness rose from 39% in 2000 to 72% in 2007 [2]. Although this sector has a large importance in Egypt's economy, it still suffering from severe shortage over the last years. It has been noted that Egypt's exports represents only 10% of the economy, this amount is a modest percentage can't eliminate unemployment problem and can't increase tax revenues needed to reform Egypt's financial position, which began to worse since the revolution of January 2011. In spite of these difficulties and problems, many analysts are betting on the boom and the recovery of Egyptian exports during the next few months if a minimum of political stability has been recovered.

Despite the geographical proximity and common culture, the volume of trade exchange between Egypt and Arab countries is considered not much between the two sides. Egypt's Exports to and imports from the Arab countries represent only 30% and 13% of the Egyptian total exports and imports, respectively during the period 2008-2013. Therefore, it is difficult to reduce the deficit of the trade balance and get the foreign cash necessary to achieve the economic development. This indicates that the Egyptian exports to Arab markets are still a little small.

As the importance of foreign trade sector in the Egyptian economy, it is important to know and identify the economic factors that affect the total trade in general, exports and imports of Egypt in particular. The research will focus on the Arab countries as it has an important role in Egypt's economic and commercial policy as mentioned before.

Egypt has a positive balance of trade with the Arab countries, estimated at 5.2 billion pounds in 2013. Therefore, the research aims to how to increase the volume of trade between Egypt and the Arab countries.

It is no doubt that identifying these economic factors that affect the trade exchange between Egypt and the Arab countries will help the government and economic policy makers to take appropriate measures to improve the foreign trade sector performance with the Arab countries.

### 2. METHODOLOGY

The research will employ the gravity model of trade based on a theoretical basis to interpret the trade and flow of goods. The model also takes into account the largest possible number of explanatory variables to the level of trade between the countries. The model was estimated using regression of cross-section data and time series "Panel Data" for the Arab countries which has available data. These countries are 19 countries (Algeria - Bahrain - Djibouti - Jordan - Kuwait - Lebanon - Libya - Mauritania - Morocco - Oman - Qatar - Saudi Arabia - Somalia - Palestine - Syria - Tunisia - United Arab Emirates - Yemen) during the period 2000-2013. The data was obtained from the United Nations database [3]. The distance between countries was obtained from [4].

## **2.1. Characterization of Gravity Model**

Gravity model has an importance in the international economy. It makes (in its basic form) expectations of trade flows based on the distance between countries and the interaction between economic sizes of these countries [5].

Jan Tinbergen [6] is considered the first one in applying the gravity model in the field of economics in 1962. He was awarded the Nobel Prize in 1969 due to the discovery of this model. The model was formulated as the following equation:

$$Y_{ij} = \beta_0 \frac{GDP_i^{\beta_1} GDP_j^{\beta_2}}{Dist_{ij}^{\beta_3}} \quad \dots \dots \dots \quad (1)$$

The previous equation can be converted to exponential equation as follows:

$$Y_{ij} = \beta_0 GDP_i^{\beta_1} GDP_j^{\beta_2} Dist_{ij}^{-\beta_3} \quad \dots \dots \dots \quad (2)$$

By taking the logarithm of both sides in the equation (2), this equation can be transformed into a linear form (Basic gravity model) for the economic analysis purposes as follows:

$$\ln Y_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j - \beta_3 \ln Dist_{ij} + \varepsilon_{ij} \dots \dots \dots \quad (3)$$

where,

$Y_{ij}$  represents the trade flow between the country i and the country j.

$GDP_i$  represents the gross domestic product of the country i. It reflects the economic size of the country i.

$GDP_j$  represents the gross domestic product of the country j. It reflects the economic size of the country j.

$Dist_{ij}$  represents the distance (in kilometers or miles) between the country i and the country j. It is an indicator of the cost of trade.

$\varepsilon_{ij}$  represents the random error of the regression equation.

In 1966 Linneman [7] added the population of the two countries to equation number 3 and called Augmented Gravity Model as follows:

$$\ln Y_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j - \beta_5 \ln Dist_{ij} + \varepsilon_{ij} \dots \dots \dots \quad (4)$$

The model also can include other independent variables as dummy variables ( $D_{ij}$ ) such as common borders, common language, common currency, and free trade agreements ...etc [8]. Because of the gravity model has double logarithmic form, the regression coefficients are the same as elasticity. The sign of this elasticity is consistent with the economic logic, where GDP has a positive relationship and the distance has a negative relationship with the dependent variable (exports or imports). The gravity model depends mainly on sectional data represent the number of countries and time series for the countries involved in the model.

As we mentioned before, this research aims to estimate the determinants of trade between Egypt and the Arab countries, using a regression analysis of cross-sectional data and time series methods (Panel Data). So in the beginning, it is useful to shed light on the approach of Panel Data used in this research.

### **2.2.2. Importance of Panel Data:**

In recent years, the panel data plays a vital role in economic studies. It takes into account the impact of time changing and the effect of changing between the data units [9]. Panel data means sectional views, such as nations or families or goods ... etc., observed over a certain period of time. In this research the panel data is employed in integrating the data of Arab countries (19 countries) over a period of time (2000 – 2013).

### **2.2.3. Model Variables and Estimation Methods:**

To achieve the objective of this study, the total trade has been employed in the first model, exports in the second model, and imports in the third model as the dependent variable, while a number of macroeconomic variables as a determinants of trade. Therefore, the research will include three models.

The first model: It indicates the determinants of total trade (exports + imports) between Egypt and the Arab countries.

$$\ln T_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j - \beta_5 \ln Dist_{ij} + \beta_6 D_{ij} + \varepsilon_{ij}$$

The second model: It indicates the determinants of Egypt's exports to the Arab countries.

$$\ln X_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j - \beta_5 \ln Dist_{ij} + \beta_6 D_{ij} + \varepsilon_{ij}$$

The third model: It indicates the determinants of Egypt's imports from the Arab countries.

$$\ln M_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j - \beta_5 \ln Dist_{ij} + \beta_6 D_{ij} + \varepsilon_{ij}$$

where:

$\ln T_{ij}$  represents the logarithm of the total trade between Egypt and Arab countries

$\ln X_{ij}$  represents the logarithm of Egypt's total exports to Arab countries

$\ln M_{ij}$  represents the logarithm of Egypt's total imports from the Arab countries

$\ln GDP_i$  represents the logarithm of Egypt's GDP

$\ln GDP_j$  represents the logarithm of Arab States' GDP

$\ln POP_i$  represents the logarithm of the population of Egypt

$\ln POP_j$  represents the logarithm of the population of the Arab countries

$\ln Dist_{ij}$  represents the logarithm of the distance between the capital of Egypt (Cairo) and the capital of the other Arab country

$D_{ij}$  represents a dummy variable takes the value 1 if there a common border between Egypt and the other Arab country, while takes a zero value if there is no common border between the two countries.

#### 2.2.4. Expected Signs of the Variables

The model includes many and different variables and it would be useful to explain some of these variables as follows:

GDP size: Income is considered one of the most important variables that determine the demand for total trade in general and the demand for exports and imports in particular [10]. GDP should be the trading index of the state, for example the GDP of the exporting country (Egypt) measures the productive capacity of Egypt's GDP, while the importing country measures the absorptive capacity of this state. Accordingly, the size of gross domestic product, whether in exporting or importing country has a positive impact on the size of trade. So, the coefficient of that variable whether for the exporting country or importing country will be positive.

Population: According to the economic logic, the population coefficient will be positive or negative depending on whether there was more business opportunities or not [11].

Distance: The distance between countries is an indicator of the cost of transportation between these countries [12]. To calculate the distance, the distance between capitals of the states is estimated. The greater the distance between the countries, the higher the transportation costs and less trade between the countries so the distance coefficient will be negative.

Common border: There is no doubt that the common border between the countries will increase the trade flow between countries; therefore, the coefficient of that variable will be positive [13].

In this research, the gravity model will be estimated through the random effects model which deals with the effects of panel data as random units and not fixed units.

#### 2.2.5. Panel Unit-Root Tests

Before estimating gravity model equations, this research analyzes the univariate characteristics of the data that entails panel unit root tests. Panel unit root test determines a potentially cointegrated relationship between the variables [14]. If all variables have no unit root i.e. are stationary, then the traditional estimation methods can be used to estimate the relationship between the variables. If the variables have unit root test i.e. are non-stationary, a test for cointegration will be performed. There are several different types of panel unit root tests, but in this paper two panel root tests will be investigated which they are Hadri [15] method and Levin, Lin and Chu (LLC) method [16]. These two methods assume that the autoregressive parameters are common across countries. The Hadri method uses the null hypothesis of no unit root, while LLC method uses the null hypothesis of a unit root. The results of these tests are presented in Table 1. The results of the LLC test show that all variables are stationary except the population of Arab countries. On the other hand, the results of Hadri test show that all variables are stationary. This paper uses a rejection of unit root by at least one test to conclude that the variables are stationary. Since the variables are stationary according to the Hadri test, it implies that there is no need to cointegration test, and gravity model equations can be estimated using the traditional estimation method.

**Table 1. Summary of panel root tests**

Variable	<b>LLC test</b>		<b>Hadri test</b>	
	<b>Null: Unit root</b>	<b>Null: No unit root</b>	<b>Null: Unit root</b>	<b>Null: No unit root</b>
T <sub>ij</sub>	-5.49905 (0.0000)***	9.61507 (0.0000)***		
X <sub>ij</sub>	-2.75667 (0.0029)**	10.3637 (0.0000)**		
M <sub>ij</sub>	-5.55620 (0.0000)**	7.79231 (0.0000)**		
GDP <sub>i</sub>	-3.93439 (0.0000)***	12.1254 (0.0000)***		
GDP <sub>j</sub>	-4.43559 (0.0000)***	13.0553 (0.0000)***		
POP <sub>j</sub>	-111.056 (0.0000)***	12.0343 (0.0000)***		
OPN <sub>j</sub>	2.18362 (0.9855)	11.4683 (0.0000)***		

Note: \*\*/\*\*\* Denote rejection of the null hypothesis at 5%/1% significance level

### 3. RESULT AND DISCUSSION

#### 3.3.1. Results of the gravity model for total trade between Egypt and the Arab countries:

Equation (1) in table (2) indicates the gravity equation for total trade to determine the factors that affect the trade between Egypt and the Arab countries. It is clear that the variables in the model (with the exception of border variable) explains about 78% of the changes in the total trade between Egypt and the Arab countries in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in the model. The model has proven to be a statistically significant at 1% level according to the value of F-test.

The results show that the increase in Egypt's GDP by 1% will increase total trade between Egypt and the Arab countries by 8.5%. Increasing the GDP of Arab countries by 1% will rise total trade between Egypt and those countries by 0.83 %. The results also indicated that increasing Egypt's population by 1% will lower total trade between Egypt and the Arab countries by 12% while increasing the population of Arab countries by 1% will increase total trade between Egypt and those countries by 0.35%. Increasing the geographical distance between Egypt and the Arab countries by 1% will lower total trade by 0.87 percent.

#### 3.3.2. Results of the gravity model for Egypt's exports to the Arab countries:

Equation (2) in table (2) indicates the gravity equation for exports to determine the factors that affect Egypt's exports to the Arab countries. It is clear that the variables in the model (with the exception of border variable) explains about 83% of the changes in Egypt's exports to the Arab countries, in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in that model. The model has proven to be a statistically significant at 1% level according to the value of F-test.

The results show that the increase in Egypt's GDP by 1% will increase Egypt's exports to the Arab countries by 9%. Increasing the GDP of Arab countries by 1% will rise Egypt's exports to Arab countries by 0.73 %. The results also indicated that increasing Egypt's population by 1% will lower Egypt's exports to the Arab countries by 11.5% while increasing the population of Arab countries by 1% will increase Egypt's exports to those countries by 0.41%. Increasing the geographical distance between Egypt and the Arab countries by 1% will lower total trade by 1.30 percent.

**Table 2: Estimation of Gravity model for Egypt's trade with Arab Countries during the period (2000-2013):**

Variables	(1)	(2)	(3)
	Total Trade	Exports	Imports
Constant	3.0355 (0.0800)	-15.0126 (-0.4268)	34.5634 (0.5320)
GDP <sub>i</sub>	8.5285 (5.8233)***	8.9666 (6.6011)***	7.4374 (2.9651)***
GDP <sub>j</sub>	0.8525 (7.2229)***	0.7333 (6.3044)***	1.3489 (5.7003)***
POP <sub>i</sub>	-12.0539 (-2.9399)***	-11.5291 (-3.0326)***	-12.9968 (-1.8522)*
POP <sub>j</sub>	0.3481 (2.6998)***	0.4108 (3.2261)***	0.1148 (0.4415)
Dist <sub>ij</sub>	-1.1271 (-3.4068)***	-1.3076 (-3.9503)***	-0.6506 (-0.9376)
D <sub>ij</sub>	-0.0396 (-0.0693)	0.2577 (0.4507)	-1.1590 (-0.9676)
N	266	266	266
Adjusted R <sup>2</sup>	0.78	0.83	0.46
F-test	156.334***	212.467***	38.628***

### **3.3.3. Results of the gravity model for Egypt's imports from the Arab countries:**

Equation (3) in table (2) indicates the gravity equation for imports to determine the factors that affect Egypt's imports from the Arab countries. It is clear that the variables in the model (with the exception of Arab countries population, distance, and border variables) explains about 46% of the changes in Egypt's imports from the Arab countries, in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in that model. The model has proven to be a statistically significant at 1% level according to the value of F-test.

The results show that the increase in Egypt's GDP by 1% will increase Egypt's imports from the Arab countries by 7.4%. Increasing the GDP of Arab countries by 1% will rise Egypt's imports from Arab countries by 1.3%. The results also indicated that increasing Egypt's population by 1% will lower Egypt's imports from the Arab countries by 11.5% while increasing the population of Arab countries by 1% will increase Egypt's exports to those countries by 13%.

## **4.CONCLUSION**

Given the importance and the role Arab countries plays in the Egyptian economy, it is important to find out the economic factors influencing Egyptian trade with these countries in order to help the government and policy makers to undertake appropriate measures to improve the performance of the foreign trade with Arab markets.

The main purpose of this research was to identify and evaluate the main factors that affect Egyptian trade in general, exports and imports in particular to the Arab countries. The analytical procedure includes the gravity model as one of the best theoretical framework to estimate total trade, exports, and imports equations using panel data for the period 2000 to 2013. Regression analysis was performed in random effects model.

Results of the gravity model for total trade between Egypt and the Arab countries indicated that the gravity equation for total trade to determine the factors that affect the trade between Egypt and the Arab countries. It is clear that the variables in the model (with the exception of border variable) explains about 78% of the changes in the total trade between Egypt and the Arab countries in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in the model. The model has proven to be a statistically significant at 1% level according to the value of F-test. The results show that the increase in Egypt's GDP by 1% will increase total trade between Egypt and the Arab countries by 8.5%. Increasing the GDP of Arab countries by 1% will rise total trade between Egypt and those countries by 0.83 %. The results also indicated that increasing Egypt's population by 1% will lower total trade between Egypt and the Arab countries by 12% while increasing the population of Arab countries by 1% will increase total trade between Egypt and those countries by 0.35%. Increasing the geographical distance between Egypt and the Arab countries by 1% will lower total trade by 0.87 percent.

Results of the gravity model for Egypt's exports to the Arab countries indicated that the gravity equation for exports to determine the factors that affect Egypt's exports to the Arab countries. It is clear that the variables in the model (with the exception of border variable) explains about 83% of the changes in Egypt's exports to the Arab countries, in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in that model. The model has proven to be a statistically significant at 1% level according to the value of F-test. The results show that the increase in Egypt's GDP by 1% will increase Egypt's exports to the Arab countries by 9%. Increasing the GDP of Arab countries by 1% will rise Egypt's exports to Arab countries by 0.73 %. The results also indicated that increasing Egypt's population by 1% will lower Egypt's exports to the Arab countries by 11.5% while increasing the population of Arab countries by 1% will increase Egypt's exports to those countries by 0.41%. Increasing the geographical distance between Egypt and the Arab countries by 1% will lower total trade by 1.30 percent.

Results of the gravity model for Egypt's imports from the Arab countries indicated that the gravity equation for imports to determine the factors that affect Egypt's imports from the Arab countries. It is clear that the variables in the model (with the exception of Arab countries population, distance, and border variables) explains about 46% of the changes in Egypt's imports from the Arab countries, in accordance with the coefficient of determination, while the rest of the changes due to other factors are not included in that model. The model has proven to be a statistically significant at 1% level according to the value of F-test. The results show that the increase in Egypt's GDP by 1% will increase Egypt's imports from the Arab countries by 7.4%. Increasing the GDP of Arab countries by 1% will rise Egypt's imports from Arab countries by 1.3%. The results also indicated that increasing Egypt's population by 1% will lower Egypt's imports from the Arab countries by 11.5% while increasing the population of Arab countries by 1% will increase Egypt's exports to those countries by 13%.

All these results can help the government and policy makers to undertake appropriate measures to improve the performance of the Egyptian foreign trade sector. However all these results are valuable, more researches and more data on Egypt's trade will add more and more to the foreign trade sector.

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## FACTORS AFFECTING EGYPT'S POTATOES EXPORTS IN THE GLOBAL MARKET

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### ABSTRACT

This paper investigates the factors affecting Egypt's potatoes exports in the global market. The research employed simple, multiple, and stepwise regressions (linear and double logarithmic) to determine the most factors affecting the demand for Egypt's potatoes export in the global markets especially to the German and Greek markets during the period 1995-2011. The results indicated that the most factor that affect Egypt's potatoes exports to Germany is the population of Germany. The results showed also that the most factors affecting Egypt's potatoes exports to Greece are the price percentage of potatoes exports between Egypt and France in the Greek market, exchange rate of USD and the percentage between Egypt's potatoes export price and the average export price of all competing countries in the Greek market.

**Keywords:** Egypt, Potatoes, Exports, Regression analysis

### 1. INTRODUCTION

Exports play an important and vital role in the economies of various countries in general and developing countries in particular. Exports are considered a major source of foreign currency needed to the economic development in those countries and to reduce the deficit of trade balance [1].

Agricultural exports have a large proportion in Egypt's total exports. Horticultural crops (fruit and vegetables) play a very important and major role in Egypt's agriculture [2]. This is demonstrated by the increase in the area planted to these crops. The main export crops in Egypt are rice, cotton, oranges, potatoes and onions. Egyptian exports in general and exports of vegetables in particular are facing many challenges and difficulties as a result of the changes that the world has witnessed in recent years. World Trade Organization played a vital role in liberalization of global trade, and a lot of economic blocs have been emerged.

Among the different types of world vegetables, potatoes have an important place. Potato is considered one of the most high economic value crops, because of its increasing demand locally and internationally for its various uses [3].

Potatoes have a special importance among vegetable crops that Egypt export. It is sharing with a large amount in Egypt's agricultural exports [4], where the average export value of that crop reached to 64.65 million Egyptian pounds during the period (1995-2012) representing about 5.5% of the annual average of total agricultural exports.

Egypt's exports of potatoes have fluctuated and deteriorated in recent years. Moreover, the geographical distribution of Egyptian potatoes in the global market is not distributed well and concentration was in few markets only. In addition to these problems, Egypt's exports of potatoes are facing competition from the other competing countries in the importing markets [5].

The main objectives of this research are to identify the relative importance of Egypt's potatoes exports in Egyptian total agricultural exports, study the geographical distribution of Egyptian potatoes, and determine the factors that affect Egypt's potatoes exports in the global importing markets.

### 2. MATERIALS AND METHODS

The research will depend on descriptive analyses methodology, in addition to the quantitative analysis methodology and using some different measurements such as simple, multiple, and stepwise regressions (linear and double logarithmic) to determine the most factors affecting the demand for Egypt's potatoes export in the global markets. This paper focused on Germany and Greece markets, where they are the biggest importing markets of Egyptian potatoes.

To identify the determinants of foreign demand for Egyptian potatoes exports, a set of factors that are believed to be more influential on the Egyptian potatoes exports were identified in these two markets. Two models have been investigated to determine the most factors affecting Egyptian potatoes exports in these two main markets.

The first model includes the exported quantity of Egyptian potatoes to the importing country as a dependent

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variable. The independent (explanatory) variables are price percentage of potatoes exports between Egypt and the competing country, population of importing country, average per capita GDP in the importing country, and exchange rate of USD in Egyptian pound.

The second model includes same variables in the first model except changing the first independent variable (price percentage of potatoes exports between Egypt and the competing country) with the percentage between potatoes export price of Egypt and average export price of all competing countries.

The relationship between variables is measured by the simple regression (linear and double logarithmic). The most appropriate forms that are consistent with expectations were chosen. Then, multiple and stepwise regressions (linear and double logarithmic) were analyzed between the dependent variable and the different explanatory variables that consistent with expectations [6].

The period chosen for this study is 1995 to 2011 (17 years) as this period witnessed substantial growth of trade. Data will be obtained from different sources including the documents of the ministry of agriculture, the central administration of agricultural economies, the central agency for public mobilization and statistics (CAPMAS) [7], food and agriculture organization (FAO) [8] and United Nations statistics division [9] concerning the years from 1995 to 2011, published journal articles, working papers, books, newspapers, conference and seminar proceedings etc.

### 3. RESULTS AND DISCUSSION

#### 3.1. The Geographical Distribution of Egypt's Potatoes Exports

Table 1 indicates that the average of Egypt's exported quantity of potatoes amounted to 278 thousand tons during the period 1995-2011. In terms of Egyptian exports of potatoes to world countries, Germany ranked first where the average exported quantity amounted to 51 thousand tons (10.5 million dollars); representing about 18 percent of Egypt's total exported quantity of that crop. Greece ranked second among the importing countries of Egyptian potatoes with 48 thousand tons (12 million dollars); representing 17 percent of Egypt's total exported quantity of potatoes. In the third ranking, Italy was among the importing countries of Egyptian potatoes with 45 thousand tons (11.8 million dollars); representing 16 percent of Egypt's total exported quantity of potatoes. Lebanon ranked fourth among the importing countries of Egyptian potatoes with 34 thousand tons (6.5 million dollars); representing 12 percent of Egypt's total exported quantity of potatoes. United Kingdom, Netherlands, Ukraine, France, Kuwait and Romania came in the fifth, sixth, seventh, eighth, ninth and tenth rankings with 32 thousand tons, 5 thousand tons, 3.3 thousand tons, 3 thousand tons, 2.9 thousand tons and 2.7 thousand tons; respectively during the study period (1995-2011).

Table 1 showed that the average export price of Egyptian potatoes amounted to 232 dollars per ton. The minimum average export price was 172 dollars per ton (in France) and the maximum average export price amounted to 341 dollars per ton (in Syria).

#### 3.2. Determinants of Egypt's potatoes exports in its main markets

The export policy of potatoes crop requires identifying the determinants of foreign demand for potatoes in global markets. Studying the demand in conventional global markets entails identifying the determinants of foreign demand for potatoes in each market of these markets, and then stand on the reasons of expansion or contraction of potatoes exports in these markets, as well as knowing the extent of competition that Egyptian potatoes faces it in global markets.

This paper focused on Germany and Greece markets, where they are the biggest importing markets of Egyptian potatoes with 99.5 thousand tons; representing 33.8 percent of the average exported quantity of Egyptian potatoes during the period 1995-2011.

To identify the determinants of foreign demand for Egyptian potatoes exports, a set of factors that are believed to be more influential on the Egyptian potatoes exports were identified in these two markets. Two models have been investigated to determine the most factors affecting Egyptian potatoes exports in these two main markets.

The first model: It includes the exported quantity of Egyptian potatoes to the importing country as a dependent variable. The independent (explanatory) variables are price percentage of potatoes exports between Egypt and the competing country, population of importing country, average per capita GDP in the importing country (in constant prices, year 2005=100), and exchange rate of USD in Egyptian pound.

The second model: It includes same variables in the first model except changing the first independent variable (price percentage of potatoes exports between Egypt and the competing country) with the percentage between potatoes export price of Egypt and average export price of all competing countries.

The relationship between variables is measured by the simple regression (linear and double logarithmic). The

most appropriate forms that are consistent with expectations were chosen. Then, multiple and stepwise regressions (linear and double logarithmic) were analyzed between the dependent variable and the different explanatory variables that consistent with expectations.

**Table 1. The geographical distribution of Egypt's potatoes exports (in average during 1995-2011)**

Country	Exported Quantity		Export Value		Export price (\$/tons)
	Quantity	%	Value	%	
Germany	51170.08	18.39	10570.78	16.35	206.58
Greece	48293.46	17.36	12208.62	18.88	252.80
Italy	45357.66	16.30	11791.98	18.24	259.98
Lebanon	34427.91	12.38	6529.40	10.10	189.65
UK	32278.69	11.60	7054.32	10.91	218.54
Netherlands	5135.84	1.85	1616.17	2.50	314.69
Ukraine	3293.99	1.18	1114.64	1.72	338.39
France	3149.52	1.13	542.96	0.84	172.40
Kuwait	2937.74	1.06	533.05	0.83	181.45
Romania	2777.57	1.00	548.96	0.85	197.64
UAE	1773.94	0.64	404.05	0.63	227.77
Croatia	1486.79	0.53	419.23	0.65	281.97
Oman	1089.24	0.39	202.80	0.31	186.13
Russia	1041.84	0.37	242.13	0.38	232.41
KSA	1039.24	0.37	285.99	0.44	275.19
Iraq	921.83	0.33	238.27	0.73	258.48
Albania	718.20	0.26	106.94	0.17	148.90
Czech	365.86	0.13	71.23	0.11	194.69
Belgium	324.93	0.12	88.76	0.14	273.17
Syria	274.06	0.10	93.51	0.15	341.20
Others	40341.61	14.50	9987.21	15.45	247.57
Average	278200.00	100.00	64651.00	100.00	232.39

Source: Central Agency for Public Mobilization and Statistics (CAPMAS)

### 3.2.1. Determinants of Egypt's potatoes exports in German market

Many attempts have been made to reach the most appropriate relationship between the exported quantity of Egyptian potato exports and its determinants in the German market during the period 1995-2011.

First model:  $\hat{Y} = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8)$

Second model:  $\hat{Y} = f(x_6, x_7, x_8, x_9)$

Where:

$\hat{Y}$  represents the estimated exported quantity of Egyptian potatoes to the German market

$x_1$  represents the price percentage of potatoes exports between Egypt and Belgium in the German market

$x_2$  represents the price percentage of potatoes exports between Egypt and France in the German market

$x_3$  represents the price percentage of potatoes exports between Egypt and Italy in the German market

$x_4$  represents the price percentage of potatoes exports between Egypt and Netherlands in the German market

$x_5$  represents the price percentage of potatoes exports between Egypt and Spain in the German market

$x_6$  represents the population of Germany (in thousand person)

$x_7$  represents per capita GDP in Germany (in dollar with constant prices)

$x_8$  represents exchange rate of USD in Egyptian pound

$x_9$  represents the percentage between Egypt's potatoes export price and the average export price of all competing countries in the German market

Multiple Stepwise regression (linear and double logarithmic) is used in the first and second models to determine the most independent variables that affect on Egyptian potatoes exports to the German market. The logarithmic form has the best results as below:

$$\text{Log}(\hat{Y}) = -692.90 + 141.68 \text{ log}(x_6) \dots \quad (1)$$

$$( -2.217)^* \quad (2.231)^*$$

$$R^2 = 0.249 \quad F = 4.978^* \quad D.W = 0.900$$

Equation 1 is consistent with the economic logic, where the population coefficient of Germany has the expected sign. The model is significant at 5% level, and the determination coefficient ( $R^2$ ) indicates that about 25% of changes in Egypt's potatoes exports to German market are due to the population of Germany.

### Determinants of Egypt's potatoes exports in Greek market

To determine the most variables affecting exported quantity of Egyptian potatoes to the Greek market, Multiple Stepwise regression (linear and double logarithmic) is used during the period 1995 – 2011.

First model:  $\hat{y} = f(x_1, x_2, x_3, x_4, x_6, x_7)$

Second model:  $\hat{y} = f(x_6, x_7, x_8, x_9)$

Where:

$\hat{y}$  represents the estimated exported quantity of Egyptian potatoes to the Greek market

$x_1$  represents the price percentage of potatoes exports between Egypt and Austria in the Greek market

$x_2$  represents the price percentage of potatoes exports between Egypt and France in the Greek market

$x_3$  represents the price percentage of potatoes exports between Egypt and Germany in the Greek market

$x_4$  represents the price percentage of potatoes exports between Egypt and Netherlands in the Greek market

$x_6$  represents the population of Greece (in thousand person)

$x_7$  represents per capita GDP in Greece (in dollar with constant prices)

$x_8$  represents exchange rate of USD in Egyptian pound

$x_9$  represents the percentage between Egypt's potatoes export price and the average export price of all competing countries in the Greek market

Multiple Stepwise regression (linear and double logarithmic) is used in the first model to determine the most independent variables that affect on Egyptian potatoes exports to the Greek market. The logarithmic form has the best results as below:

$$\text{Log}(\hat{y}) = 82193.34 - 48422.27 \log(x_2) \dots \quad (2)$$

(7.846)<sup>\*\*</sup>      (-3.676)<sup>\*\*</sup>

R<sup>2</sup>=0.470      F = 13.515<sup>\*\*</sup>      D.W = 2.050

Equation 2 is consistent with the economic logic, and the model is significant at 1% level. The determination coefficient (R<sup>2</sup>) indicates that about 47% of changes in Egypt's potatoes exports to Greek market are due to the price percentage of potatoes exports between Egypt and France in the Greek market.

Multiple Stepwise regression (linear and double logarithmic) is used in the second model to determine the most independent variables that affect on Egyptian potatoes exports to the Greek market. The logarithmic form has the best results as below:

$$\text{Log}(\hat{y}) = 49049 - 52872.93 \log(x_9) + 9068.01 \log(x_8) \dots \quad (3)$$

(2.730)<sup>\*</sup>      (-3.895)<sup>\*\*</sup>      (3.274)<sup>\*\*</sup>

R<sup>2</sup>=0.650      F = 13.012<sup>\*\*</sup>      D.W = 2.165

Equation 3 is consistent with the economic logic, and the model is significant at 1% level. The determination coefficient (R<sup>2</sup>) indicates that about 65% of changes in Egypt's potatoes exports to Greek market are due to exchange rate of USD and the percentage between Egypt's potatoes export price and the average export price of all competing countries in the Greek market.

#### 4. CONCLUSION

Potatoes have a special importance among the exports of vegetables in Egypt. . It is sharing with a large amount in Egypt's agricultural exports, where the average export value of that crop reached to 64.65 million Egyptian pounds during the period (1995-2012) representing about 5.5% of the annual average of total agricultural exports.

The main importing markets of Egyptian potatoes are Germany , Greece , Italy , Lebanon , the United Kingdom with averaged exported quantities 51.17 , 48.29 , 45.34 , 32.28 , 32.28 and 32.18 million tons respectively; represent approximately 18.39 % , 17.36 % , 16.30 % , 12.38 % , 11.60% of the annual average of Egyptian potato exports during the period (1995-2011).

This research aimed mainly to determine the most factors affecting Egypt's potatoes exports in Germany and Greece as the most important importer of Egyptian potatoes.

To identify the determinants of foreign demand for Egyptian potatoes exports, a set of factors that are believed to be more influential on the Egyptian potatoes exports were identified in these two markets. Two models have been investigated to determine the most factors affecting Egyptian potatoes exports in these two main markets. The first model included the exported quantity of Egyptian potatoes to the importing country as a dependent variable. The independent (explanatory) variables are price percentage of potatoes exports between Egypt and the competing country, population of importing country, average per capita GDP in the importing country (in constant prices, year 2005=100), and exchange rate of USD in Egyptian pound. The second model included same variables in the first model except changing the first independent variable (price percentage of potatoes exports between Egypt and the competing country) with the percentage between potatoes export price of Egypt and average export price of all competing countries.

The relationship between variables was measured by the simple regression (linear and double logarithmic). The most appropriate forms that are consistent with expectations were chosen. Then, multiple and stepwise regressions (linear and double logarithmic) were analyzed between the dependent variable and the different explanatory variables that consistent with expectations.

The results indicated that the most factor that affect Egypt's potatoes exports to Germany is the population of Germany. The results showed also that the most factors affecting Egypt's potatoes exports to Greece are the price percentage of potatoes exports between Egypt and France in the Greek market, exchange rate of USD and the percentage between Egypt's potatoes export price and the average export price of all competing countries in the Greek market.

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## THE REFLECTIONS OF EGYPT'S AGRICULTURAL AND ECONOMIC POLICIES ON PRODUCTION AND FEDDAN COSTS OF WHEAT CROP

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### ABSTRACT

The wheat crop is one of the most important crops in Egypt where it is imported from it is used to meet the lack in its production to face the consumption needs from it. So this research aims to shed light on the effect of the agricultural policies on production or costs for the wheat crop through achieving the secondary objectives in:

1-Studying the effect of the agricultural policy on the total productive costs items of the wheat crop.  
2- Studying the effects of the followed agricultural policies on the outcome of the feddan of the wheat crop.  
3-Studying the resulted effects of the followed agricultural policies on producing wheat by using the policy analysis Matrix [ P.A.M] Through it we calculate the economic outcomes and costs of the feddan to calculate the deals of effective protection and its rates and the standard factor to produce wheat. To achieve this aim, the study depends on the published and unpublished secondary data through the period [1986-2012] declared from the Ministry of Agriculture and the Economic Sector and the Central System for Public Statistics, besides the various references and researches and the scientific papers related to the topic of the study. This study reached to what follows.

1- It becomes clear from the records of production costs that the increase in the total cost resulted basically on the value of both the human, robot work and the rent among the rest of the items of the total cost of the crop which is the topic of this study.

Whereas this rate advantage increased after the State had adopted the policy of the economic release [1986-1997] About 0.08 while the increase in the rate advantage reached during the complete release period [1998-2012] to 0.09 .The Study reached some recommendations by which we can activate the policy of the economic reform to raise the strategies of farming the cereal crops especially the wheat.

**Keywords:** Egypt, Wheat, Production, Policy Analysis Matrix

### INTRODUCTION

Heading for releasing the agricultural sector began since the early eighties has begun to crystallize its framework in the state adoption to the policy of the gradual release aiming at getting rid of the disorders which hinder its way for long years and weakened its abilities in achieving the hoped targets from it these policies include several modifications, the most important one is deleting the quantity and price restrictions applied on the Egyptian farmer's shoulder And Reducing the role of the state in possessing Agricultural lands.

And deleting the obligatory system of importing crops. And releasing the prices of the agricultural production needs releasing the relation between the owner and the tenant of farm lands. Allowing the agricultural sector to trade in the agricultural production supplies. Besides entering the private sector in the fields of marketing and local and abroad trade to the basic agricultural goods.

Wheat is one of the most important crop of the strategic cereal crops. It's even the most important of the basic food groups of food which we can't live without it in feeding the population in Egypt. It's considered an essential resource of energy. In regard with Egypt's suffering in the lack of producing wheat. It seeks to complete the food gap from it by import.

### RESEARCH PROBLEM

The basic problem of the study crystallizes in working the volume of food gap from wheat in Egypt. Despite the multiplication of the political policies to reduce the food gap and increase the self-sufficiency through the economic reform programs generally in different sectors and especially in the agricultural sector ,but any modification or change in agricultural policies mechanism must be followed by several advantages and disadvantages on the efficiency of the agricultural and economic changeable items, Hence the problem of the study is related to the range of the efficiency of the adopted agricultural policies, whether the earlier periods in adopting the programs of the economic reform compared to the period adoption on the feddan production or costs of the wheat crop.

### RESEARCH OBJECTIVES

The research basically aims to study the agricultural policies and their effects on production and the feddan production of the wheat crop in Egypt through achieving the secondary aims as follows.

1-Studying the effects of the agricultural policies on the items of production and the outcome of the feddan.

2-Studying the resulted effects on the adopted agricultural policies of producing the wheat.

#### **DATA SOURCES**

The study depends on the published and the unpublished secondary data announced from the Ministry of Agriculture, the economic sector and the central **system of** general packaging and **statics** in addition to several references and findings and the scientific messages related to the study topic.

#### **MATERIALS and METHODS**

The style of the descriptive and quantitative analysis to appreciate and explain the phenomena related to

$$In_a = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**2 \_ The index of production costs Alfdanah change in labor costs Animal (B): -**

$$In_b = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**3 \_ The index of production costs Alfdanah of change in the automotive labor costs (C): -**

$$In_c = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**4 \_ The index of production costs Alfdanah change in the value of the seeds used (D): -**

$$In_d = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**5 \_ The index of production costs Alfdanah change in the value of municipal fertilizer (E): -**

$$In_e = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**6 \_ The index of production costs Alfdanah change in the value of chemical fertilizer (F): -**

$$In_f = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**7 \_ The index of production costs Alfdanah of the change in the value of pesticides used (G): -**

$$In_g = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**8 \_ The index of production costs Alfdanah change in the value of petty cash (H): -**

$$In_h = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**9 \_ The index of production costs Alfdanah change in the value of the wage (I): -**

$$In_i = \frac{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o}{A_1 + B_o + C_o + D_o + E_o + F_o + G_o + H_o + I_o} \times 100$$

**(B)**\_ Indices net yield of the crop: To measure the impact of each factor a component of the net yield per feddan Ali factors changes the incident which has been split record the simple to the following components:

**1\_ simple record net earnings change as a result of the amount of output (productivity per acre):**

$$In_Q = \frac{(Q_1 \cdot P_o) - C_o}{(Q_0 \cdot P_o) - C_o} \times 100$$

**2\_ record simple to change as a result of the net return per acre production costs:**

$$In_Q = \frac{(Q_1 \cdot P_o) - C_o}{(Q_0 \cdot P_o) - C_o} \times 100$$

Because crop under study is one of the crops resulting, one major and one minor secondary has been converted to the equivalent of the output of the main output. Using the following equation:

$$Q_{adjusted} = Q_1 + \frac{Q_0 \cdot P_0}{P_1}$$

Where it refers  $Q_1$  ,  $Q_0$  to the productivity per Feddan from the main output and secondary, respectively, and indicate  $(P_1 \cdot P_0)$  to an average price of the main product and secondary, respectively

Second: the style of the Mirrored policy analysis (PAM): -

In terms of knowledge, which can calculate the following: -

Protection measures (such as the nominal protection coefficient, and the coefficient of effective protection) or comparative advantage (DRC).

## RESULTS and DISCUSSION

### **First: The impact of agricultural policies on productivity costs Per Feddan wheat crop: -**

Table (1) shows the development of production cost of the wheat crop in terms of the Arab Republic of Egypt during the study periods (1986\_1997), (1998\_2012) of both current and real prices Based on this table data was calculated records of the costs of wheat production, which will be described in the following :-

#### **1\_index acre production costs as a result of change all cost items ( $In_1$ ):**

Table indicators show (1) that the record for the average total production costs per acre average during the period (1986\_2012) has reached 350.4%, 142.1% of the wheat crop and current prices on the real arrangement.

#### **2\_index acre production costs as a result of change in each of the various items of the wheat crop: -**

To determine the responsibility of each of the various items of cost Alfdanah of wheat and of the value of each of: the wages of workers, seeds, fertilizers, municipal, chemical fertilizers, machinery and wages, rentals in addition to all other cost items. That using current prices that these items may have caused changes in the total cost of the wheat may increase amounted to about 141.7%, 106.5%, 102.4%, 112.5%, 121.9% 152.1% 99.9% 102.9% 105.8%, respectively. When using real prices shown in Table (1) that these items may have contributed to the arrangement in the changes in the total cost of wheat by about 97.4%, 100.8%, 99.6%, 102.1%, 102.2% 0.136%, 101.8% 99.2% 101.4 % Respectively. The results of the analysis, whether ongoing or in real terms to an increase in the total cost of wheat during the period (1986\_2012) as a result of the increase in the value of each of the workers' wages, seeds, fertilizers municipal, chemical fertilizers, machinery, and wages.

### **Second, the impact of agricultural policies on the net yield per feddan of wheat: -**

#### **1\_record for net yield change as a result of all the factors ( $In_\pi$ ) :-**

Analysis shows the table number indicators (3) that the record for the net yield of wheat crop has reached 340.7%, during the study period (1986\_2012).

#### **2\_indexes to the net yield of wheat crop: -**

##### **A\_record simple net yield as a result of productivity change Per Feddan ( $In_q$ ) :-**

The results of the analysis in Table (3) that the record for the net yield due to changes in the quantity produced amounted to about 127.6% during the study period(1986\_2012), which shows that the positive effect of agricultural policies on the productivity per acre of wheat crop.

##### **B \_ To record the simple net yield farm price change as a result of: -**

Noted the table number data (3) indicates that the record for the net yield as a result of change farm price reached 442.2% during the study period (1986\_2012) which Abeben the positive effect of agricultural policies along the study period, the wheat crop.

##### **C\_Simple to record net return per Feddan as a result of changing production costs per Feddan:**

Study table No. (3) showed that the index of net feddan of wheat crop yield as a result of change of production costs per acre was about 50.8% during the study period(1986\_2012) where we note the low record for net yield along the study period . Which illustrates the negative impact of agricultural policies including the abolition of labor on agricultural production requirements and raise the rental value of acres and pricing that Almseitzimat by a strong market and the entry of the private sector in the field of production inputs trade.

**Table ( 1 ) : The development of production cost per Feddan wheat crop items at the level of the Arab Republic of Egypt during both periods study (1986\_1997)-(1998\_2012): Pound and current real prices .**

Statement year	Workers' wages		Animal labor costs		Agricultural machinery costs		Seeding costs		Municipal compost costs		Chemical fertilizer costs		Pesticide costs		General expenses		Rent farmland		Total	
	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms	At current prices	In real terms
1986	143.0	143.0	11.1	11.1	17.6	17.6	11.4	11.4	23.8	23.8	59.9	59.9	1.4	1.4	16.1	16.1	34.6	34.6	318.9	318.9
1987	134.5	120.8	3.4	3.1	81.0	72.8	19.7	17.7	14.9	13.4	26.1	23.5	1.1	1.0	22.2	20.0	50.3	45.2	353.2	217.5
1988	149.8	106.9	4.7	3.4	83.9	59.9	21.9	15.6	17.2	12.3	25.6	18.3	3.3	2.4	24.6	17.6	52.2	37.3	383.2	273.7
1989	148.6	84.7	4.6	2.6	90.9	51.8	26.5	15.1	17.4	9.9	42.5	24.2	1.7	1.0	23.3	13.3	52.1	28.7	407.6	232.3
1990	167.7	79.9	4.9	2.3	99.3	47.0	34.6	16.5	19.1	9.1	50.3	23.9	1.7	0.8	24.2	11.5	82.0	39.0	483.8	230.3
1991	170.0	69.8	5.2	2.1	114.4	47.1	44.4	18.2	20.5	8.4	73.1	30.0	2.3	0.9	36.6	15.0	95.6	39.3	562.1	230.7
1992	187.3	67.5	4.1	1.5	144.4	52.0	54.5	19.6	19.8	7.1	105.3	37.9	11.4	4.1	42.2	15.2	95.4	34.4	664.4	239.3
1993	200.3	68.6	6.5	2.2	160.8	55.1	57.8	19.8	27.9	9.6	116.9	40.1	7.7	2.6	62.9	21.6	300.0	102.8	940.7	322.4
1994	204.4	64.1	6.5	2.0	170.9	53.6	58.2	18.2	30.7	9.6	127.0	39.8	6.9	2.2	67.4	21.1	300.4	94.2	972.4	304.8
1995	216.6	63.9	8.2	2.4	202.4	59.7	61.1	18.0	31.2	9.2	133.5	39.4	9.3	2.7	72.8	21.5	300.6	88.7	1035.7	305.5
1996	228.8	62.7	7.6	2.1	212.3	58.4	64.3	17.7	40.4	11.1	136.0	37.4	15.3	4.2	77.5	21.3	305.3	83.9	1086.9	289.8
1997	239.2	65.8	7.1	2.0	218.6	60.1	71.8	19.7	42.1	11.6	136.9	37.6	21.4	5.9	80.9	22.2	308.6	84.9	1126.6	309.8
Average first period	182.5	83.1	6.2	3.1	133.0	52.9	43.9	17.1	25.4	11.3	86.1	34.3	7.0	2.4	45.9	18.0	164.8	59.5	694.8	281.7
1998	244.2	65.7	3.1	0.7	241.2	64.9	32.2	8.7	78.9	21.2	152.5	41.0	13.2	3.6	84.2	22.7	703.4	189.3	1552.9	417.9
1999	256.1	66.8	2.7	0.7	264.5	69	68.0	17.7	35.5	9.3	145.4	37.9	18.5	4.8	87.0	22.7	655.0	170.8	1532.7	399.7
2000	265.0	69.1	2.4	0.6	253.4	66.1	67.8	17.7	45.1	11.8	134.5	35.1	19.4	5.1	86.6	22.6	636.2	165.8	1510.4	393.9
2001	283.9	71.7	2.8	0.7	234.2	59.1	57.6	14.5	41.3	10.4	131.8	33.3	20.3	5.1	86.9	21.9	645.8	163.1	1504.6	379.8
2002	292.6	70.6	2.7	0.7	233.2	56.5	79.8	19.3	50.5	12.2	138.6	33.4	24.0	5.8	90.4	21.8	646.6	156.0	1558.4	376.3
2003	332.0	76.7	3.0	0.7	254.0	58.7	89.0	20.6	55.0	12.7	150.0	34.7	28.0	6.5	100.0	23.1	704.0	162.7	1715.0	396.4
2004	359.0	79.5	4.0	0.9	282.0	62.5	97.0	21.5	55.0	12.2	177.0	39.2	31.0	6.9	100.0	22.2	799.0	177.0	1904.0	421.9
2005	376.0	80.1	4.0	0.9	292.0	32.2	115.0	24.5	37.0	7.9	188.0	40.0	36.0	7.7	105.0	22.4	828.0	176.2	1971.0	421.9
2006	411.0	84.2	5.0	1.0	322.0	66.0	123.0	25.2	49.0	10.0	200.0	41.0	46.0	9.4	115.0	23.6	872.0	178.7	2143.0	438.2
2007	476.0	67.6	6.0	0.9	345.0	49.0	126.0	17.9	69.0	9.8	255.0	63.2	58.0	8.2	134.0	19.0	975.0	138.6	2444.0	347.2
2008	593.0	69.6	7.0	0.8	428.0	50.2	166.0	19.5	39.0	4.6	378.0	44.4	103.0	12.1	171.0	20.1	1260.0	147.9	3145.0	366.2
2009	648.0	80.6	7.0	0.9	456.0	56.7	177.0	22.0	54.0	6.7	404.0	50.3	57.0	7.1	182.0	22.6	1456.0	181.1	3441.0	428.0
2010	698.0	77.1	8.0	0.9	483.0	53.3	188.0	20.8	49.0	5.4	426.0	47.0	90.0	9.9	188.0	20.8	1550.0	171.1	3680.0	406.3
2011	845.0	81.4	7.0	0.8	557.0	53.6	206.0	19.8	78.0	7.5	435.0	41.9	93.0	9.0	222.0	21.4	1626.0	156.5	3869.0	391.9
2012	1006.0	94.5	8.0	0.8	580.0	54.5	230.0	21.6	106.0	10.0	433.0	40.9	100.0	9.4	247.0	23.2	1713.0	161.0	4423.0	415.9
Average second period	472.4	75.7	4.8	0.8	348.4	58.8	121.5	19.4	56.2	10.1	249.9	39.8	49.2	6.8	133.3	22.0	1004.7	166.3	2434.4	400.3

Source : Collected and calculated by the Ministry of Agriculture and agricultural land reclamation \_ Economic Affairs Sector \_ Agricultural Statistics Bulletin ' Sporadic numbers

- The referee based on the index of wholesale prices , considering that a year

**Table (2): the effect of changes in the various items of the average cost Alfdanah on changes in total costs for wheat during the study periods (1986\_1997), (1998\_2012)**

Cost items	At current prices%	At Real prices%
All cost items	350.4	142.1
Workers' wages	141.7	97.4
Wages animals	99.9	99.2
Wage machinery	121.9	102.2
Seeds	106.5	100.8
Municipal fertilizer	102.4	99.6
Chemical fertilizers	112.5	102.1
Pesticides	102.9	101.8
Expenses	105.8	101.4
Rent	152.1	136.0

Source: collected and calculated data from Table (1).

**Table (3): indexes to the net yield of wheat crop and the changes during the period (1986\_2012)**

Statement	The first period (1986_1997)	The second period (1988_2012)
	$\pi_0$	$\pi_1$
Net return per feddan by pound	660.7	2013.1
Indexes to the net yield in pounds as a result of change of each		304.7%
1_ All the factors influencing		
2_ Productivity per feddan		127.6%
3_ Price farm		442.2%
Production per Faddan costs		50.8%

Source: collected and calculated from the Ministry of Agriculture, bulletins Agriculture statistics, various issues.

### Third, the results of agricultural policy analysis matrix:

#### 1\_ Nominal Protection Coefficient Devices:

coefficient and the rate of nominal protection for wheat: The study showed that the value of the nominal protection coefficient of productivity requirements for wheat (during the study) less than the correct one, reflecting lower production requirements Introduction to producers of wheat prices on the global value ' The study also showed that the protection rate of wheat crop value during that periodic less than zero, which indicates that the implicit tax on the product internally. If it reaches the value of the nominal protection coefficient of the kits in the two periods before full liberalization towards 0.70, 0.90, in accordance with Table (4) This means decreasing directed to producers of 30% support rate, in the first period (1986\_1997) to about 10% in the period (1998\_2012).

#### 2\_ estimate coefficient and the nominal protection rate of return per feddan of wheat: -

As laboratories during the period (1986\_1997) according to Table (4) at about 0.70and this indicates the presence of an implicit tax on the product and consumer support, The product gets the equivalent of 70% of the value of its products at world prices. And it carries an estimated 30% of the revenues of these products at world price simplicit taxes. During the second period (1998\_2012) after full economic liberalization has been estimated at 0.80, which indicates the existence of support for wheat. This suggests the existence of an implicit tax on the product g is estimated at about20% of the revenues of these products is a resident at world prices.

#### 3\_ Estimate coefficient and the effective rate of protection (EPC) for wheat: -

Table shows indicators (4) The effective protection of wheat plants during periods ofthe study was about 0.70, 0.80, which indicates that the farmer only gets about 70%.80% of the added value of the global crop prices And bear implicit taxes and support for the consumer accounts for about 305.20% over the study periods despite the decline in the value of local production requirements for its economic value. In other words, the full economic liberalization to rent farmland policy led to higher value-added wheat crop.

#### **4\_ comparative advantage coefficient (DRC) for wheat:**

Results of measuring the comparative advantage of wheat transactions schedule No (4 ) During the lead up to full economic liberalization ( 1986 \_ 1997 ) It shows that it's about 0.08 . While this factor indicates 0.09 after full economic liberalization has shown that the Arab Republic of Egypt has a comparative advantage in the cultivation of wheat, because the results of laboratory fall from the correct one by a large margin and that throughout the study period

**Table.No (4) : Measure the results of the agricultural policies of the wheat crop in Egypt analysis matrix during both periods (1986 \_ 1997 ) (1998 \_ 2012 )**

Items	The first period	The second period
Nominal Protection Coefficient Devices	0.7	0.90
The rate of Nominal Protection Devices	30%	10%
Nominal Protection Coefficient products	0.70	0.80
The rate of nominal protection products	30%	20%
Effective Protection Coefficient	0.70	0.80
The effective rate of protection	30%	20%
The cost of local resources coefficient	0.08	0.09

Source: Collected and calculated by the Ministry of Agriculture\_Agricultural Statistics Bulletin Sporadic numbers

#### **RECOMMENDATIONS**

In light of the outcome of the results of the study were reached following recommendations: \_

- (1) Work to increase the output of wheat crop by providing this high productivity varieties in addition to encouraging and supporting the expansion of cultivation in the reclaimed land .
- (2) Rationalizing the consumption of wheat crop and work to reduce the proportion of quantitative and qualitative losses.
- (3) Studies need to work the crisis to assess the impact of liberalization policy on the production of the wheat crop in order to avoid the negative effects of this policy and that by modifying programs and procedures for economic freedom.

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**AN ANALYTICAL STUDY FOR THE DEVELOPMENT OF CONSUMERS' EXPENDITURE  
AND CONSUMPTION OF ANIMAL PRODUCTS IN EGYPT  
(CHALLENGES-OPPORTUNITIES)**

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**ABSTRACT**

This study aims to analyze the development of the Egyptian consumer spending and consumption of some important food commodities with a focus on animal products particularly in Egypt, during the period 1951 / 1952 - 2010 / 2011 to highlight the extent of change that has occurred on the average per capita of these commodities during the study period as well as estimating changes in consumer spending by estimating consumer spending functions on animal products to get to know the nature of those functions, so that it could be used in the development of consumer policy for such goods and to fill the gap between supply and demand for these commodities in Egypt.

It has been proved that the increase per capita consumption of animal production commodities in Egypt in recent years at the expense of other commodities, especially grains and starches was due to increased production but this increase is very small for the rate of increase of the population in the study period, especially if compared to average per capita consumption in the developed countries.

And has resulted in the statistical measurement of expenditure functions estimated that the values of the coefficients Elasticity calculated for commodities of animal production in studied period in urban and rural Egypt, do not represent significant differences for both consumption sectors and were all higher than the right one which indicates that the goods of animal production in Egypt until now are from the luxury goods. This research used the quantitative and descriptive statistical analysis to analyze the data. The study used the analysis of the most important factors affecting the consumption of animal products.

**Keywords:** Egyptian consumer, animal products, consumer policy, expenditure functions, Elasticity.

**INTRODUCTION**

Food from animal products' contains a large amount of proteins needed by the human in all different ages. Egypt is one of the poorest countries in the consumption of animal protein such that animal products which contain the protein with its continuous rising prices when compared to the rest of the food commodities (non-animal protein), which contain plant protein.

Animal products received acceptance in their consumption from various Income levels and various consumption patterns. As a result of lack of domestic production and a lack of supply of such goods in the market (food gap of meat), the constantly rising prices, affect the relatively low average per capita, especially for low-income levels .The study aims to identify the development of consumption of some important food commodities of interest to consumer goods in general and animal production, especially in Egypt, during the period 1951 / 1952 - 2010 / 2011, in order to highlight the extent of the change in the average per capita of these commodities during the period of study. It also aims at estimating the functions of consumer spending for animal products to get to know the nature of those functions, so that they could be used in the development of consumption policy plans of these consumer goods in Egypt. The study also is exposed to the most important problems facing reduced food gap of these commodities, with some points of solutions to fill in this gap.

**MATERIALS AND METHODS**

This research used the quantitative and descriptive statistical analysis to analyze the data. The study used the analysis of the most important factors affecting the consumption of animal products, red meat, white meat, fish, dairy products and eggs, a simple regression model in different forms, especially the linear model with all grades as well as the logarithmic function, and also used these models to estimate spending functions of animal products studied.

The research was based on data received from the Central Agency for Public Mobilization and Statistics, the food consumption data from various publications, research data of the family budget year 1974 / 1975 - 1981 / 1982 - 1995 / 1996, as well as research income, expenditure and consumption for 2010 / 2011 with the help of

some the data from the Statistical Yearbook, in addition to some references and research related to the subject of study in Egypt.

## RESULTS AND DISCUSSION

First: - In this part of the research, the study will tackle the annual household expenditure on food groups whether in urban or rural Egypt. It will also deal with the development of the average per capita consumption of food items in general and livestock production in particular, so that it can highlight the rate of the change in the average per capita of each of the items in the study period.

### 1 - Annual spending on the different food groups in both rural and urban Egypt :

To compare the developments in the annual expenditure of the sample households in both rural and urban Egypt to groups of different food and drink in the years from 1974/1975 until 2010/ 2011, as shown in table 1, shows that the portion of the annual expenditure of the sample households in rural areas of animal commodities, livestock production (animal protein) have risen from 30.5% to 43.5% of the overall spending on food and drink, compared with urban areas that proportion rose from 35.8% to 49.7% and a greater proportion of the countryside. It is clear also that the consumption of plant production rose in the countryside than in urban areas. For household expenditure on group of vitamins, it was found that the increase in the proportion of household expenditure in rural areas was clear as they reached about 5.5%, while in urban areas rose only by 1.2% in the period from 1974 / 1975 to 2010 / 2011.

As for spending on groups of carbohydrates, oils and fats has declined in both rural and urban areas are clearly for the benefit of animal proteins, vitamins in the previous study period.

### 2 -The development of per capita food commodities in Egypt:

Table 2 shows the development of average per capita of various food commodities in kg in the period 1951/1952 - 2010/2011, as shown in the following table: --

A - Declining per capita consumption of grain, starch and roots, tubers by 11.9% and 9.2% respectively, between the time periods 1981 / 1982 - 2010 / 2011.

B - An increase in average per capita consumption of vegetables and seeds from 7.3 kg on average from 19 81 / 1983 to 12.8 kg average during the period 2010 / 2011 and at an altitude estimated at 75.3%, while per capita consumption for each of sugar and plant oil from 35.1 to 44.5 kg and 13.9 to 15.4 kg, respectively, for the same prior periods.

### Second: - Estimating the functions of consumer spending on items of animal production:

Per capita consumption of several food commodities is estimated by several economic factors that affect consumption of livestock products in Egypt. These factors can be identified in: Changes in income, changes in commodity prices, changes in prices and quantities of alternative and complementary goods as well as demographic changes.

It is time-trend study of the relationship between the average annual per capita consumption of protein for each of the white meat, fish, dairy, eggs, and total livestock production Table 3, indicating that the amount of the annual increase in per capita consumption of protein was about 034. , 077. , 0.25, 023. , 0.36 kg per year, respectively (equations 3, 5, 7, 9, 11.), While a decrease in per capita consumption of red meat and plant protein product by 0.032 and 0.53 kg / year, respectively, equations (1, 13 ).

Note that the rates of increase and decline in all these equations (except equation 1) had been found significant at levels of 0.05 and 0.01.

It has been shown that the equations (2, 4, 6, 8, 10, 12) in its quadratic, Cubic and a half logarithmic forms of the amount of increase and decrease in the share of individual commodities as well as from the previous total livestock production (animal protein) and total plant production (plant protein) for the periods of different time series studied.

To measure the impact of the change in gross annual spending per capita in Egyptian Pound (L.E.) on food commodities per capita consumption expenditure on goods of animal production, red and white meat, fish, milk, cheese and eggs in both urban and rural areas of Egypt and the research data of income and expenditure and consumption common 2010 / 2011, it was the best reconcile mathematical model of a double-logarithmic form (Cobb Douglas) to represent the relationship between these two variables, as consumer spending on both types of meat y1, y4 fish y2, y5, milk, cheese and eggs, y3, y6 as dependent variables and in both urban and rural Egypt,

respectively and consumer spending total on food x1, x2 as independent variables in both urban and rural areas respectively. Table 4 shows the estimated relationship and features for both urban and rural areas.

As Seen from equations 1, 3, 5, representing the functions of consumer spending on both red and white meat, fish, milk, cheese and eggs in Urban Egypt in 2010 / 2011, it has been proved statistically that significant regression coefficients for all the models are described. Also proved that the value of coefficient of determination indicates that the total annual consumer spending on food (x1) (independent variable) explains between 95 - 99% of the changes in consumer spending on goods earlier, ranging from the value of the correlation coefficient between the two variables of 90 - 99%.

The elasticity of consumer spending power were estimated at 1.11, 1.01, 1.23, for each of red and white meat, fish, milk, cheese and eggs, respectively. They all exceeded the one, meaning that an increase in total consumer spending on food by 10% resulting in an increase in consumer spending goods studied at 11, 10, and 12%, respectively.

As shown in Equation 2, 4, 6, and represented the functions of consumer spending on the same goods in rural Egypt in 2010 / 2011 that it has proved statistically significant coefficients at the common levels for the previous models studied. Indicates coefficient of determination for these models and also the total annual consumer spending on food (x2) (independent variable) explains between 98 - 99% of the changes in consumer spending on the same goods, the value of the correlation coefficient between the two variables about 99%, while the elasticity of consumer spending were estimated at 1.23, 1.12, 1.23, of the goods, respectively, they all exceeded the One in the countryside, where an increase in consumer spending per capita by 10% resulting in increased spending on the same goods by about 12%, respectively, which indicates that the demand for goods of animal production in both urban and rural Egypt is elastic.

Spending elasticity is always higher than the Quantitative elasticity, which is the quantity multiplied by the price and the difference between the two is the quality elasticity, which are assumed positive. Higher income consumer uses the higher quality commodities. Thus; the dual logarithmic elasticity are reliable and closer to reality especially that the studied livestock production commodities are considered luxury goods.

### Third: - Challenges and Opportunities

The study shows that some problems facing reduced food gap of food products are:

- 1 - Rising food prices in the production of bio-fuel and competition between human and animal food.
- 2 - The prevalence of certain diseases affecting livestock led to reducing the supply of livestock products in Egypt.
- 3 - High prices of vaccines and drugs and the inability of small farmers for purchase, with the slaughter of female veal outside the proper places without supervision.
- 4 - Stopping the veal project which was adopted by the Ministry of Agriculture for the needs of markets and the provision of meat at reasonable prices.
- 5 - Exporting large quantities at certain times of the year to Arab countries which decreases quantity of meat in these times.
- 6 - The usage of raw sewage, agricultural and industrial pollution in the production of fish in lakes or fish farms, leading to contamination of fish disease and mortality, which is reflected on humans.
- 7 - The un-Conscious Management of the development of livestock through the import of living animals from East Africa, which may be infected with epidemic diseases.

### CONCLUSION

The study suggests some possible solutions to fill in the gap of food of animal products in Egypt in the following points:

- 1 - Government's interest in producers' especially young graduates in the desert areas and providing them with animal feeds, subsidized loans and veterinary medicines by means of exemption from customs to cope with rising prices.
- 2 - Increased self-sufficiency rate of feed through the use of components and materials from local field with raising the value of protein and starch.
- 3 - Depending on Municipal Buffalo which is appropriate for the Egyptian environment and resistant to most

diseases and the introduction of genetic improvements to increase it until it produces more of its meat and milk.

- 4 - Returning back to fattening veal project and providing loans to producers and recommending not to slaughter females, with access to the economic weight of small animals for sale.
- 5 - Importing meat slaughtered disease-free to cover the deficit in livestock products and provide investment for scientific research to increase the supply.
- 6 - Using clean water and treatment of fish production and increasing the wealth of fish.
- 7 - Providing animal products in the consumer cooperatives and reducing the number of greedy traders and high prices.
- 8 - Providing a database to build a linked system of livestock variables.

**Table 1: Pound annual spending compared to the families of the sample different food groups in both rural and urban Egypt in the family budget 1974/1975, 1981/1982, 1995/1996, 2010/2011**

Period	1974/1975		1981/1982		1995/1996		2010/2011	
Food Groups	(%)	L.E. <sup>(1)</sup>	(%)	L.E.	(%)	L.E.	(%)	L.E.
<b>Rural:</b>								
Food & Beverages	100.0	220.6	100.0	598.1	100.0	3152.4	100.0	4007.5
1- Proteins	30.5	75.0	36.2	216.8	41.1	1295.2	43.5	1981.2
2- Carbohydrates	35.9	79.2	31.9	190.6	270.7	870.8	23.8	1084.1
3- Vitamins	14.2	24.5	14.7	88.2	15.7	496.0	19.7	900.4
4- Others <sup>(*)</sup>	19.4	41.9	17.2	102.6	15.5	490.4	13.0	591.8
<b>Urban:</b>								
Food & Beverages	100.0	278.4	100.0	665.6	100.0	3574.6	100.0	5498.3
1- Proteins	35.7	99.5	37.6	250.1	48.9	1747.6	49.7	2731.2
2- Carbohydrates	24.6	68.3	22.8	152.0	20.1	713.9	18.7	1030.2
3- Vitamins	16.5	33.1	21.2	141.2	14.8	229.1	18.7	1029.5
4- Others <sup>(*)</sup>	23.1	77.5	18.4	122.5	16.3	584.2	12.9	707.4
<b>Average:</b>								
Food & Beverages	100.0	249.5	100.0	631.9	100.0	3363.5	100.0	4996.9
1- Proteins	33.2	87.3	36.9	233.5	45.2	1521.3	46.8	2337.0
2- Carbohydrates	30.3	73.8	27.4	171.3	23.6	792.4	21.1	1053.4
3- Vitamins	15.4	28.8	18.0	141.7	15.2	512.5	19.2	960.7
4- Others <sup>(*)</sup>	21.1	59.6	17.8	112.6	16.0	537.3	12.9	645.8

<sup>(1)</sup>Dollar = 6 Egyptian Pound (L.E.)

Source: Calculated from the family budget 1974/1975, 1981/1982, 1995/1996, 2010/2011.

**Table 2: The development of per capita of different food commodities in kg / year in Egypt in the period 1951/1952 – 2010-2011**

Period Food Commodities	(%) of Change between 1981-83 And 2006-08	1951/1952	1974/1976	1981/1983	1995/1997	2010/2011
Cereals	-11.9	169.4	260.0	308.8	335.8	272.0
Starch and Tubers Roots	-9.2	7.7	15.3	23.7	23.9	21.5
Sugar and Sweets	+26.8	16.1	26.5	35.1	37.0	44.5
Legumes and Seeds	+75.3	10.6	12.2	7.3	11.3	12.8
Fresh Vegetables	+16.4	36.1	96.1	129.6	149.3	150.8
Fruits	+46.5	36.5	64.5	67.6	92.0	99.0
Red Meat*	+23.2	9.1	<sup>(1)</sup> 7,4	9.9	10.6	12.2
White Meat	+215.9	...	3.1	4.4	10.2	13.9
Fresh Fish	+194.0	2.2	3.2	5.1	9.0	15.0
Dairy Products	+186.6	49.0	49.0	31.4	28.6	90.0
Eggs	+72.7	0.7	1.6	2.2	1.9	3.8
Plant Oils	+10.8	2.9	11.1	13.9	11.7	15.4
Total	+176.2	340.2	550.0	638.4	921.3	750.9

Unpublished data

\* Domestic and Imported

(1) Only Local

Source: Calculated from Bulletin consumption of goods in Egypt, various issues, Central Agency for Public Mobilization and Statistics.

**Table 3: Equations of general time trend of the average annual per capita consumption of animal and plant production in kg in the period of 1994-2010**

No.	Equations	R <sup>2</sup>	F
	A. Red Meat:		
1	$\hat{Y}_1 = 2.507 - 0.032t$ $(11.01)^{**} \quad (-1.032)$	0.10	1.1
2	$\hat{Y}_1 = 1.787 - 0.529t - 0.104t^2 + 0.005t^3$ $(0.016) \quad (0.197) \quad (0.152) \quad (0.146)$	0.32	1.24
	B. White Meat:		
3	$\hat{Y}_2 = 1.176 + 0.034t$ $(2.507)^{*} \quad (8.775)^{**}$	0.26	3.45
4	$\hat{Y}_2 = 0.919 + 0.315t - 0.063t^2 + 0.004t^3$ $(3.268)^{*} \quad (-2.1) \quad (2.283)^{*} \quad (2.293)^{*}$	0.63	4.53
	C. Fish:		
5	$\hat{Y}_3 = 0.506 + 0.077t$ $(8.976)^{**} \quad (10.077)^{**}$	0.91	100.95
6	$\hat{Y}_3 = 0.843 - 0.18t + 0.047t^2 - 0.002t^3$ $(10.982)^{**} \quad (-3.662)^{**} \quad (5.462)^{*} \quad (-5.483)^{**}$	0.98	138.37
	D. Milk:		
7	$\hat{Y}_4 = 0.506 + 0.077t$ $(2.738)^{*} \quad (5.718)^{**}$	0.77	32.69
8	$\hat{Y}_4 = 2.721 - 0.931t + 0.188t^2 - 0.009t^3$ $(4.1)^{**} \quad (-2.21)^{*} \quad (2.527)^{*} \quad (-2.258)^{*}$	0.89	21.49
	E. Eggs:		
9	$\hat{Y}_5 = 0.154 + 0.023t$ $(4.343)^{**} \quad (4.77)^{**}$	0.7	22.75
10	$\hat{Y}_5 = 0.277 - 0.029t + 0.004t^2$ $(7.42)^{**} \quad (-2.23)^{*} \quad (4.08)^{**}$	0.9	37.5
	F. Animal Production:		
11	$\hat{Y}_6 = 5.228 + 0.356t$ $(12.7)^{**} \quad (6.359)^{**}$	0.8	50.63
12	$\hat{Y}_6 = 6.282 - 0.096t + 0.035t^2$ $(10.779)^{**} \quad (-0.466) \quad (2.256)^{*}$	0.87	30.97
	G. Plant Production:		
13	$\hat{Y}_7 = 39.605 - 0.532t$ $(34.892)^{**} \quad (-3.453)^{**}$	0.55	11.92
14	$\ln \hat{Y}_7 = 39.719 - 0.015t$ $(32.695)^{**} \quad (-3.579)^{**}$	0.56	12.81

Where: \* significant at 0.05, \*\* significant at 0.01.

And  $\hat{Y}_1$ ,  $\hat{Y}_2$ ,  $\hat{Y}_3$ ,  $\hat{Y}_4$ ,  $\hat{Y}_5$ ,  $\hat{Y}_6$ ,  $\hat{Y}_7$  are annual averages for the estimated amount of red meat, white meat, fish, milk and eggs as well as the total animal production and plant production, respectively. T: is the element of time, 1, 2, 3.....,17.

Source: Calculated from Bulletin consumption of goods in Egypt, various issues, Central Agency for Public Mobilization and Statistics.

**Table 4: Double logarithmic function estimate for consumer spending on livestock production goods in Egypt in the period of 1994-2010**

No.	Equations	R <sup>2</sup>	F	E
	A. Red and White Meat:			
1	Urban: $\ln \hat{Y}_1 = 0.131 + 1.105 \ln x_1$ (8.064)** (65.06)**	0.99	642.297	1.11
2	Rural: $\ln \hat{Y}_4 = 0.012 + 1.234 \ln x_2$ (3.787)** (34.109)**	0.99	1163.421	1.23
	B. Fish:			
3	Urban: $\ln \hat{Y}_2 = 0.133 + 1.008 \ln x_1$ (4.776)** (35.150)**	0.99	1235.54	1.01
4	Rural: $\ln \hat{Y}_5 = 0.124 + 1.119 \ln x_2$ (6.102)** (48.642)**	0.99	2366.178	1.12
	C. Milk, Cheese and Eggs:			
5	Urban: $\ln \hat{Y}_3 = 0.010 + 1.229 \ln x_1$ (1.434) (12.561)**	0.9	159.779	1.23
6	Rural: $\ln \hat{Y}_6 = 0.02 + 1.233 \ln x_2$ (3.989)** (35.029)**	0.98	1227.039	1.23

Where:  $\hat{Y}_1$  ,  $\hat{Y}_4$  ,  $\hat{Y}_2$  ,  $\hat{Y}_5$  ,  $\hat{Y}_3$  ,  $\hat{Y}_6$  = annual consumer spending per capita on the red and white meat, fish, milk, cheese and eggs pound in both urban and rural areas in Egypt, respectively,

E: consumption spending elasticity

Source: Calculated from the income, expenditure and consumption research in Egypt in 2010/11, Volume IV, September, 2013.

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## COMMUNITY AWARENESS AND ADAPTATION STRATEGY TO THE EFFECT OF CLIMATE CHANGE IN YOBE STATE, NIGERIA

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### ABSTRACT

This study assessed community awareness and adaptation strategy to effect of climate change in Yobe state, Nigeria. Multi stage sampling technique was used to select 160 respondents in the state. Primary data collected from the respondents included the socio-economic characteristics of the respondents such as gender, age, marital status, and educational qualification, as well as their climate change awareness and adaptation strategy. The data were analyzed using descriptive statistics. Majority of the respondents in the state had low awareness to climate change and submitted that climate change has affected their socio-economic and agricultural activities in recent years. The effects identified were: reduced crop yield, shortage of water and biomass for animals due to low rainfall. It was also noticed that, there were frequent dry spells, cold spells, strong winds and thunderstorms. Similarly, high temperature causes wilting of crops and diseases. The respondents are making efforts to adapt to climate change in various ways such as planting resistant crop varieties, altering planting schedules, planting early maturing varieties and crop diversification. They however lack adequate information on how to adapt. It thus recommended that, adequate information and sensitization from the site of the government, non-governmental organizations and communities should be made available. Hence, appropriate technology as well as inputs should equally be made available in the study area.

**Keywords:** Adaptation, community awareness, climate change, effect, Yobe State.

### INTRODUCTION

Globally, climate change is recognized as a critical phenomenon with strong implications for socio-ecological, biophysical and human systems, and consequently human development. In Africa and many parts of the world, the impact of climate change is visible and widespread. Indeed, Nigeria is already experiencing the impacts of climate change, with more extreme weather events occurring, more variability in timing and intensity of rainfall and higher temperatures over the whole country (Abiodun et al. (2011).

It is evident that, Nigeria's key vulnerabilities to climate change, as stated by Nigeria's First National Communication (FNC) on climate change are: Heavy dependence of the economy and of individual livelihoods on rain-fed agriculture that is highly susceptible to fluctuations in rainfall and water supply; Exposure of northern Nigeria to accelerated desertification linked to increasing drought with resulting impacts on the local population and the natural resource base; Exposure of the nation's 850 km coastline to the threats of increased sea level rise and storm surge risk which could impact communities, infrastructure, coastal oil installations, endemic species of flora and fauna and spawning grounds for fish; Sensitivity of other sectors of the economy to climate variability such as Nigeria's electrical supply, which is heavily dependent on hydropower and thus is affected by fluctuations in rainfall; The pressure of high population growth in Nigeria which reduces resilience to a number of climate impacts; A lack of defined policies, low political will and limited financial resources to address the need for early action on climate change; and Limited organizational and technical capacity to respond. FNC, (2003)

Yobe state being an agrarian state; evidence on climate change have indicated that, there were delayed onset date of rains particularly in Northern part of the state, increase in the number of dry days during the raining season and increase in maximum temperature, strong winds, thunderstorms respectively (Abba, 2014). The state has also experienced accelerated desertification linked to increasing drought with resulting impacts on the local population and the natural resource base. Therefore, communities in the state had a serious problem of crop failure, or low yield arising from climate variability particularly the delayed onset of rains and the increasing length and frequency of dry spells during the growing season. In addition the problem of flood, high temperature and incidences of pests and diseases have also aggravated the irrigation and upland farmers' losses which consequently increase the incidence of poverty and malnutrition in the state. Unless appropriate mitigation and adaptation measures are taken, climate change will frustrate common man, particularly farmers' in their efforts to achieve sustainable agricultural production and food security. (Abba, 2014)

However, developing such strategies will require information from the target respondents in the study area since; the ability to adapt and cope with climate change depends on their knowledge, skills, experiences and other socio economic factors (Maharjan et al, 2011). It is against this background that this study seeks to assess community awareness on climate change and identify the community's response and their adaptation to climate change.

## METHODOLOGY

The study was carried out in Yobe State. The State as an agrarian home is located in the North East zone of Nigeria with its headquarters at Damaturu. It lies between latitude 12° 00'N and longitude 11.30° E, covering a land area of about 45,502 square kilometres (km<sup>2</sup>), with a population of about 2,321,591 people (NPC, 2006). It should be noted that, the climate of Yobe is hot and dry for most part of the year. In northern part which is hotter and drier in places like Geidam, Bade and Yusufari, while in the southern part the climate is milder especially in the rocky areas of Gujba, Gulani and Fika Local government areas (Orounye, 2009, Illoeje, 2000). The mean annual temperature of the state is 37°C, while the highest mean annual temperature is 420 c (Abba, 2014). Hence, the Annual rainfall in Yobe state ranges from 500mm-1000mm and the rainy season is normally from June to September in the north and May to October in the south. There is also, a dry season of between 3 to 4 month. It is therefore pertinent to note that, rainfall is one of the major climatic factor in the state and its distribution is highly irregular because, of the effect of continental air mass or Easterlies (T.C.A.M) and this makes farming difficult since little differences in the amount and timing of rain received determine the success and failure of critical stages in vegetation development and crop production (Abba, 2014). Desertification is also a major environmental factor affecting the state. It has been estimated that, the country loses about 5.11 billion dollars to environmental degradation and desertification (UNCCD, 1999). Yobe is estimated to have account for 73% of annual loss of resources from desertification among the eleven frontline states in Nigeria (YOSERA III, 2012 -2015).

However, in order to examine community awareness and adaptation strategies of respondents on climate change in the study area, all the three senatorial zones of the State were selected; taking one Local Government Area from each zone. The zones include: Northern senatorial zone; Central and South Zone respectively. Hence, to determine the sample size of the population in the study area, a multistage sampling technique was employed to get the respondents. In the first stage, three Local Government Areas were purposively selected in each zone: Bade in Northern zone, Bursari in Central and Fika in South zone, out of the seventeen LGAs in Yobe state, because of easy accessibility and to cut across the State. In the second stage, simple random sampling technique was used to select two villages from each Local Government Area, making a total of six villages. Thirdly, 10% of the population was randomly selected from each village, which form the sample size of (160) of the total population. The data collected were socio-economic characteristics of respondents, as well as their climate change awareness and adaptation in the study area. Data on Global Reports for climate change and related periodicals were also collected. The data were analyzed using descriptive statistics, involving frequencies and percentages.

## RESULTS AND DISCUSSION

This section presents the results and discussion of the data obtained from respondents on their socio-economic characteristics, community awareness on climate change and community's response and adaptation to the climate change.

### Socio-economic Characteristics of Respondents

The socio-economic characteristics of the respondents identified include; age gender, marital status, Household size and educational level. The results revealed that the age of the respondents ranged between 20 and 65 years with an average of 40 years. This implies that, the respondents are middle aged and so still physically active. This has direct bearing on the availability of able bodied manpower for agricultural production and also on the ease of adoption of climate change adaptation strategies. Also, age influences the ability to seek and obtain off-farm jobs, which could increase respondents' income that could help them cope with adverse change in climate. It was also observed in Table 1, that 97% of the respondents were married and 3% were single. This shows that most of the respondents will have greater responsibility than the single, which may encourage respondents to be committed towards their participation in agricultural production and off-farm jobs. Perez-Morales (1996), noted that there is a trend for rural youth to start having responsibilities at an earlier age than urban youth. The result in Table 1, further indicates that about half (49%) of the respondents had 6-10 people in their households, while, 31% had household size of less than 6 people. This implies that respondents had dependents to cater for and this could encourage their adaptation to climate change and their participation on farming and non-farm activities thereby improving their livelihood. The result on respondents' educational level

as indicated in Table 1 equally reveals that about 68% of the respondent had formal education. The respondents with no formal education were about 32%. This implies that majority of respondents had formal education. This could have implication for agricultural production and adoption measures that could result in climate adaptation. This could also be easier and faster among the educated respondents than the uneducated respondents.

Table: 1 Socio –economic Characteristics of respondents in the study area

<b>Variable</b>		<b>Frequency</b>
<b>Percentage</b>		
<b>Age (years)</b>		
20-29	19	11.9
30-39	52	32.2
40-49	54	33.8
50-59	34	21.2
60- above	1	0.6
<b>Marital status</b>		
Married	156	97.5
Single	4	2.5
<b>Household size</b>		
0-5	49	30.6
6-10	78	48.8
11-15	29	18.2
16-20	3	1.9
21-25	1	0.6
<b>Level of education</b>		
No education	51	31.9
Adult education	21	13.1
Primary	34	21.2
Secondary	38	23.8
Tertiary	5	3.1
Others	11	6.9
<b>Total</b>	<b>160</b>	<b>100</b>

### **Respondents' awareness and assessment of climate change**

#### **Awareness of climate change:**

Awareness of climate change help communities plan their socio-economic and agricultural production activities and reduce risks and uncertainties associated with farming and off-farm jobs. The distribution of the respondents according to climate change awareness is presented in Table 2. The distribution shows that majority of the respondents (about 88%) are not aware of climate change, while only about 12% seem to be aware of climate change.

**Table 2: Awareness of Climate Change**

Awareness of climate change	Respondents	Percentage
Yes 12.5		20
No 87.5		140
<b>Total 100.00</b>		<b>160</b>

**Assessment of temperature trend:**

The assessment of temperature trend in the State by the respondents is presented in Table 3.

The temperature trend in the State has been increasing as claimed by majority of the respondents (about 78%). Only about 11% of the respondents stated that temperature trend in the state has been decreasing, while about 6% claimed to have noticed no change. The increase in temperature in question has the tendency to inflict more harm not only on agricultural production but also on the ecosystem.

**Table 3: Assessment of temperature**

Temperature trend	Number	Percentage
Increasing	125	78. 1
Decreasing	17	10. 6
No change	10	6.2
Don't Know	8	5.0
<b>Total</b>	<b>160</b>	<b>100.00</b>

**Assessment of annual rainfall trend:**

Average annual rainfall in the state has been fluctuated due to effect of climate change. The distribution of the respondents according to their assessment of rainfall trend in the area is presented in Table 3. Majority of the respondents (about 75%) claimed that rainfall trend has been decreasing, while about 17% opined that rainfall trend has been on the increase. Only about 4% of the respondents claimed not to have noticed any change in rainfall trend in the area. Again, this opinion corroborated the previous research findings on general decline in annual rainfall in many part of Nigeria (Odjugo, 2009; Umar, 2011; Adebayo, 2011).

**Table 4: Assessment of annual rainfall**

Rainfall trend	Number	Percentage
Decreasing	120	75.0
Increasing	27	16.9
No change	7	4.4
Don't Know	6	3.7
<b>Total</b>	<b>160</b>	<b>100</b>

**Assessment of onset dates of rains:**

The trend in the onset dates of rains was assessed among respondents and the distribution is Presented in Table 4. The distribution shows that majority of the respondents (about 79%) claimed to have noticed delay in the onset dates of rains in the area, while about 9% claimed to have noticed early trend in the onset dates of rains. However, about 8% of the respondents claimed not to have noticed any change, while about 4% claimed ignorant. This study has revealed that climate change has brought about delay in the onset dates of rains in the area.

**Table 4: Assessment of onset dates of rains**

Trend of onset	Number	Percentage
Delay	127	79.0
Early	15	9.3
No change	12	7.5
Don't Know	6	3.7
<b>Total</b>	<b>160</b>	<b>100</b>

**Effect of climate change:**

On the effect of climate change on farming the distribution in Table. 5 shows that majority of the respondents (91%) claimed that climate change has affected their farming activities in the last ten years, while only 9% of the respondents claimed not to be affected by climate change in recent years. This study has revealed that climate change has affected farming activities in recent years of Yobe State.

**Table 5: Effects of climate change on farming activities in the last 10 years**

Awareness of climate change	Respondents	Percentage
No	145	90.6
Yes	15	9.3
<b>Total</b>	<b>160</b>	<b>100 %</b>

**Effect of low rainfall on farming activities:**

Rainfall amount in recent years has fluctuated in the State due to climate change. The distribution of respondents on how low rainfall affected their farm activities is presented in Table 6. The distribution shows that majority (about 83%) of the respondents had their crop yield reduced, about 13% had reduced water for animal, while about 4% had reduced grass or biomass. This therefore implies that low rainfall brought about by climate change has affected agricultural activities in the State.

**Table 6: Ways low rainfall affected farm activities**

Low rainfall effect	Number	Percentages
Reduced crop yield	133	83.1
Reduced water for animals	21	13.1
Reduced grass/biomass	6	3.7
<b>Total</b>	<b>160</b>	<b>100%</b>

**Effects of extreme/high temperature on farm activities:**

The results in Table 7 revealed that high temperature resulting from climatic change has affected agricultural production in the State. The distribution of the respondents according to the effect of extreme/high temperature shows that, majority of the respondents (about 81%) stated that high temperature has brought about wilting of their crops, 15% had their farm produce spoilt, while about 4% had their livestock dead. It is evident from this result that, high temperature brought about by ozone layer depletion has affected agricultural production in the State.

**Table 7: Effect of extreme/high temperature**

Temperature effect	Number	Percentages
Wilting of crops	130	81.2
Spoilage of farm produce	24	15.0
Death of livestock	6	3.7
<b>Total</b>	<b>160</b>	<b>100%</b>

### **Community adaptation to climate change**

#### **Respondents' effort to adapt to climate change:**

Table 8 shows the distribution of respondents on whether there were efforts made by communities to adapt to climate change. The information reveals that majority of the respondents (about 72%) stated that they have made efforts to adapt to climate change, while only about 28% claimed not to have made any effort to adapt to climate change. This reveals that most of the respondents in the study area have made efforts to adapt to climate change.

**Table 8: Efforts to adapt to climate change**

<b>Effort</b>	<b>Respondents</b>	<b>Percentage</b>
Yes	115	71.8
No	45	28.1
<b>Total</b>	<b>160</b>	<b>100 %</b>

#### **Adequacy of adapting information:**

The respondents were asked on whether they had adequate information on how to adapt to Climate change and their responses is presented in Table 9. The distribution shows that more than half of the respondents (about 75%) claimed not to have enough information on how to adapt to climate change, while about 25% claimed to have enough information. This study reveals that many farmers in the area do not have enough information on how to adapt to climate change. This corroborates the findings of Ishaya and Abaje (2008) in Jemaa local government area of Kaduna state, Nigeria.

**Table 9: Adequacy of information on how to adapt**

<b>Responses</b>	<b>Number</b>	<b>Percentage</b>
Yes	120	75
No	40	25
<b>Total</b>	<b>160</b>	<b>100 %</b>

#### **Factors limiting adaptation to climate change:**

Adaptation to climate change in the State is constrained by various factors. The distribution of the respondents on these factors is presented in Table 10. The table shows that about 66% of the respondents claimed that lack of information was the main factor hindering adaptation to climate change, while about 22% complained of appropriate technology. Also, about 9% of the respondents claimed the lack of necessary input as the factor hindering adaptation to climate change, while only about 3% complained of labour. This study reveals that lack of adequate information is the main factor hindering adaptation to climate change.

**Table 10: Factors hindering adaptation**

<b>Limiting Factors</b>	<b>Number</b>	<b>Percentages</b>
Information	105	65.6
Appropriate technology	35	21.8
Necessary input	15	9.3
Labour	5	3.1
<b>Total</b>	<b>160</b>	<b>100.00</b>

#### **Adaptation measures:**

Adaptation measures embarked upon by the respondents to minimize the effect of climate

Change in the area is presented in Table 11. The distribution shows that about 56% of the respondents use seed tolerant variety, while about 19% alter their planting schedule. Also, about 15% of the respondents' plant early maturing seed, about 6% use different tillage system, and about 3% diversify their crops. This study has revealed that farmers adapt different adaptive measures to minimize the effect of climate change in the area.

**Table 11: Adaptation measures being used by communities**

<b>Adaptation measures</b>	<b>Number</b>	<b>Percentages</b>
Tolerant seed variety	90	56.2
Altering plant scheduled	30	18.7
Planting early maturing seed	25	15.6
Using different tillage system	10	6.2
Crop diversification	5	3.1
<b>Total</b>	<b>160</b>	<b>100.00</b>

### **Conclusion and Recommendations**

Majority of the respondents in chosen communities of the state are aware of climate change and they submitted that climate change has affected their farming activities in recent years. The effects mentioned include lesser income, reduced crop yield, shortage of water and biomass for animals due to low rainfall and frequent dry spells. Similarly high temperature causes wilting of crops and diseases while excessive rainfall leads to destruction of farmlands and properties by flooding. The farmers are making efforts to adapt to climate change in various ways such as planting tolerant varieties, altering planting schedules, planting early maturing varieties and crop diversification. They however lack adequate information on how to adapt. However, the following recommendations were made towards effective mitigation of adaptation to climate change in the state; farmers should adjust planting dates to avoid crop failure due to late onset and early cessation of rains; Extension agents should be trained on climate change science to enable them pass adequate information to farmers on appropriate adaptation measures or strategies; farmers should be encouraged to go into dry season farming with support from relevant agencies.

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## CLIMATE CHANGE AND THE AGRICULTURAL SECTOR IN TURKEY

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### ABSTRACT

Turkey is a country located in a semi-arid climate. Future projections for the country show an increase in temperature and a reduction in precipitation. Climate change influences agriculture in Turkey in three ways: agricultural productivity; development (GDP -Gross Domestic Product); and food security. Productivity of wheat, the most important crop may decrease up to 15%. In terms of development, agriculture's share of GDP has fallen from 12% to 7.2 % over the past 10 years. Finally, food security will be affected by climate change in some areas of the country leading to the potential for environmental damage and social unrest.

**Keywords:** Climate change, Agriculture, Water Resources, GDP, Turkey.

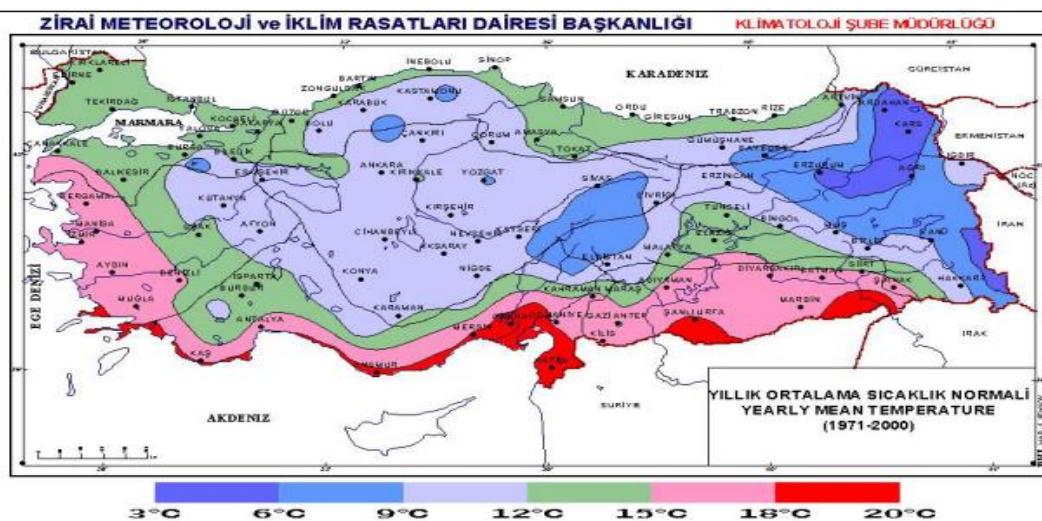
### INTRODUCTION

Turkey is located in the Mediterranean region and is susceptible to the effects of climate change (Ozcan and Strauss, 2015). As noted, the conclusions of most scholars is that future climate change will result in an increase in temperatures throughout the country as well as a reduction in precipitation in the southern half of the country. The Intergovernmental Panel on Climate Change (IPCC) (4th and 5th Reports) and other national and international scientific modeling studies demonstrate that Turkey in near future will get hotter, more arid and unstable in terms of precipitation patterns. In the case of increases in the global temperature of up-to 2°C; the expected impacts in the Mediterranean Basin which includes Turkey show the extent to which measures taken against the impacts of climate change need to be programmed (IPCC, 2007; IPCC, 2014; NCCAP, 2012). These findings are summarized below:

In the 4th IPCC Report it is indicated that a 1°C - 2°C increase in temperatures in the Mediterranean Basin would be observed. This suggests that aridity will be felt in an even wider area, and heat waves and the number of very hot days will increase especially in inland regions. For Turkey, on the other hand, the average increase in temperatures is estimated to be around 2.5°C - 4°C, reaching up to 5°C in inner regions and up to 4°C in the Aegean and Eastern Anatolia.

It is inevitable that for these changes to impact the country's water resources negatively by reducing the water potential in the southern basins. The projections that were based on the high emissions scenarios indicate water potential reductions up to 37% in the Mediterranean basins, up to 70% in Konya basin and up to 10% in the Euphrates and Tigris basins by the mid twenty first century (IPCC, 2007; Giorgi and Lionello, 2008). The decline in the water resources will, first and foremost, influence the agriculture, animal husbandry and related sectors. Hydroelectric energy production is another sector that will be negatively affected by the water potential reduction in Turkey. In addition, Turkey will be subjected to more droughts, heat waves and forest fires. The wider prevalence of Mediterranean climate in Turkey in the future (together with the expansion of warm summer period) will have positive effects in terms of both human life and tourism.

### Map: Average Temperature Distribution (1971-2000)



Source: (Turkish State Meteorological Service, 2010).

The most sensitive and weak areas against heat and cold waves in Turkey are Central Anatolia and Eastern Anatolia region. The weakest and most sensitive areas in terms of Turkey's precipitation climatology are Central Anatolia Region, inner Aegean and Eastern Anatolia Region. Central Anatolia Region is also quite sensitive to temperature. All action plans and strategies for adaptation to climate change should be prepared in accordance with these data.

**Table 1: Turkey's Top The Ten Warmest Years**

Year	Average Temperature °C	Normal Temperatures (1971-2000)	Difference °C
2010	15,20	12,81	2,39
2001	14,22	12,81	1,41
1999	14,10	12,81	1,29
1998	13,80	1,81	0,99
2007	13,75	12,81	0,94
2009	13,70	12,81	0,89
2005	13,68	12,81	0,87
2006	13,59	12,81	0,78
2008	13,54	12,81	0,73
2004	13,40	12,81	0,59

Source: (TSMS, 2011: 3)

The effects of climate change on the agriculture sector in terms of following three dimensions: (1) Agricultural productivity, (2) Food security, (3) Development (GDP and Agriculture).

### METHODOLOGY

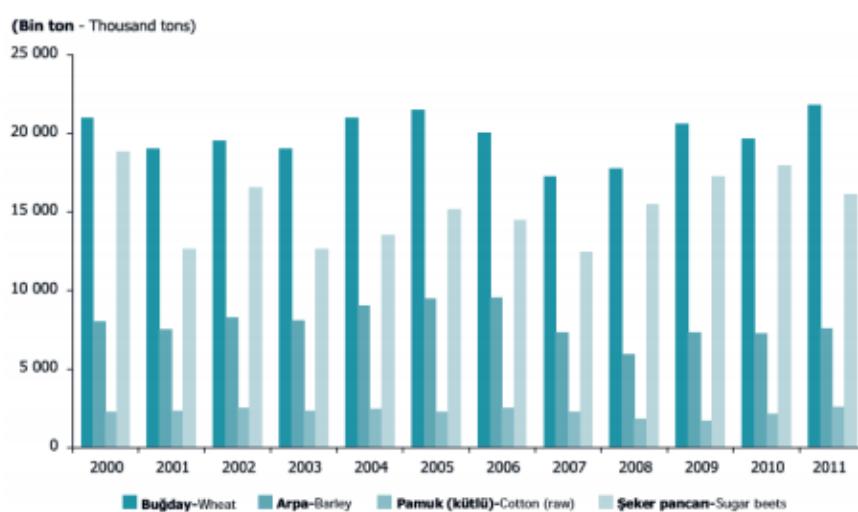
This study is part of a project whose overview was introduced in an earlier publication (Ozcan and Strauss, 2015). The methodology in this document is the same as stated earlier:

As this study is based on a literature review, it includes the studies on the general sources discussing the impacts of climate change on farmland and farming policies in Turkey carried out by several private and state institutions. Internet sources, books and articles published abroad on these topics have also been used. The research

methodology consists of interpreting previous studies, evaluating and synthesizing sources, identifying the impacts of climate change on farmland in Turkey. By this way, it has aimed to discuss the results of impact assessment of climate change on Turkish agriculture sector. The main method adopted has to evaluate, synthesize and establish relationships among the works from the relevant literature.

**Climate Change and Agricultural Productivity:** According to the Fourth and Fifth Assessment Report of the IPCC, it is estimated that climate change will cause agricultural product losses, devastation, reductions in product yield. It is also estimated that while 2°C temperature increase across the world will result in a 5% reduction in grain yield, and 4°C temperature increase will cause a 10% reduction in the yield. It is reported that the decrease in yield in Mediterranean region can reach to 25-35% (IPCC, 2007; IPCC, 2014). Arid and semi-arid regions such as South East and Central Anatolia and Aegean and Mediterranean Regions which do not have enough water and semi-humid areas will be affected a lot more by the temperature increase (Öztürk, 2002).

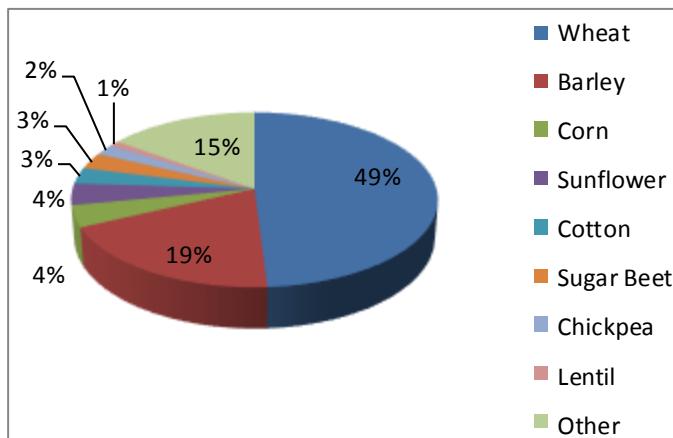
**Graph 1: Selected Cereals and Crops Varies by year (Turkey)**



Source: (TSI, 2012).

Grain crops is a group of the most cultivated products in Turkey. Wheat is the most planted crop and wheat production constitutes about half of the total arable land (49%). The crop is cultivated in all regions. Despite the variable amount of wheat production in some years in general, the values are fairly consistent over time. One of the most important reasons for wheat production flour and bakery products hold an important place in the nutrition structure of the population in Turkey. Barley production in 2005 and 2006 reached its the highest level. Production has been at a lower level since 2008 due to the effect of climate change. Cotton production has been steady and so ar unaffected by climate change. Sugar beet production in 2000 was at the highest level; in 2001, 2003 and 2007 the production has been decreasing gradually (see Graph 2, TSI, 2012).

**Graph 2: Product Design in Annual Production**



Source: (Biodiversity Monitoring and Evaluation Report, 2012).

As it can be seen from the above data, Turkey is one of the agricultural producers in the world. As of 2010, Turkey ranks the first in the world with a share in the hazelnut, apricot, fig, cherry, sour cherry and poppy production; ranks the second in the world with a share in the lentil, melon, watermelon production; chickpeas, pistachios, chestnuts, apples, cucumber, green beans, bell pepper in the third; tomatoes, mandarin orange, walnut, spinach in the fourth; sugar beet and olive in the fifth; wheat, barley, cotton and other products such as sunflower, lemon, tea is located in the top ten (Russell and et all, 2004, TUIK, 2012).

**Table 2: The Effects of Climate Change on Crop Yield\***

	Wheat	Barley	Corn	Cotton	Sunflower
<b>Black Sea</b>	-6,0	-7,0	<b>-7,4</b>		<b>-5,0</b>
<b>Marmara</b>	-10,3	-8,5	-7,9	-5,0	-5,9
<b>Aegean</b>	-7,2	-7,2	-11,0	-3,6	-6,6
<b>Mediterranean</b>	-6,5	-6,0	-10,9	-2,8	-6,8
<b>Central Anatolia</b>	-7,4	-8,2	-12,5		-7,3
<b>Eastern Anatolia</b>	-8,3	-8,5	-12,1		-7,9
<b>Southeastern Anatolia</b>	-7,2	-7,5	-9,2	-4,0	-6,3
<b>TURKEY</b>	-7,6	-7,6	-10,1	-3,8	-6,5

Source: (Gokyigit, 2013; NBSAP, 2007).

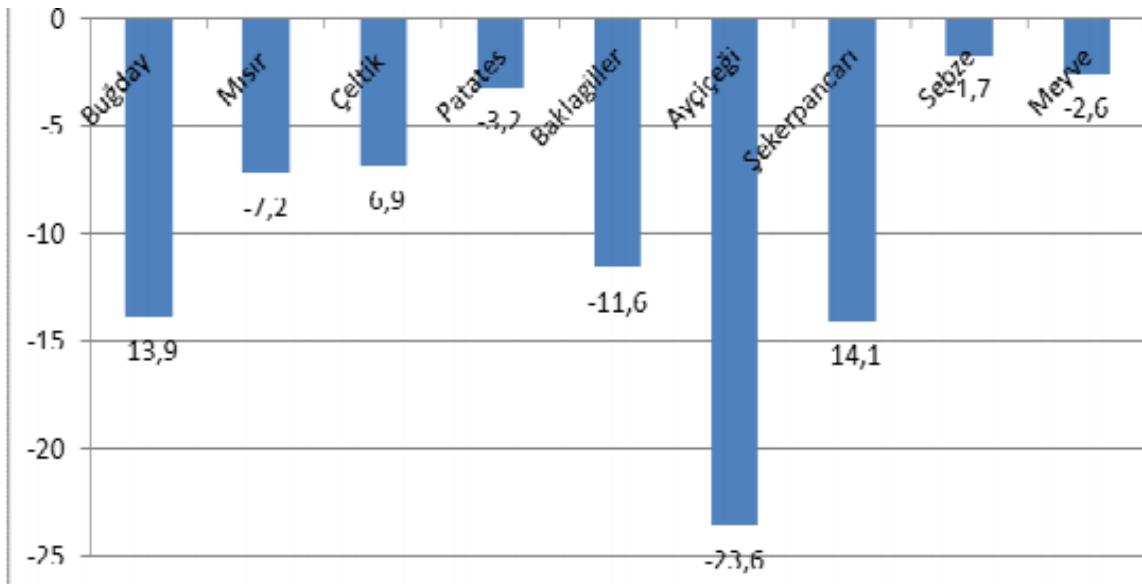
Climate change will force farmers to change their products. As a result of this, the sowing and planting dates and products types will be significant changes. Low yield in production of many products such as wheat, corn, soybeans would appear to be consistent with the dramatic climatic changes in the future (Ekim and et all, 2000).

The data suggest that 2007 can be taken as a sample year for the analysis of climate change impacts on agriculture. This is because the average increase in temperature and decrease in precipitation in 2007 showed a similar pattern to the climate projections for Turkey. In 2007, precipitation in all regions except East Anatolia realized lower than normal years and temperatures recorded 1.5 °C higher than normal years (TSMS, 2010).

\* There is no crop cultivation in empty spaces.

Reduced rainfall and increased temperatures have led to a decline in agricultural productivity and an increase in the loss of agricultural products. As can be seen in Graph 3 the amount of crop production decreased compared with the previous year. Ratios according to the type of crop are as follows: 14% of wheat, 7% of corn, %7 of rice and potatoes, 12 % of legumes, 24 % of sunflower, % 14 of sugar beet, 2% of vegetables and 3% of fruits decreased (TSI, 2008).

**Graph 3:: Changes in the amount of crop production for 2006-2007 (%)**



Source: (TSI, 2008)

**Climate Change and Food Security:** Today, it is already known that the agriculture sector is not only a victim of climate change but it is also one of the reasons that contribute to this phenomenon. The destructive impacts of climate change on agriculture should be dealt through the development, food security, environmental, biodiversity and sustainability of the ecosystem services (FAO, 2008, 9).

The effect of climate change on the agricultural sector is essential to food security. It is clear that agriculture in Turkey is the priority sector. Socioeconomically it has a dominant position in the supply of food needs of the population. Currently, those effects associated with climatechange have posed serious threats on food security. These include the reduction in water availability for agriculture, the degradation of water quality and the lack of protection of biodiversity and ecosystem services. This has led to the degradation of agricultural ecosystems, changing patterns of sustainable agricultural production, effects on livestock, pasture degradation and the lack of capacity of farmers on adaptation to climate change, and so on (Dellal and Butt 2005; Dellal and McCarl, 2007).

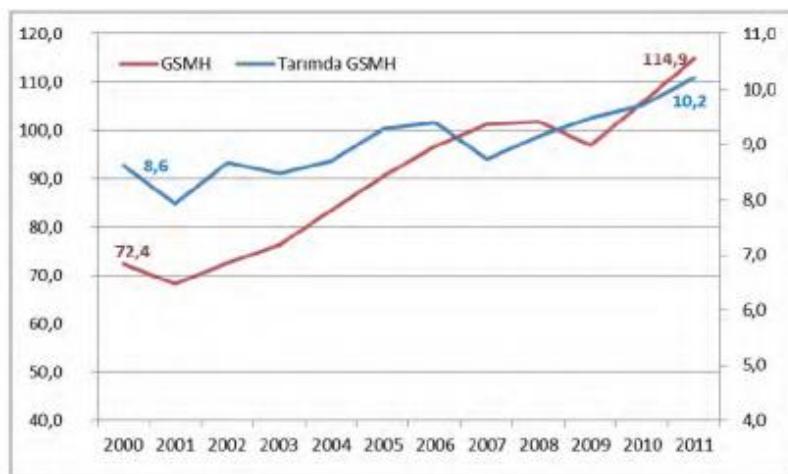
**Table 3: Impacts of Climate Change and Vulnerable Sectors/Region in Turkey**

Impacts	Intensity	Susceptible regions	Susceptible Sectors /Themes
Modification of river / basin regimes	Low	All regions	Ecosystem services and biodiversity
Diminishing surface waters	Medium	Western Anatolian region	Agriculture, water distribution infrastructure
Scarcity of exceeding usage water	High	Istanbul, Ankara, Aydin, Nevsehir, Bursa	Urban areas
	Medium	Afyon, Izmir, Kayseri, Muğla, Manisa	Agriculture, industry, energy
Floods	Medium	Black Sea and South-eastern Anatolian Regions	The survival of the agricultural farmer, human health
Soil loss / salinity	Low	Mediterranean, Black Sea and Aegean Regions	Tourism, ecosystem services, biodiversity, marine products
Soil loss / loss of quality of soil	Medium	South-western Anatolia	The survival of the agricultural farmer, human health, shallow lakes and wetlands
Coastal Erosion	Low	Black Sea Region	Fishing, unemployment
Degradation of marine ecosystems	Low	Mediterranean, Black Sea and Aegean Regions	Ecosystem services and biodiversity
Forest fires	Medium	Western Anatolia	Tourism, agriculture
Migration of species to other areas in order to survive	Low	Mediterranean region	Tourism, agriculture, food security
Decreasing agricultural productivity	Medium	Mediterranean and Aegean coastal areas	Agriculture (employment), food security
Lowering Hydro – Energetic potential	Low	Mediterranean region	Energy, industry
Lowering production of sea products	Low	Mediterranean region	Agriculture, food security, water distribution networks

Source: (Turkey's NCCAP, 2011:27).

**Agriculture and GDP:** As of 2013, the share of Turkey's agriculture sector in GDP is 8.4 percent (8.4%). In a 10-year period, the share of agriculture in GDP has declined from 12 % up to 8.4%, even though the amount of money continues to increase in GDP. As seen in Graph 4 below, while agricultural GDP at constant prices was 8.6 billion Turkish Liras (TL) in the early 2000s, this value increased to 10.2 billion TL in 2011 (Graph.4). However the share declined to 8.4 % with the development of other sectors. This ratio is less than 3% in countries like European Union and the US. This means that the importance of agriculture in Turkish economy is still ongoing (Ministry f Food and Agriculture... , 2014; TSI, 2015).

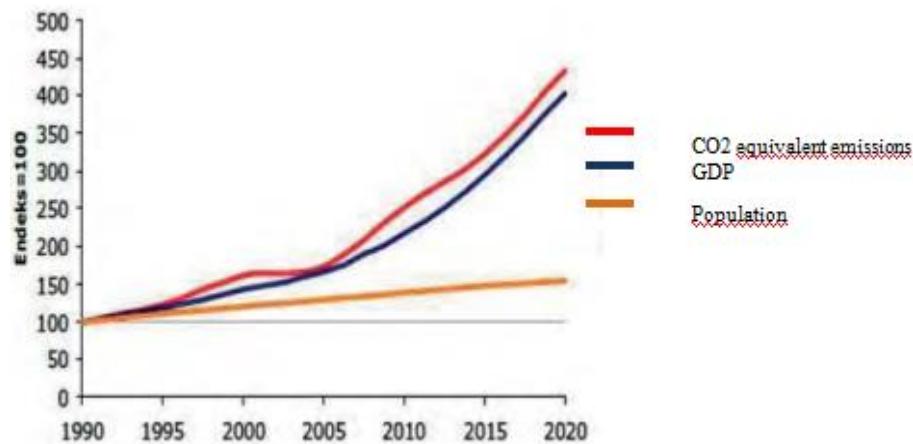
**Graph 4: Development of Agriculture in GDP in Turkey (at constant prices, 1998=100, TL billion)**



Source: (TSI, 2012a)

Carbon emissions have increased as a result of changes the sectoral GDP. Since 1990, GDP has increased and CO<sub>2</sub> emissions have increased in parallel in Turkey. It is estimated that this trend will continue to increase until 2020 (as seen in the Graph.5).

#### Graph 5: Turkey's GDP-CO<sub>2</sub> Emissions and Population Estimates



Source: (TSI, 2014)

Table 4: Greenhouse Gas Emissions by Sectors (CO<sub>2</sub> equivalent), 1990-2012

Year	Energy	Industrial processes	Agriculture	Waste	Total	Change compared to 1990 (%)
1990	132,9	15,5	30,4	9,7	188,5	-
1991	138,8	17,8	31,0	13,1	200,7	6,5
1992	145,1	19,0	30,9	16,7	211,	12,4
1993	151,6	21,0	31,1	19,5	223,1	18,4
1994	149,4	19,3	29,8	20,1	218,6	16,0
1995	161,5	24,3	29,2	23,9	238,9	26,7
1996	179,7	24,4	29,7	26,3	260,0	37,9
1997	192,1	24,2	28,2	28,7	273,2	45,0
1998	191,3	24,8	28,9	30,2	275,2	46,0
1999	191,3	24,0	29,1	31,6	276,0	46,4
2000	213,2	24,4	27,8	32,6	298,1	58,2
2001	196,6	23,4	26,4	32,7	279,1	48,1
2002	204,6	25,6	24,9	32,0	287,1	52,3
2003	218,6	26,3	25,8	32,8	303,6	61,1
2004	228,0	28,6	25,4	31,1	313,1	66,1
2005	242,4	28,8	26,3	33,3	330,7	75,5
2006	259,2	31,0	27,0	33,7	350,9	86,2
2007	289,4	31,0	26,8	35,3	382,4	102,9
2008	278,4	31,7	25,5	33,2	368,7	95,6
2009	279,0	33,2	26,1	32,9	371,1	96,9
2010	285,1	55,7	27,1	35,6	403,5	114,1
2011	301,3	58,6	28,8	35,3	424,1	125,0
2012	308,6	62,8	32,3	36,2	439,9	133,4

Source: (TurkStat, Greenhouse Gas Emissions Inventory, 1990-2012)

- No information.

- Denotes magnitude null.

The emissions and sinks from landuse, landuse change and forestry are not included.

Figures in table may not add up to totals due to rounding.

#### CONCLUSION

When evaluated in this framework, Turkey is dealing with an environment in which it is estimated that the world population will exceed 9 billion by the year 2050. Therefore, sustainability will become the common practice of farmers, not the exception. Therefore, development and implementation of new production methods adopting the principle of sustainability is an important requirement in the agriculture sector. There is a history of government commitment to this issue. Turkey is a country that has been a party to the Convention to Combat Desertification

in 1998. The main theme of the Convention was “soil and soil sustainability” in 2012.

Any changes in land use for agricultural production as a result of climate change in Turkey can affect the potential of agriculture production, plant species and their distribution and growth periods. Most farmland areas in Turkey is generally poor in terms of nitrogen that is one of the macro nutrients and the total rate of farmland areas that contain high organic matter is only 12%. Methods and implications reducing susceptibility to drought and heavy rainfall, and providing an increase in soil organic matter are so important options (Kanber, 2010).A balance must be sought between protection of the environment and enhancement of the physical resources of the soil.

Once the problem has been identified and the trends have been documented, the government faces some policy choices that are strategically important. These include the protection of agricultural areas, the effective use of soil and water resources, the support of the process of sustainable development with correct product planning, the development of the role of agricultural R & D to ensure food security as well as efficient resource use.

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## EVALUATION OF THE EFFICIENCY IN OLIVE GROWING FARMS IN TERMS OF INNOVATIVE SUSTAINABILITY (A CASE STUDY OF IZMIR AND MANISA)

Fatma ÖZTÜRK      Mine YALÇIN

### ABSTRACT

The efficiency in olive growing farms has a complex structure that many factors contribute. The farms have to have innovative features in order to consider each factor effectively. The main objective in the sector is to reduce costs, increase the efficiency and improve the quality of products. On the other hand, conservation of soil, water and the nature are important factors to be considered in the long-term.

The European Union member countries supply %70 of the olive production while the land size is about %50 of the total olive production land. This can be explained by the high productivity per unit area. In terms of global competition, the olive growing areas are considerably larger but the total production is low. In major olive production countries such as Spain and Italy, the yield reaches to 3000 kg per hectare while the yield in Turkey varies between 2000 and 2500 kg.

Based on the economies of scale, the most important issue affecting the efficiency is the size of the farm. The olive growing farms are at small and moderate size and the average land size is about 1.2 hectares. In this study it was found that the land size of %30 of the farms are at equal or less than 1 hectare and the ratio of non-innovative farms is about %51 (the ratio of being innovative in terms of technical and marketing issues).

Some socio-cultural issues also affect the innovation level and the efficiency of olive growing farms. It was determined that the farms that can be adopted to innovative concepts have more experience and higher education levels.

Another issue that affects the efficiency is the application of cultural operations and how they are performed in timely manner. It was also found that the farms with innovative approach are better than the non-innovative farms in terms of pest and disease control, irrigation, fertilizer application, implementation of soil fertility analysis, determination of harvest time and harvest type. But the level of the innovative farms is not sufficient.

In this study, the efficiency in innovative farms were found to be higher. In parallel to this, the profit of the innovative farms was found to be two fold of the profit gained by the non-innovative farms.

### 1. Material and Method

#### 1.1. Material

The main material in this study includes the data obtained from the olive growing farms in the Aegean region, provinces of Izmir and Manisa (the towns of Bayındır, Bergama and Akhisar).

#### 1.2. Method

##### 1.2.1 The Selection Method of Towns, Villages and Producer

##### 1.2.2. The Method Used for the Evaluation of the Data

#### 1.2. Metot

##### 1.2.1. Selection Method of Town, Village and Farmer

In this study that covering the provinces of Izmir and Manisa, three districts have been selected taking economic and ecological criterias. In addition to 3 villages have been selected in accordance with the opinion of the District Agricultural Directorate. Number of producer survey to be charged was selected from Producer Registry System. Using stratified random sampling method, 374 producer have been identified and in this research, interviews were conducted face-to-face. Land width of producer is divided into layers as 1-10, 10-20, 20-30 and over 30 acres.

##### 1.2.2. Evaluation Method of Data

The innovations of olive cultivation were determined. According to the innovations that have applied of each producer, points have been given to producers. The points scored are calculated into the index. Then all producer "highly innovative" and "low-level innovators" is divided into two subgroups.

Innovation index is calculated as follows:

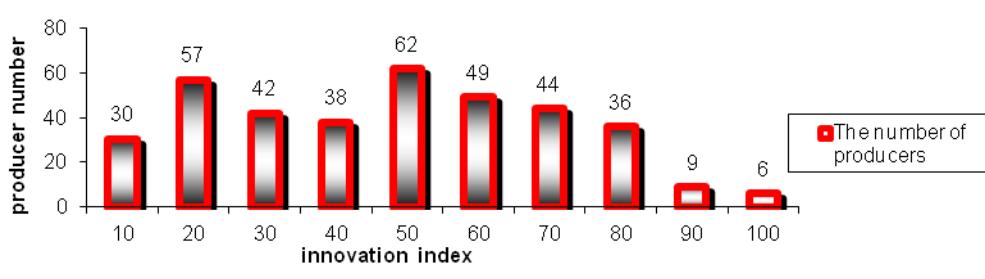
### **Innovation index = (PTP/PM )\*100**

PTP: Producer's total point

PM: Producer's maximum points can be taken

The number of olive producers whose innovation index is less than %50 is 230 and this group is accepted as lower level of innovators; the number of olive producers whose innovation index is more than %50 is 144 and this group is accepted as high level of innovators.

Figure 1. Distribution of Olive Growing Farms According to Innovation Levels



Moreover, description statistics like frequency and distribution of % accordance with the purpose were used. Chi-square test of independence is another statistical method was used (Düzungün et al. 1983).

## **2. BASIS SOCIO-ECONOMIC FEATURES OF OLIVE GROWING FARMS**

### **2.1. Age, Education and Experience Status of Producers According to Innovativeness Features**

Significant differences of age, experience and education status according to land size in observed farms were not determined.

Age averages are observed very close to each other considering age, olive production and education status according to innovativeness level among the groups. Olive cultivation experiences in non-innovative farms is detected as avergely 20 years, 9 years in innovative farms; education level as at primary level in both groups.

Taking into account of innovativeness level, it is observed that the total cultivated area in innovative farms are more (42,8), the average farm size in non-innovative farms is less (37,7). %30 of olive farms is determined as non-innovative and their size is 10 daa and less considering the size of farm. It can be expresses that farms adopt innovations take place among different groups at close rates.

### **2.2. Population and Labor Status in Farm**

When the average population is 3,6 in innovative farms, it is 3,1 in non-innovative farms. Although farms use family labor, employs external labors. Small farms are making olive production largely on their own resources. Observed farms are limited in terms of labor, and unqualified labors are employed to eliminate this problem. Although farms have convenient opportunities, they do not take advantage of technologies which will reduce the use of labor such as machine harvesting and drip irrigation system.

%67 of innovative farms is working in their own farms while this rate increases to %75 in non-innovative farms. It can be concluded that innovative farms are more relatively to the social life.

The olive growing farms in discussed, %17 of them are observed as member to none of any social security institution. However, considering at the distribution by groups, non-membership rate to any social security institution is %22 for non-innovative farms, while it is %9 for innovative farms. Non-membership rate to any social security institution of non-innovative farms is remarkable.

### **2.3. Relations between Cooperatives and Associations**

Considering relations between cooperatives and associations in terms of innovativeness level, more than one membership to organizations is determined. 21 innovative farms are the member of Agricultural Credit Cooperatives, while 98 of innovative farms are member of Chamber of Agriculture, 62 of them to Water Users Association and 21 farms to Agricultural Development Cooperative. However, all in addition, 26 producers are not member of any cooperatives or associations in non-innovative group.

### **3. ASSESSMENT OF CULTURAL OPERATIONS AND INNOVATION SUSTAINABILITY IN OLIVE GROWING FARMS**

#### **3.1. Reasons to Choose of Olive Cultivation and Seedlings Selection**

In terms of reasons for choosing olive grooving of farms, the most important reasons for non-innovative farms is traditional production habits, land suitability and possibility of product diversification. While land suitability is at the first place for innovative farms, second reason is profitable olive production, and lasfy preference of the product for family consumption.

One of the significant issues related to yield is to choose the seedlings of quality, suitable to region, ecology and purpose. Approximately %46 of innovative farms obtains their seedlings from special nurseries, while %35 of them from individuals, approximately %24 of non-innovative group produce their own seedlings by themselves.

#### **3.2. Plant Disease and Pest Control and Achievement Status**

Pests and diseases causes quality and yield lost for Olive growing in Turkey are olive fruit fly, olive fruit moth, black olive fruit maggot, olive fruit maggot, comma maggot, (*Phloeotribus scarabaeoides* Bern., *Zeuzera pyrina* L. (Lepidoptera: Cossidae), *Hylesinus oleiperda*, F., (Coleoptera. Curculionidae), *Spilocaea oleagina* (Cast) Hughes, and cancer. It is demonstrated with several studies that these pests and diseases consist %10–15 loss of olive fruit.

Olive fruit fly and olive fruit moth are determined as the most common pests at the research areas. Moreover, *Verticillium* is counted as an important disease. Other than these, diseases such as black olive fruit maggot, olive fruit maggot and *Spilocaea oleagina* (Cast) Hughes existed. Olive fruit fly is one of the most common pests which the pesticide is applied to generally within producer applying pesticide, through struggle troops of mass spraying by plane in peak periods of pests. Mass spraying was not applied at the period of this research project.

Considering period of producers applying pesticide according to their innovativeness levels, there is no much difference between two groups determined.

Considering the failure reasons of pests and disease control according to innovativeness levels of the farms, failure rate is observed high (%58,3) in non-innovative farms. Financial difficulties take the second place as a failure reason for pests and disease control. While all innovate farms make pest control by disinfection, about %20 of non-innovative farms do not apply any pest control methods.

Because of external dependence of applied pesticides, particularly insensible pesticide usage cause big problems for human health, protection of the ecology and exports. To resolve the problems arising from pesticide residue, awareness of producers should be raised in this regard and unnecessary usage should be avoided.

#### **3.3. Leaf and soil analysis Motivations Status**

On the whole, approximately quarter of the farms make leaf and soil analysis. Wen farm groups are evaluated separately, %95 of small scale farms do not make analysis, approximately %40 of 30 daa and over large farms make these analysis.

Considering innovativeness status of the farms, Leaf and soil analysis Motivation is high of innovative farms. Leaf and soil analysis Motivation rate is %60 for innovative farms, while /8 for non-innovative farms.

#### **3.4. Fertilizer Use Status**

Plant nutrition control through fertilization is one of the primary care techniques to reach desired level of production quantity and quality and ensuring sustainability. Then, besides the growth of the tree, approach of plant nutrients taken by products to be given to the soil again is given particular importance. Olive fruit production on poor and poor-base soil, on unproductive or less productive soils and dry conditions affect the yield negatively. Plant nutrition needs can be provided by fertilizer considering the periodicity property.

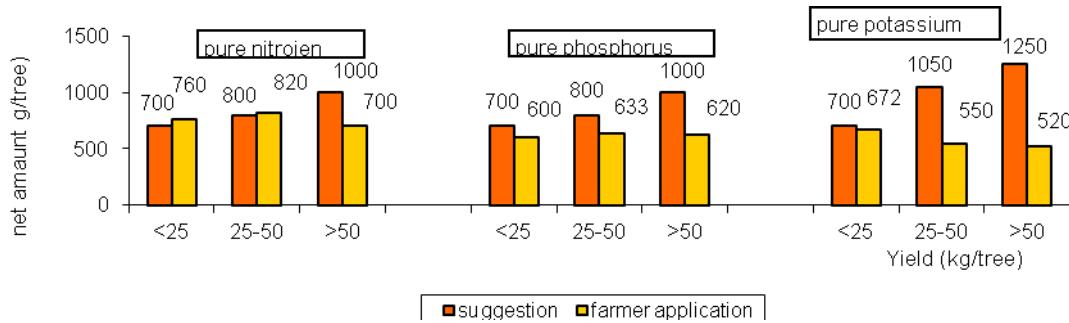
Inadequate fertilizer use at orchards reveals drawbacks such as low yield, not to attain the desired size of the fruit, not enough coloration, and inadequate fruit set; while excess fertilizer use cause negativeness such as blocking the reception of some other nutrients by fertilizers, infertile soil every year and disruption of soil structure, pollution of underground water and increase of product price because of antagonistic effects between nutrients.

It was determined in the study that non-innovative farms give less importance to fertilization. All fertilizer doses used is below the needed level and inadequate use of fertilizers is concerned

Fertilization issue is not neglected by innovative olive fruit producers. Nitrogen fertilizer usage is above the

optimal level while phosphorus and potassium fertilizers usage is at insufficient level which affects the quality of table olives positively (Figure 2).

Figure 2. Fertilizer usage level at innovative farms



### 3.5. Irrigation Status

Olive fruit is produced situated on more than 200 mm rainfall less than 1000 mm in Akdeniz basin, and known as drought tolerant tree that generally gives product without irrigation. Even it is known as drought tolerant plant and needs less water; this statement is not valid for obtaining economical products. Irrigation is effective for improving of quality while coarsening of the fruit, increasing of pulp/core rate; also providing regular yield of tree through stimulating the development of exile. Increase on quality provided by irrigation gain importance in terms of olive fruit production (Özilbey, 1998). %41 of the farms addressed in the study do not make irrigation.

When the irrigation resources is concerned according to farm size, it is observed that all the land groups benefit from artesian water at above % 80 rate.

Considering water researches usage in terms of innovativeness level of the farms, approximately %82 of innovative farms use artesian water, while it is %30 at non-innovative farms. 139 of 154 farms which are not watering olive trees are situated in non-innovative group which means %60 of dry olive cultivation farms are at non-innovative group and %10 of the rest of the farms that make dry cultivation is at innovative group.

Mainly preferred irrigation system by producers watering olive trees is drip irrigation this research. While Land width is increasing the proportion of preference for drip irrigation is increased. Drip irrigation usage rate is above %81 at big scale farms which are addressed as 30 daa and above. If the farm is innovative usage rate of drip irrigation is increased to %91.

It is determined that irrigation is more taken importance at Akhisar region where table olive fruit producers are more. Importance of drip irrigation system is increased each passing day while particularly water is very important nowadays. Therefore, trainings and extension studies related to irrigation systems should be given importance.

### 3.6. Pruning in the Olive Tree

Pruning olives; is the processing chain applied to the trees to change their natural growth shapes by encouraging or preventing the growth of the branches in order to give a specific shape on trees and to bring them to the maximum efficiency. Even pruning in certain times, pruning gives the possibility to regulate or renovation all or a portion of the tree (Ozen, 1998). By implementing proper pruning techniques in olive, reduction of alternans, increasing the average product amount of plantation, raising the quality and profitability of olives can be provided (Pastor, 1989). In terms of aquaculture, substantially, by pruning, there is an aim to strike a balance between the vegetative and generative growth of tree, in current development conditions.

It has been determined that, according to farms groups 55% of the olive farms which have 30 acres and over of pruning make professional working people done this cultural process. (cümle böyle daha doğru)

When the pruning situation of farms is investigated according to the level of innovation, it is determined that while about 68% of innovative farms having somebody (professional persons) do pruning, about 76% of non-innovative farms doing the pruning by itself.

While half of the innovative farms are learning the pruning by going to the course, it is seen that in non-innovative farms the ratio of pruning learners who go to the courses is 23.6% while a large majority as 64.9% seems to do the pruning with the ancestral knowledge.

### 3.7. Harvest Time & Form

It has been determined that in the research area the production is made mainly by Gemlik, Ayvalik, Domat, Memecik, Uslu and Yamalak varieties. In the period under review, it has been seen that 50% of farms harvest in October-November, while the rest spreading to the December and January. Whether olives are considered as black or green, experts propose making the harvest manually and express the harvest made with hitting stich is not appropriate (Tetik, 1995). Almost all of the manufacturers who understand the importance of this issue harvest with collecting by hand manually, minimize the loss of quality in the harvest. Some large farms being in the search for harvesting machine (branch shaker) is attracting attention.

Harvesting which is one of the final stages of the production income the beginning of the jobs that require the most labor. Classic harvest methods are based largely on labor. In different cost works, olive maintenance costs in total,

If the harvest and transport are considered to be 35% of the total maintenance costs of olive in different cost works, the importance of the subject will be better understood. (Turgay Dizdaroglu et al, 2003).

When the harvest ways are considered according to the groups of the operating size, in studied farms, it was determined that the harvest with pole which is not recommended as a technical is used more as proportionally in 1. and 2. groups of farms which are in smaller scale.

Harvesting machines which are selected according to the terrain conditions, tree size or structure reduce the costs considerably, and decrease the alternation violence caused by beating pole.

While innovative farms preferred relatively higher proportion of machine harvest (14.6%), compared to other applied harvesting methods, it may be indicated that it remained at fairly low rate.

### 4. The Evaluation of the Olive Farms in Terms of Profitability Innovative Sustainability

In all examined olive farms, Mann-Whitney U test has been used in order to test whether there is a statistically significant difference between innovative and non-innovative groups. Results have showed that Z value is determined as the value -5928 it is significant at 0.01 level.

While gross margin per decares is 637,20 £ in farms which implement innovation and research results, it has been calculated as 311,16 £ in farms which don't implement innovation and research results (Table 1).

Table 1: Gross Production Value in Innovative and Non-Innovative Olive Farms, Variable Costs and Gross Margin Per decares

	GrossProductionValue (£ / decares)	VariableCosts (£ / decares)	Gross Marjin / decares
Innovative Olive Farms	981.75	344.55	637.20
Non-Innovative Olive Farms	558.05	246.89	311.16

P (Significant value is significant for <0.05 and 0.01)

In table olive farms which are the sub-sector of the olive sector, the gross margin is calculated in the farms which implement and don't implement the innovations, and the results are statistically significant (at 0,01 level). Gross margin per decares is calculated around 747 £ in farms which implement innovation, around 570 £ in farms which don't implement innovation.

In olive farms for oil which is the other sub-sectors of the olive sector, the gross profit is calculated in the farms which implement and don't implement the innovation and the results of research and the results are statistically (at 0,05 level) significant. The gross margin of the farms is calculated as 380,56 £ in farms which implement the innovation and the results of research, 165 £ in the farms which don't implement the innovation and the results of research. Although per decares gross production value in innovative olive farms for oil production is higher than non-innovative farms, because of the variable costs per decares of innovative farms is 2 times more than the variable costs per decares of the other group, it has been found that the gross margin per decares of innovative farms to be lower.

## 5. CONCLUSION

For sustained profitability and success in olive farms in Turkey, it is necessary for olive farms to follow the R & D activities therefore the innovations. 39% of the company discussed in research area has appeared as the farms which follow and implement the innovations. Socio-cultural structures of the farms carry a decisive feature in being innovative. In all other respects, cultural practices implemented by farms directly affect the efficiency therefore the profitability. Besides in the different cultural practices (irrigation, fertilization, pruning, harvesting etc.) although different approaches have been identified, innovative farms have been found to be with a number of deficiencies. Especially in recent years, low yields experienced due to the drought in the olives has attracted the attention. From the obtained findings in this study, 139 of a total 154 farms that don't irrigate their olive trees appear in non-innovative group, this situation can be interpreted that it is meant as the farms engaged in dehydrated olive cultivation are in non-innovative group at 60% rate while the 10% remaining group is in the innovative group.

Deficiencies have been identified also in the subject of the fertilization which can be done depending on irrigation. It is detected that although the innovative olive growers don't neglect fertilization subject, they use the nitrogen fertilizer at slightly above the optimal level and the phosphorus and potassium fertilizers at insufficient levels.

Two other important issues are pruning and harvesting. It has been found that the farms with innovative structure have been receiving the professional support for pruning at 68% rate. Besides on pruning, also the size of land has a decisive feature and the level of consciousness of 58% of the farms which have 30 decares and more appeared to be better. Although the innovative farms preferred machine harvest at relatively higher proportion (14.6%), it can be indicated that compared to other harvesting methods it remained at a relatively low rate.

When the farms are examined in terms of the innovative sustainability, efficiency, and thus the profitability, it is calculated that the farms which don't adopt and apply the innovations live a severe economic losses. While the gross margin per decares is 637.20 £ in enterprise which implement innovation and research results, it has been calculated as 311.16 £ in farms which don't implement innovation and research results.

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## RISK PERCEPTION AND MANAGEMENT STRATEGIES IN AGRICULTURAL PRODUCTION: A CASE OF ADANA PROVINCE OF TURKEY

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### ABSTRACT

This study aims to determine and analyze farmers' risk perceptions and risk management strategies in agricultural production. Data were obtained in 2015 production year from face-to-face interviews of 99 farmers in Yüregir and Karaisali district of Adana province of Turkey. Factor analysis was used in data reduction to identify a small number of factors related to risk sources and risk strategies in this study. Then, multiple regression model was used to evaluate the influence of socioeconomic characteristics on the farmers' risk perceptions and risk management strategies using factor loadings. The results of this study show that the most important risk source that the farmers' perceive is availability of many middlemen in agriculture and food market and risk management strategy that the farmers' perceive is producing at the lowest cost. The result of factor analysis showed that the risk scale consists of 5 factors explaining 60.66% of total variance. The internal consistency coefficient Cronbach Alfa of the scale is 0.918 and KMO is 0.869. The risk management scale consists of 4 factors explaining 64.23% of total variance. The internal consistency coefficient Cronbach Alfa of the scale is 0.944 and KMO is 0.910. According to the results, perceptions are farmer-specific, a number of socio-economic variables are found to be related to risk and risk management. Improving of risk management strategies is useful for farmers as well and might help them to avoid many risks and reduce losses.

**Keywords:** Risk, Risk Perception, Agriculture, Turkey

### INTRODUCTION

Agricultural activities are carried out largely under the influence of natural conditions. Farmers don't estimate their yield and income due to fluctuations in the factors that they can not control such as rains, temperature, disease, frost, wind, flood and so on. As a result of input-output price change, there are income fluctuation and important differences in agriculture year after year. As a result of this, farmers are forced to take risky decisions. Farmers show different reactions and attitudes to changes, depending on the objectives and capital structure. It will be useful that analysis of the risk faced by farmers and their weight and determining of farmers' attitudes toward to risk. Therefore when planning in crop and livestock production, it is quite necessary that analysis of risks involved in agricultural production and understanding farmers' risk behaviors (Ceyhan, 2003; Ceyhan et al., 2003; Hardaker et al., 2004). There are quite a large literature about farmers' risk perception and understanding risk behavior in the World (Bergfjord, 2009; Dewan, 2011; Flaten et al., 2005; Gebreegziabher and Tadesse, 2014; Hanson et al., 2004; Lien et al., 2006; Meuwissen et al., 2001; Stordal et al., 2007; Toma and Mathijs, 2007; Zhou et al., 2012) but limited in Turkey (Agır et al., 2015; Akcaoz et al., 2009a; Kızılıay, 2006). In study has attempted to fill this gap a little bit in Turkey.

This study aims to determine and analyze farmers' risk perceptions and risk management strategies in agricultural production and examine relationship between farmers' risk perception and socioeconomic variables.

### MATERIALS AND METHODS

Data were obtained in 2015 production year from face-to-face interviews of 99 farmers in Yüregir and Karaisali district of Adana province in Turkey. In determining of the farmers which were included in survey, the following formula was used (Kaya et al., 2014).

$$n = \left( \frac{\left( \frac{Z}{2} \right)^2}{d} \cdot p \cdot q \right)$$

As determining sample volume, calculations were made by including values for 10% error margin ( $d = 0.10$ ) and 95% confidential intervals ( $Z = 1.96$ ),  $q = p = 0.50$  into the formula. According to these calculations, it was found that total 96 farmers should be interviewed.

In order to determine farmers' risk perception, they were presented and asked to rating according to their own perception risk and risk strategies statements which prepared in accordance with the five-point Likert scale (Akcaoz et al., 2010; Akcaoz et al., 2009b; Akçaöz et al., 2006; Bergfjord, 2009; Cukur et al., 2011; Dewan, 2011; Lien et al., 2006). Farmers' risk perception was analyzed using descriptive statistics and factor analysis. The large number of variables were reduced into smaller. This was done through factor analyses for sources of risk and risk management strategies. Factor analysis is a popular multivariate technique used to assess the variability of variables of a data-set (in our case, risk sources and risk management strategies variables) through linear combination of smaller number of latent variables, called factors. The extent of variation between variables in each factor is expressed by eigenvalues. If there is a strong relationship between variables, the first few factors explain a high proportion of the total variance and the last factors contain very little additional information. In our analysis, factors which eigenvalues are greater than one were retained. Varimax rotation was used to maximize the variance of the squared loadings for each factor, and thus polarizes loadings (either high or low) on factors for easy interpretation. To check the internal reliabilities, we calculated Cronbach's alpha. Kaiser–Meyer–Olkin (KMO) measures of sampling adequacy for sources of risk and risk management strategies scale was calculated to check scales were adequate for factor analysis due to large portion of communality (Alpar, 2011; Hair et al., 1994; Kalayci, 2008).

Multiple regression analysis was used to study in order to examine relationship between farmers' risk perception and socioeconomic variables (Alpar, 2011; Hair et al., 1994; Kalayci, 2008). Regression model was established accordance with the following general form.

$$Y = \alpha_0 + \beta X_1 \dots X_n + e_i$$

In equality;

Y: Perception of risk and risk amnagement strategies (as the factor scores)

X<sub>i - n</sub>: Socioeconomic variables.

## RESULTS AND DISCUSSION

### Farmers' socioeconomic characteristics

Farmers' socioeconomic characteristics examined by descriptive statistics like as frequency, percentage, mean, standart deviation and are presented in table 1. According to the result, farmers are average 51.52 years old and their agricultural experience is 24.97 years. Farmers' family size is 4.12 persons average. Average farm size is 158.97 and annual income is 66,691.92 TL. 30% of farmers have off-farm work and their education levels are shown in the table 1.

**Table 1. Farmers' soscioeconomic characteristics in Adana**

Socioeconomic Variables			
Age (years) (mean - standard deviation)		51.52	12.25
Household size (person) (mean - standard deviation)		4.12	1.43
Number of employees (person) (mean - standard deviation)		2.52	2.44
Agricultural experience (years) (mean - standard deviation)		24.97	12.49
Land size (da) (mean - standard deviation)		158.97	152.18
Annual income (TL) (mean - standard deviation)		66.691.92	56.663.33
Education	Uneducated (frequency - percentage)	11	11.11
	Reader / Writer (Frequency - Percentage)	3	3.03
	Primary / Secondary School (frequency - percentage)	27	27.27
	High School (Frequency - Percentage)	46	46.46
	University (frequency - percentage)	12	12.12
Off-farm work (frequency - percentage)*		30	30.30

\* The number of farmers have a off-farm works

### RISK SOURCES

Farmers' perception of risk sources was examined using a scale contain of 22 items. The risk scale was pepared based on five-point Likert scale. In total, 22 sources of risk were presented to the respondents. Farmers were asked to score each source of risk on a Likert-scale from 1 (not important) to 5 (very important) to express how significant they considered each source of risk to be in terms of its potential impact on the economic performance of their farm. The first column of table 2 shows average scores and third, fourth, fifth, sixth and

seventh columns of table 2 shows factor analysis results for all farmers. The most important risk sources that the farmers' perceive are the availability of many middlemens in agriculture and food market (4.16), fire (4.10), drought (4.09), changes in agricultural policy (4.03) and variability in input prices (4.03) in Adana.

Farmers' perceptions of the risks was evaluated by factor analysis. KMO measure of sampling adequacy was found to be 0.732 and the Bartlett sphericity test result was  $p<0.001$ , the internal consistency coefficient Cronbach Alfa of the scale was 0.919. These values showed that scale was suitable for factor analysis. As a result of factor analysis, the risk scale consists of 5 factors explaining 60.92 % of total variance. These factors according to the factor loading are named "finance and technology", "insurance and human resources", "market and meteorology", "economy and diseases" and "veterinary or engineering services and drought", respectively.

Factor 1, finance and technology, loads significantly from technologic and finanical variables like changes in agricultural policy, variability in input prices, relationship between family members, variability in product price, indebtedness and unable to repay debts, inability to use modern technologies due to low capacity, lack of technical knowledge and changes in interest rate. Risk arising from activities as theft, labor costs, the lack of agricultural insurance and difficulty in finding labor variables indicates insurance and human resources risk in factor 2. Significant loading of the availability of many middlemens in agriculture and food market, fire, variability in land value, meteorological events such as floods ect. reflects role of marketing and meteorological conditions in agriculture because that factor 3 is called market and meteorology. Factor 4 is called economy and diseases because of the extremely high loadings of possibility of not marketing the products, animal/plant diseases and pests, and credit availability changes in the economic situation of Turkey. Factor 5 is labeled as veterinary or engineering services and drought because of the loadings drought and misuse of veterinary or engineering services variables (Table 2).

### Risk management strategies

Farmers' perception of risk management strategies was examined using a scale contain of 22 items. The risk management scale was pepared based on five-point Likert scale. In total, 22 risk management strategies were presented to the respondents. Farmers were asked to score each source of risk on a Likert-scale from 1 (not important) to 5 (very important) to express how significant they considered each risk management strategies to be in terms of its potential impact on the economic performance of their farm. The first column of table 3 shows average scores and third, fourth, fifth and sixth columns of table 3 shows factor analysis results for all farmers. The most important risk management strategies that the farmers' perceive are producing the lowest possible cost (*ceteris paribus*) (4.01), collecting market information (3.94), working with appropriate to climate conditions and highly efficient animal breeds / plant varieties (3.94), working with modern equipment (such as cold air tank) (3.93), taking precautions to prevent animal / plant disease (3.92) in Adana (Table 3).

Farmers' perceptions of the risk management strategies was evaluated by factor analysis. KMO measure of sampling adequacy was found to be 0.944 and the Bartlett sphericity test result was  $p<0.001$ , the internal consistency coefficient Cronbach Alfa of the scale was 0.910. These values showed that scale was suitable for factor analysis. As a result of factor analysis, the risk management strategies scale consists of 4 factors explaining 64.23 % of total variance. These factors, according to the factor loading, are maned "planning and insurance", "financial and market-based instruments", "cost reduction" and "producing the lowest cost", respectively (Table 3).

**Table 2. Risk Sources and Factor Analysis Results**

Risk Sources	Mean	SD	Factors				
			Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Availability of many middlemens in agriculture and food market	4.16	0.77	0.182	0.210	<b>0.555</b>	0.234	0.248
Fire	4.10	0.76	-0.068	0.363	<b>0.486</b>	0.208	0.286
Drought	4.09	0.76	0.136	0.145	0.319	0.328	<b>0.699</b>
Changes in agricultural policy	4.03	0.87	<b>0.598</b>	-0.183	0.327	0.455	0.064
Variability in input prices	4.03	0.83	<b>0.731</b>	0.099	0.097	0.248	0.131
Variability in land value	4.02	0.78	0.089	0.116	<b>0.827</b>	0.062	-0.005
Possibility of not marketing the products	3.99	0.75	0.132	0.060	0.269	<b>0.744</b>	0.153
Relationship between family members	3.98	0.81	<b>0.615</b>	0.249	0.150	0.231	0.313
Meteorological events such as floods ect.	3.98	0.77	0.280	0.064	<b>0.690</b>	0.170	0.117
Animal / plant diseases and pests	3.98	0.82	0.365	0.182	0.026	<b>0.623</b>	0.268
Theft	3.97	0.78	0.158	<b>0.771</b>	0.029	0.088	0.179
Variability in product price	3.97	0.83	<b>0.638</b>	0.102	0.054	0.311	0.065
Indebtedness and unable to repay debts	3.95	0.80	<b>0.483</b>	0.366	0.039	0.278	0.287
Misuse of veterinary or engineering services	3.95	0.88	0.466	0.179	0.136	0.000	<b>0.651</b>
Credit availability	3.94	0.73	0.358	0.446	0.039	<b>0.571</b>	-0.012
Inability to use modern technologies due to low capacity	3.92	0.89	<b>0.521</b>	0.247	0.409	-0.082	0.093
Changes in the economic situation of Turkey	3.89	0.73	0.334	0.343	0.280	<b>0.496</b>	-0.100
Lack of technical knowledge	3.87	0.79	<b>0.734</b>	0.188	0.068	0.184	0.086
Labor costs	3.86	0.76	0.363	<b>0.543</b>	0.282	-0.048	0.160
Changes in interest rates	3.83	0.94	<b>0.633</b>	0.304	0.254	0.031	-0.007
The lack of agricultural insurance	3.82	0.86	0.107	<b>0.641</b>	0.196	0.179	0.173
Difficulty in finding labor	3.82	0.90	0.291	<b>0.633</b>	0.261	0.243	-0.344
Explained variance (%)			18.74	12.45	11.57	10.87	7.29

Factor 1, planing and insurance, loads significantly from variables like planning expenditure, making production in multiple fields, farmers union membership - cooperative partnership, working with future markets, making agricultural insurance, debt management with the help of expert, making personel insurance. Significant loading of collecting market information, working with modern equipment (such as cold air tank), obtaining non-farm income, keeping cash, benefit from agricultural extansion services, family members working off-farm, division of labor among family members, benefit technical consultancy services, appling strict hygiene rules reflects role of financial and market-based instruments in agriculture because that factor 2 is called financial and market-based instruments. Factor 3 is called cost reduction because of the high loading of take precautions to prevent animal / plant disease, off-farm investment, reducing of farm capacity, reducing fixed costs such as rent machinery ect. Factor 4 is labeled as producing the lowest cost because of the loading to produce the lowest possible cost (*ceteris paribus*) and work with appropriate to climate conditions and highly efficient animal breeds / plant varieties variables (Table 3).

#### **Relationship between risk perception and socioeconomic variables**

In order to examine relationship between farmers' risk perception and socioeconomic variables, multiple regression models carried out in this study. The regression coefficients and significant variables and models are presented in Table 4. In regrestion analysis, we used farmers' perception of risk sources and management strategies as dependent variables and socioeconomic characteristic as independent variables.

According to the result of regression analysis, only one model which establish for veterinary or engineering services and drought risk, is significant. Land size is negatively related to "veterinary or engineering services and drought" risk. This implies that farmers who have higher area of land allocated to agricultural production are likely to perceive this risk sources as significantly more less than farmers who have smaller agricultural land. Annual income is positively related to "veterinary or engineering services and drought" risk perception but coeffient is higly low. This result shows that have the more annual income perceive risk related to "veterinary or engineering services and drought" as important.

**Table 4. Relationship between risk perception and socioeconomic variables**

Independent Variables	Risk Sources					Risk Management Strategies				
	Factors					Factors				
	1	2	3	4	5	1	2	3	4	
	coef.	coef.	coef.	coef.	coef.	coef.	coef.	coef.	coef.	coef.
(Constant)	-0.001	-1.052	0.167	-0.674	0.851	1.018	-1.046	0.276	0.550	
Age (years)	0.001	0.014	0.007	-0.006	-0.010	-0.003	0.034	-0.004	-0.003	
Education <sup>a</sup>	-0.038	0.130	0.114	0.030	-0.049	-0.013	0.195	0.044	-0.017	
Household size (person)	0.041	0.091	-0.033	0.091	-0.100	-0.009	-0.018	-0.095	-0.079	
Number of employees (person)	-0.010	-0.023	0.008	0.005	0.063	-0.072	-0.042	0.036	0.018	
Agricultural experience (years)	0.004	-0.004	-0.010	-0.010	0.009	-0.001	-0.031	0.020	-0.001	
Off-farm work <sup>b</sup>	-0.087	-0.006	-0.407	0.421	0.006	-0.439	-0.281	-0.130	0.063	
Land size (da)	-0.001	0.002	0.000	0.000	<b>-0.004*</b>	0.002	0.000	0.000	-0.003	
Annual income (TL)	0.000	0.000	0.000	0.000	<b>0.000*</b>	0.000	0.000	0.000	0.000	
R2	0.023	0.102	0.064	0.080	0.145	0.072	0.100	0.087	0.023	
p-value	0.976	0.262	0.629	0.456	<b>0.069*</b>	0.547	0.279	0.390	0.258	

**a** reader / writer is not:

1 Reader / Writer: 2, Elementary / secondary: 3, High School: 4, University (Undergraduate-Graudate): 5

**b** 1 if the farmer has off-farm work, 0 if no off-farm work

\* Variables and models significant at p < 0.10

**Table 3. Risk Management Strategies and Factor Analysis Results**

Risk Management Strategies	Mean	SD	Factors			
			Factor 1	Factor 2	Factor 3	Factor 4
Pproducing the lowest possible cost ( <i>ceteris paribus</i> )	4.01	0.74	-0.165	0.307	0.020	<b>0.783</b>
Collecting market information	3.94	0.92	0.267	<b>0.609</b>	0.275	0.352
Working with appropriate to climate conditions and highly efficient animal breeds / plant varieties	3.94	0.74	0.274	-0.195	-0.037	<b>0.801</b>
Working with modern equipment (such as cold air tank)	3.93	0.91	0.290	<b>0.805</b>	0.127	0.010
Taking precautions to prevent animal / plant disease	3.92	0.88	-0.039	0.374	<b>0.772</b>	0.210
Obtaining non-farm income	3.89	0.83	0.208	<b>0.609</b>	0.257	-0.068
Keeping cash	3.88	0.88	0.405	<b>0.464</b>	0.140	0.132
Planning expenditure	3.87	0.91	<b>0.466</b>	0.292	0.386	0.355
Make production in multiple fields	3.83	1.02	<b>0.551</b>	0.507	0.305	-0.053
To benefit from agricultural extansion services	3.82	0.91	0.328	<b>0.470</b>	0.407	0.200
Family members working off-farm	3.82	1.09	0.467	<b>0.473</b>	0.443	-0.115
Division of labor among family members	3.80	0.95	0.403	<b>0.489</b>	0.264	0.194
To benefit technical consultancy services	3.79	0.94	0.323	<b>0.519</b>	0.479	0.077
Farmers union membership - Cooperative partnership	3.79	0.96	<b>0.481</b>	0.416	0.455	0.252
Working with future markets	3.76	1.01	<b>0.751</b>	0.302	0.162	0.012
Off-farm investment	3.74	1.07	0.346	0.198	<b>0.745</b>	-0.055
Making personel insurance	3.74	1.07	<b>0.691</b>	0.272	0.342	-0.029
Debt management with the help of expert	3.74	0.99	<b>0.672</b>	0.300	0.378	0.088
Reducing of farm capacity	3.73	1.04	0.363	0.186	<b>0.697</b>	-0.114
Appling strict hygiene rules	3.72	1.04	0.537	<b>0.558</b>	0.248	0.092
Reducing fixed costs such as rent machinery ect.	3.71	0.97	0.472	0.107	<b>0.652</b>	0.036
Making agricultural insurance	3.65	1.03	<b>0.678</b>	0.330	0.219	0.228
Explained variance (%)			20.56	18.66	17.03	8.28

## CONCLUSIONS

In order to examined farmers' perception of risk sources, a scale used consists of 22 items in its Cronbach' Alpha 0.918. The most important risk source that the farmers' perceive is the availability of many middlemens in agriculture and food market. In order to examined dairy farmers' perception of risk management strategies, a scale used consists of 22 items and its Cronbach's Alpha was 0.944. The most important risk management strategies that the farmers' perceive producing the lowest possible cost (*ceteris paribus*). It is suggested that the most effective measures that can be taken farmers organization and contract farming against fluctuations in the input and output price. Through farmer organization, farmers could control supply amount and they can be reach production level for establish an effective marketing network. And also, through the veterinarian, agriculture or food engineers will be employed within farmer organization, can be enable a better production quality and taken measures against the disease. Via contract farming, farmers could be guaranteed a certain price level and they could applying strict hygiene rules in order to fulfill the contract terms and they could reduce the number of middlemens in the sector. Also included in the contract as buyer industrial enterprises could also provide technical support to producers.

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## DEVELOPMENTS OF CITRUS FOREIGN TRADE IN TURKEY

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### ABSTRACT

Although citrus comprises one of the most important chapters of Turkish export, the rate of that crop group in total export decreases in the course of time. World citrus export is increasing correspondingly in the last years. While the total World trade is increasing over the last decade, attempts of export countries, foremost Spain, Netherlands, THE USA, China, South Africa, Morocco for getting more shares from the World markets make a pro-competition effect. Therefore, it is more significant to determine, whether Turkey maintains its share in the import of destination countries than the increase of Turkish export in citrus in the course of time. So, the size and direction of the intensity of Turkey in import of destination countries is critically important. The aim of that study is to scrutinize the change of value and direction of trade flow between Turkey and citrus importing countries as per time. Consequently, the Turkey's share in the markets in which Turkish export products addressed and the changes in these markets in the course of time will be determined. Trade Intensity Analysis has been used in the study. The intensification coefficients of the export of Turkish citrus which have mostly comparative advantage indicate that Turkey is losing its market share even in respect of the leading destination countries. The market losses come out of many reasons. There are a lot of problems to be tackled in that area. Firstly, production of these crops does not match the conformity with market demand concerning the quantity and some peculiarities.

**Keywords:** citrus, export, Intensification (Regionalization) Coefficient, Turkey

### INTRODUCTION

Foreign trade policy includes all kind of interventions which influence volume, composition and direction of the foreign trade of a country. Considering the trade with other countries and country groups and the changes of the traded countries in the course of time, intensification or diversification of traded countries in the whole trade volume are important subjects for the determination of the direction of a country's foreign trade. Through following a foreign trade policy states can intervene in the foreign trade for changing its direction. These interventions can be varied according to the foreign policy priorities of the country and also due to its economic structure being dependent on other countries in terms of some commodities (Seymen et al., 2009).

Increase in world population and purchasing power of developing countries is raising demand and consequently trade in the world. Sanctions of the World Trade Organization (WTO) on trade liberalization prevent the developed countries taking measures for supporting agriculture that divert ordinary function of international price mechanism, and that influences the world trade expansion. That kind of globalization wave has affected world trade with agricultural commodities and the world trade volume of agricultural products increased between the years 2001-2010 about 2.5 times parallel to the total world trade volume increase (FAOSTAT, 2013).

The rate of Turkey in the total World trade was 0.8 per cent in 2013. The portion of Turkey in citrus export of the World, on the other hand, was 7.3 percent in the same year. Turkey has the 5th place among citrus exporting (ITS, 2014).

Although citrus is one of the most important chapters of Turkish export, its does not catch the world citrus export growth rate. Export value increase in the World reached to 25.2 percent in the years 2009-2013, while in Turkey 18,3 percent (ITS, 2014).

While the total World trade is increasing over the last decade, attempts of export countries, foremost Spain, Netherlands, THE USA, China, South Africa, Morocco for getting more shares from the World markets make a pro-competition effect. Therefore, it is more significant to determine, whether Turkey maintains its share in the import of destination countries than the increase of Turkish export in citrus in the course of time. So, the size and direction of the intensity of Turkey in import of destination countries is critically important.

Studies on import intensity have been mainly considered in the framework of trade with the EU Member States (Eraktan, 2012), and the results of these studies indicate that fruit and vegetable sector has comparative advantage (Çağatay and Güzel, 2003; Fernandez-Alvarez, 2008; Grethe, 2003; Hughes, 2004; Yercan and Işıkçı,

2006; Zahariadis, 2005). Erkan (2011), in the study used Balassa and Vollrath indexes, stated that Turkey has comparative advantage concerning export of dried figs, Sultanas, hazelnuts, pistachios and dried apricots, however its competition power decreased relatively. Eraktan and Arisoy (2012) searched the share of Turkish products in import of several fruits and vegetables of the main partner countries in the period of 2000-2008 and found out that the trade intensity for various products concerning many trade partners declined in the mentioned period.

The aim of that study is to scrutinize the change of value and direction of trade flow between Turkey and citrus importing countries as per time. Consequently, the Turkey's share in the markets in which Turkish export products addressed and the changes in these markets in the course of time will be determined.

## MATERIALS AND METHODS

Main material of the study is the data provided from UN Trade Statistics Database (UN comtrade). Besides, the documents of FAO, ITC, Undersecretary of Foreign Trade-Turkey and Turkish Statistical Institute, and add to these documents related references prepared in this topic are the other sources.

There are several methods for analyzing the development of international trade that give similar results, such as Trade Intensity Analysis, Export Similarity Index, Balassa Index, Vollrath Index, Gravitational Model. Trade Intensity Analysis which indicates the progress of bilateral trade relations has been used in the study. Change in the share of trade between exporting and importing countries and trade intensity as well can be put forward through that method. The concept of trade intensities is based on the assumption that trade flows depend on the "push" of the exporting country, the "pull" of the importing country and on particular factors regulating bilateral relations (ECE, 1973; Eraktan, 1988; Froment and Zighera, 1964; Kommission der Europäischen Gemeinschaften, 1969; Nagy, 1979; Theil, 1967). Stability and continuity in trade between two countries can be determined and thus it can be contributed to the planning of future trade.

Not only the trade between two countries, but also the trade change as of commodity groups can be determined through Trade Intensity Analysis Method (Francescon and Nagy, 1988). Selected products are **lemons, oranges, mandarins and grapefruits**. Type, value and direction of trade flow of related products have been searched through Trade Intensity Analysis Method in order to determine the regional intensification of Turkey in World trade. So, trade intensity and the variations in that area for the mentioned products of Turkey have been scrutinized. The handled trade partners have been selected taking account of some criteria such as the most important destination countries for mentioned Turkish products and the share of these countries in export of relevant products of Turkey.

Model is based on the assumption that the share of an export country in the import of an import country related a product is constant. If that fixed rate changes in the course of time, some factors ought to have influence on that development (Froment and Zighera, 1964).

$$\text{Intensification (Regionalization) coefficient} = \frac{X_{ik}^j * X_k}{X_{jk} * X_{ik}}$$

$X_{ik}^j$  = Export value of j country to i country concerning k product

$X_k$  = World trade value of k product

$X_{jk}$  = Total export value of j country concerning k product

$X_{ik}$  = Total import value of i country concerning k product.

According to the assumption, the share of the exporting country in the import of the importing country concerning a product and also the share of importing country in the World trade concerning the same product will not change unless importing and exporting countries are not under the effect of some structural and regional factors that influence the trade flow. In case the share of the export of an exporting country intending for an importing country in the World trade concerning a product is higher than the hypothetical rate, competition variable indicates that the manner and interest of the importing country, as a trade partner, is for the benefit of that exporting country.

What kind of trade intensification has been achieved between two countries can be found out through dividing the share in the World trade to the hypothetical World trade rate concerning the handled product. Increase in intensity index in the course of time indicates the developments of trade position. If the intensity coefficient is  $>1$  it indicates that importing country tended to import from the export country more than hypothetical rate, namely its attitude is in favour of the exporting country.

## RESULTS AND DISCUSSION

Turkey is one of the most important citrus exporting countries. Almost each product in this group is being exported to different countries. The most important export products have been handled in the research. The changes in the value and direction of the trade flow between Turkey and the importing countries have been scrutinized.

### Lemons

Total import value of lemon in the World was \$ 1. 96 billion in 2012, according to the statistical data of the UN. The leading importing countries are the USA (\$ 244 million), Russia (\$ 208 million), Germany (\$ 179 million), Nederland (\$ 175 million), and France (\$ 156 million) (UN comtrade, 2013). These countries, in other words, are substantial destination countries for the lemon producer countries in the World.

Major lemon exporting countries are Spain (\$ 496 million), Mexico (\$ 274 million), Turkey (\$ 267 million), Argentinean (\$ 201 million), and Nederland (\$ 187 million) (UN comtrade, 2013). The share of Turkey in lemon trade was 13, 6 percent and the most important competitor of Turkey is Spain regarding its regional location.

Turkey exports lemon to many countries, foremost to Russia. Russia imported lemon of totally \$ 208 million, of which a considerable high rate, namely million \$ 75 were imported from Turkey (UN comtrade, 2013). Calculated intensity coefficient was >1 and that indicates that trade relations between Turkey and Russia somehow intensive. However, intensity coefficient decreased in the last years (Diagram 1) and the situation indicates that there is no sign of trade intensification between two countries.

Poland's lemon import value from Turkey reached only \$ 8 million, of which total lemon import value was \$ 85 \$ million in 2012, and the figures of Greece were respectively \$ 3 million and \$ 31 million in the same year; namely the both destination countries realized about 10 percent of total import value from Turkey.

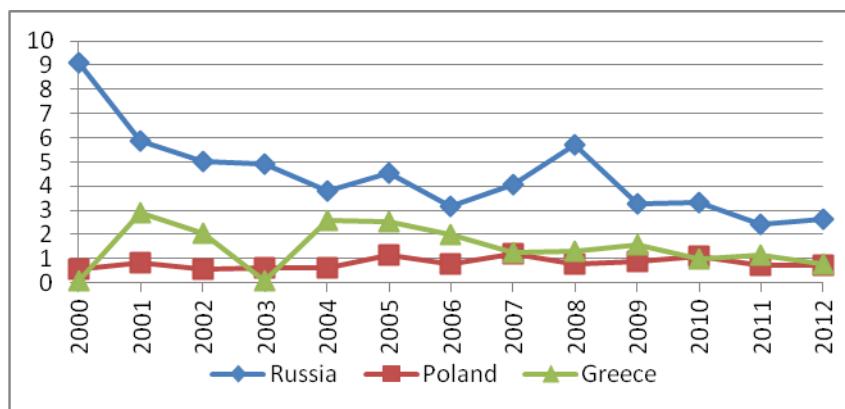


Diagram 1. Intensification coefficients of Turkey's lemon trade

### Oranges

Total orange import value of the World was billion 4, 09 in 2012. The most important importer countries are Russia (\$ 43 million), France (\$ 394 million), Germany (\$ 369 million), Nederland (\$ 362 million) and Korea (\$ 220 million). The leading five countries that have a say in exporting oranges are Spain (\$ 1.29 billion), the USA (\$ 661 million), the Republic of South Africa (\$ 584 million), Egypt (\$ 456 million), and Nederland (\$ 250 million) according to the figures of the same year. Turkey, however, is one of the leading countries in the world orange export with its million \$ 230 export value, but its rate in total world trade f orange gets hardly up to 5.6 percent (UN comtrade, 2013).

Turkey is exporting oranges many countries, but notably to Russia. Russia imported oranges from Turkey reached \$ 45 million, while its total import value achieved \$ 431 million. Ukraine's import from Turkey attained \$ 16 million, of which total import was \$ 112 million. The figures were for Romania \$ 2.8 million and \$ 31 million; for Germany \$ 0.8 million and \$ 369 million; for the United Kingdom \$ 0.5 million and \$ 215 million respectively. Turkey's trade relations with these countries are intensive, but trade intensity decreases in the course of time (Diagram 2).

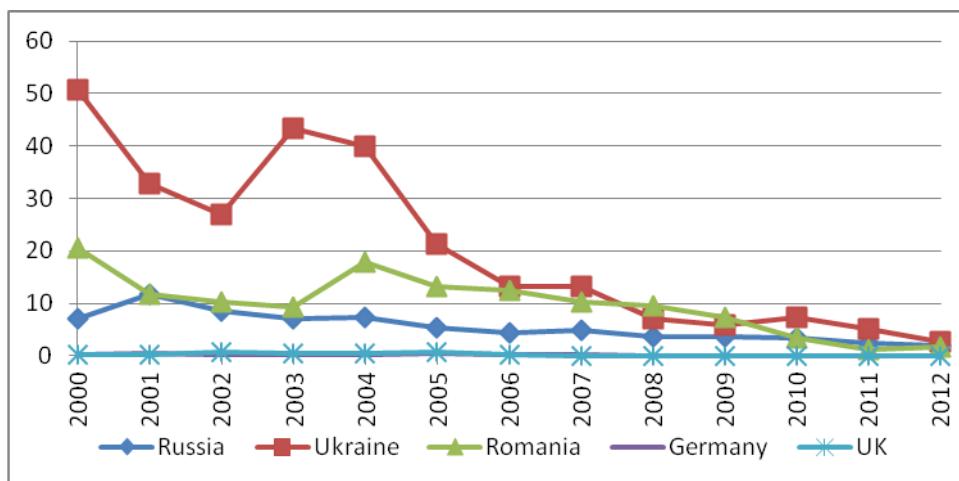


Diagram 2. Intensification coefficients of Turkey's orange trade

### Mandarin

The World mandarin export was \$ 4.02 billion according to the data of the United Nations in 2012. The prominent importers are Russia (\$ 747 million), France (\$ 428 million), Germany (\$ 386 million), the United Kingdom (\$ 313 million), and the USA (\$ 222 million). The leading mandarin exporters, at the other hand, are Spain (\$ 1.67 billion), China (\$ 748 million), Turkey (\$ 293 million), Morocco (\$ 257 million), and Pakistan (\$ 148 million) (UN comtrade, 2013). The share of Turkey in the world mandarin trade was 7.3 percent.

Russia is the foremost importer country regarding Turkey's mandarin export. Russia imported mandarin from Turkey reaching a value of \$ 114 million, while its total import value was \$ 747 million in 2012. The figures were \$ 46 million and \$ 157 million for Ukraine; \$ 6.7 million and \$ 22 million for Romanian; \$ 4.2 million and \$ 313 million for the United Kingdom; \$ 5.6 million and \$ 386 million for Germany respectively. These are the most important destination countries for Turkish mandarins, but the trade intensity showing a decreasing trend (Diagram 3).

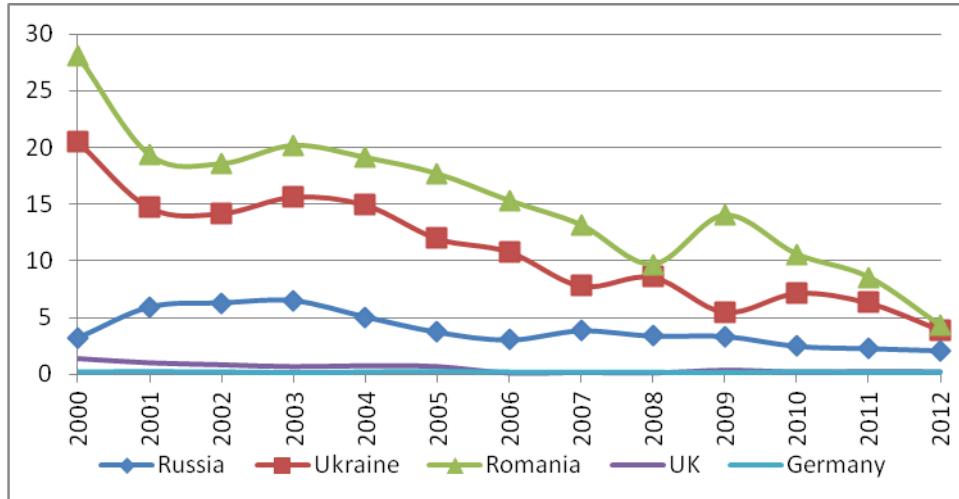


Diagram 3. Intensification coefficients of Turkey's mandarin trade

### Grapefruit

The world's grapefruit import value was million \$ 943 in 2012. The most important importers are Japan (\$ 172 million), Netherland (\$ 169 million), Russia (\$ 118 million), France (\$ 77 million), and Germany (\$ 62 million). The foremost exporter countries are the USA (\$ 159 million), Netherland (\$ 129 million), China (\$ 108 million), Turkey (\$ 108 million), and the Republic of South Africa (\$ 94 million). The share of Turkey in the world's grapefruit export was 11.5 percent in 2012.

The important trade partners of Turkey in that manner are Russia and Romanian. Russia imported grapefruit from Turkey of which value reached \$ 29 million, while its total import value concerning that product was \$ 118 million; the figures were \$ 8 and \$ 15 million for Romanian. The trade of Turkey with those countries is intensive, but the trade intensity is showing a decreasing trend in recent years (Diagram 4).

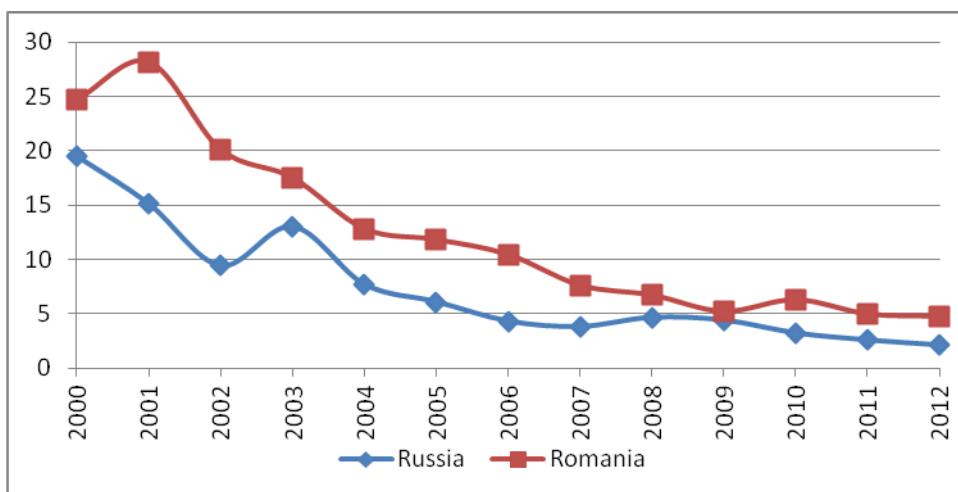


Diagram 4. Intensification coefficients of Turkey's grapefruit trade

## CONCLUSION

Agricultural sector has also been affected by the globalization like the rest of the world. The increase in the world trade has continued. The monitoring of the development in citrus trade which is one of the most important sectors in Turkish agricultural exports is also the most crucial. For this reason, the markets in citrus that Turkey exports to are examined and the concentration coefficients that reflect the demand for Turkish products are calculated.

The share of handled Turkish citrus is rather small on the world market. Maybe Turkey is among the first five exporter countries for many of the surveyed products. However, the leading importing countries are not the recipients of Turkish products. Turkey is exporting citrus mostly to the same countries that are not far from Turkey. The advantage of transportation facilities and closeness to the markets are not used properly too. The market share in these markets cannot be raised. The EU markets, instead of the relative closeness, do not offer advantage due to prioritizing other export countries, and being an associated country and even to be in the Customs Union (agricultural commodities are not in the framework of the Customs Union certainly) does not play a role for favoring Turkish products.

The intensification coefficients of the export of Turkish citrus which have mostly comparative advantage indicate that Turkey is losing its market share even in respect of the leading destination countries. There is a market share lost from the beginning of 2000s to 2012 even in the Russia market that is the most important trade partner though the export values increased in reality in the foregoing years.

Polish and Greek markets represent instability on the subject of lemon export. Ukrainian, Romanian, and the United Kingdom put other origin countries before Turkey regarding oranges and mandarins. While the share of Turkey decreased in the oranges import of Germany, an inconsistency import policy was observed regarding mandarin import of Germany from Turkey. The share of Turkey in the import market of Romanian's grapefruit decreased rapidly

The market losses come out of many reasons. There are a lot of problems to be tackled in that area. Firstly, production of these crops does not match the conformity with market demand concerning the quantity and some peculiarities. Keeping pace with demand is necessary for keeping the market share and improve it. Audit, monitoring and control of the production and pesticide residues are some other problems of exporting. It is crucial to activate control mechanism of the state, to create rapid alarm system, to enhance laboratories, to increase analysis in wholesale marketplaces and in orchards. Additionally, the high agricultural input prices raise the costs and ultimately sales prices and decrease the competitive power on the world markets. The market share losses can be prevented through tackling that kind of structural problems. However, the sole responsibility ought not to focus on control and cost problems, and advertisement, promotion and trade publicity should not be ignored.

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## RISK COMMUNICATION IN FOOD PRODUCTS: CASE OF MILK IN ADANA

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### ABSTRACT

In this study, it is aimed to carry out research into people living in Adana province about risk communication in milk consumption. For this reason, randomly 384 people were selected for face to face interview to collect data about their main information sources at milk consumption. As a result, it is found out that the majority of respondent trust information about risks in milk consumption when provided from doctors and scientist. About 58% of the respondents stated that they consume street milk because it is cheaper than pasteurized, home delivery and better taste. The survey results showed that the respondents considered food poisoning, bowel infection, digestive problems and additives as the most possible health problems when consuming milk. Unfortunately, 18 % of participants did not complain anywhere when they had problems after milk consumption. Only 6% of them made call “ALO 174 Food Line” to inform the Ministry of Food, Agriculture and Livestock about problems with milk. There was no relation between amount of milk consumed with number of children.

**Keywords:** Milk, Adana, Risk, Risk Communication

### INTRODUCTION

Nutrition is one of the main needs of human beings and they have a right to have safe food to continue their life. Food safety is a strategic problem all over the world. Nowadays, to feed the increasing world population, unfortunately producers use hormones, pesticides and additives in their products. Many risks are invisible and sometimes consumers have no idea what they consume.

The public has become increasingly concerned about the risks associated with food (Frewer, 2000). Many different psychological factors, ethical concerns, trust and distrust (in scientific institutions, risk regulators and information providers) and perceptions of social exclusion from risk management processes, influence public risk perceptions (Slovic et al. 1991; Frewer et al. 1998a; Frewer, 2000). Two major dimensions have emerged as being important in determining trust. The first is that of competence, the expertise held by the communicator and the extent to which they are able to pass on information about a particular subject area. The second is honesty, the extent to which a communicator will be truthful in communication of information (McGuire, 1985; Frewer, 2000). Trust appears to be linked to perceptions of accuracy, knowledge and concern with public welfare. Distrust is associated with perceptions of deliberate distortion of information, bias, and having been proven wrong in the past. Sources that are perceived to be over-accountable, or protecting a vested interest, are unlikely to be trusted (Frewer et al. 1996; Frewer, 2000).

Most recently researchers are interested in risk communication (Bean, 1987; Covello et al., 1987b, 1988; Davies et al., 1987; Fischhoff, 1987; Lind, 1988; Otway, 1987; Plough and Krinsky, 1987; Zimmerman, 1987; National Research Council, 1989; Frewer, 2000; Peterson, 2000; Gordon, 2003; Lofstedt, 2004; McCarthy, 2006, 2009). It is defined as a process of communicating responsibly and effectively about the risk factors associated with industrial technologies, natural hazards, and human activities (Powell and Leiss, 1997; Leiss, 2004). Effective risk communications require authoritative and trustworthy sources (Fischhoff, 1992; Morgan et al., 2002). Trust and credibility in risk communications are determined by knowledge and expertise, openness and honesty, and concern and care (Peters et al. 1997). The efficacy of risk information depends on several factors, including the level of receivers' trust in the sender, prior knowledge about risk information, clarity of information, and the role of unofficial risk information messengers such as unofficial local opinion leaders, the media, networks of family members, and neighbors (Fessenden-Raden et al., 1997; Ibitayo, 2006). Risk communication can be broadly understood as an iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk (McComas, 2006).

The European Food Safety Authority (EFSA) has recommended that the risks associated with drinking raw milk should be better communicated to consumers. Also stated that there was a clear link between the consumption of unpasteurized milk and a long list of illnesses with potential severe health consequences in some individual patients (EFSA, 2015).

Milk and milk products are excellent sources of daily nutrition (Bozoglu et al. 2014). Unfortunately, Turkish consumers do not consume enough milk when compare to most developed countries. There have been many studies conducted about consumer preferences, behavior and factors effecting the consumption of milk in Turkey

(Hasipek & Kaleli, 2002; Hatirli et al. 2004; Celik et al 2005; Akbay & Tiryaki, 2008; Kılıç et al. 2009; Ates & Ceylan, 2010; Tiryaki & Akbay, 2010; Seker et al. 2012; Karakaya & Akbay, 2013; Bozoglu et al. 2014). However, consumers' risk perception and the information sources about milk safety and illnesses do not studied in deeply. Thus, the aim of this paper is to provide information of consumers' perceived risks and information sources about risks and illnesses about milk they consume. Also their purchasing behavior toward milk consumption analysed.

## MATERIAL and METHODS

Data came from a pre-tested consumer survey conducted by researchers in Adana, the largest province on the Mediterranean region of Turkey. The questionnaire was pretested with 30 consumers. In this study, a 8 page questionnaire was used to collect information from households. Questions were related to regarding the respondents' milk consumption, health concerns, information sources about milk risks, factors' affecting purchasing behavior and demographics. By using a simple random sampling method, adequate sample size was determined as 384 households who live in city center of Adana province. The questionnaire was consisted of 4 parts. The first part of the questionnaire was related about demographic variables. The second part was related to the importance of milk attributes on purchase behavior. In this part, the respondents were asked to rate, on a 5-point Likert-type where one represents unimportant and five very important. The third part was related to the probability of illnesses when consume milk. In this part, data were also collected with 5-point Likert-type scale where one very probably not, four very probably and five no idea. The fourth part of the survey was dealing with the information sources about risks and illnesses about milk. Also 5-point Likert-type scale was used in this part, where one never and five always.

$$n = \frac{p.(1-p)}{(e/Z)^2}$$

Where;

n = The sample size

p = The frequency of the opinion of the examined event

e = The margin of error rate

z = The confidence intervals

The sample size which is calculated with a 95% of confidence interval is 384 consumers.

## RESULTS and DISCUSSION

### Consumers' Characteristics and Purchasing Behavior

Respondents consisted of 53% women and 47% men. Sixty one percent of the respondents were married and 35% had a high school diploma. Only 18% had a university degree and 86.2% had at least one child. The age were ranging from a low of 18 years to a high of 62. Mother is the primary food shopper (68%) and milk shopper (75%) in the households. More than half of the respondents (52%) had no job, mainly housewife. According to results, 37% households devoted approximately 201-350 TL of their total income to total food consumption. About 37% of the respondents stated that main reason for purchasing milk was to drink, 38% to make yoghurt, 16% to bake cake and only 9% to prepare baby food. About 58% of the respondents stated that they consume street milk because it is cheaper than pasteurized, home delivery and better taste. Also, 30% of the respondents who bought street or open-air market milk mentioned that they are getting from parents (probably free) from farms. Even though respondents' mentioned that they consume milk every season, winter season is higher (25%) than the other seasons. Respondents' main package preference was paper (58%) because it is easy to find and healthy. No relation was found between number of child and the amount of milk consumed. But income level, education level and presence of child were the biggest influencing factors when purchasing flavored UHT milk.

**Table 1: Respondents' monthly household income, monthly food expenditure, monthly milk consumption, milk price and number of child**

	Definition	Percentage in (n=384)
<b>Household monthly income</b>		
Low	846 TL ≥	10,3
	847-1500 TL	54,9
Medium	1501-2500 TL	22,1
	2501-4000 TL	9,1
High	4001 TL ≤	3,6
<b>Household monthly food expenditure</b>		
Low	100 TL ≥	5,5
	101-200 TL	24,2
Medium	201-350 TL	37,0
	351-500	17,2
High	501 TL ≤	16,1
<b>Average milk consumption</b>		
Street or open-air market milk	16 kg	
Pasteurized milk	9 kg	
Flavored UHT milk	6 kg	
<b>Average milk price</b>		
Street or open-air market milk	1,50 TL	
Pasteurized milk	2,50 TL	
Flavored UHT milk	5,00 TL	
<b>Number of child</b>		
None child		13,8
1 child		36,7
More than 1 childs		49,5

So many attributes of product has an affect on consumers' purchasing behavior. For this reason, in this study respondents were asked to rate the importance of the milk attributes on their purchase behavior. According to survey respondents, hygiene, production and expiration date, freshness, reliability and inartificiality were considered to be five most important factors affecting purchase decisions of milk (Figure 1). Even though more than half of our respondents (58%) consume street milk, these results show that actually they give more attention to safety of milk instead of price. As seen from the Figure 1, advertisement and promotion had found the least important attributes when it comes to milk consumption.

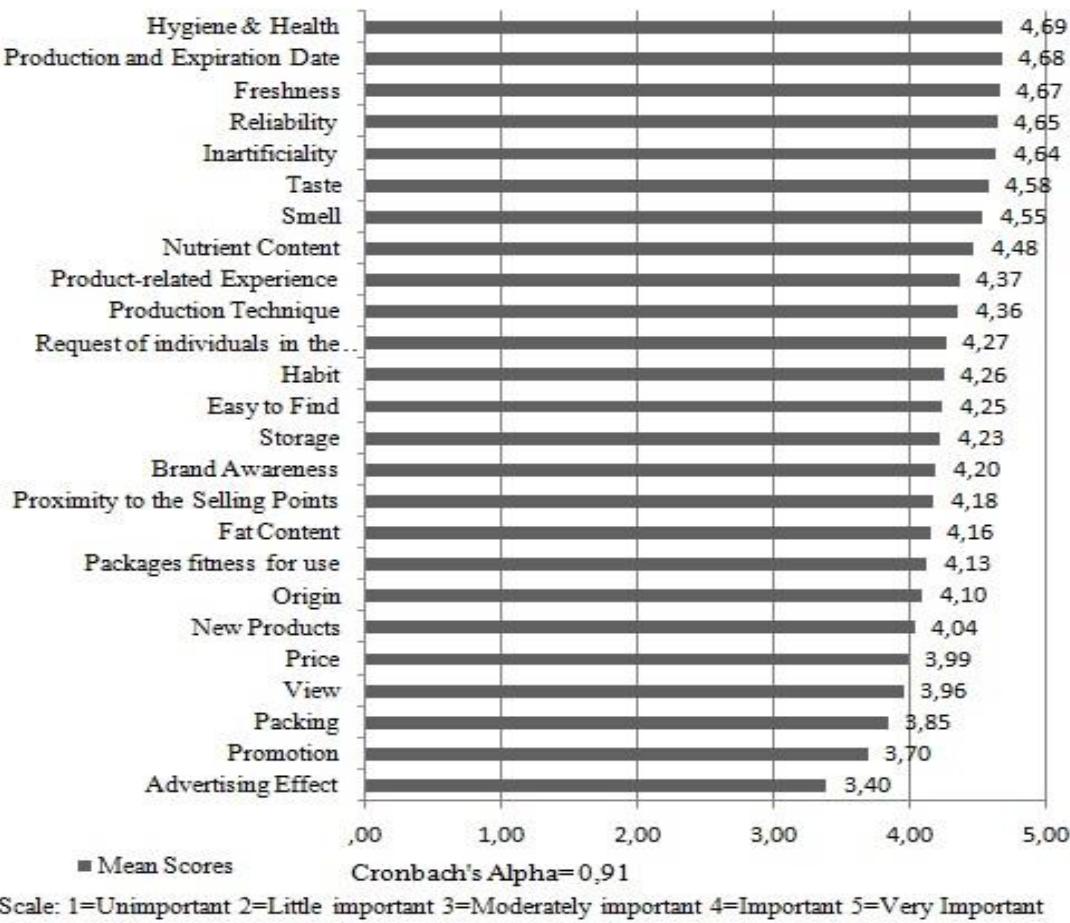


Figure 1. The importance of milk attributes on purchase behavior

People can face a wide variety of illness when consume milk and milk products, especially raw milk. People are more concern about milk and milk products after milk scandal in China, in 2008. Also, in 2013 China has halted imports of some New Zealand milk powders. The survey results showed that the respondents considered food poisoning, bowel infection, digestive problems and additives as the most possible health problems when consuming milk (Figure 2). Bozoglu et al., (2014) also found that food poisoning, spoilage and additives as the most important hazards to dairy products. For 6 years Ministry of Agriculture and Livestock provides a service, which is called "Alo 174 Food Line" for consumer to complain damaged or unhealthy food to the government, in Turkey. In this study it is found out that the use of this line was very low, only %6.

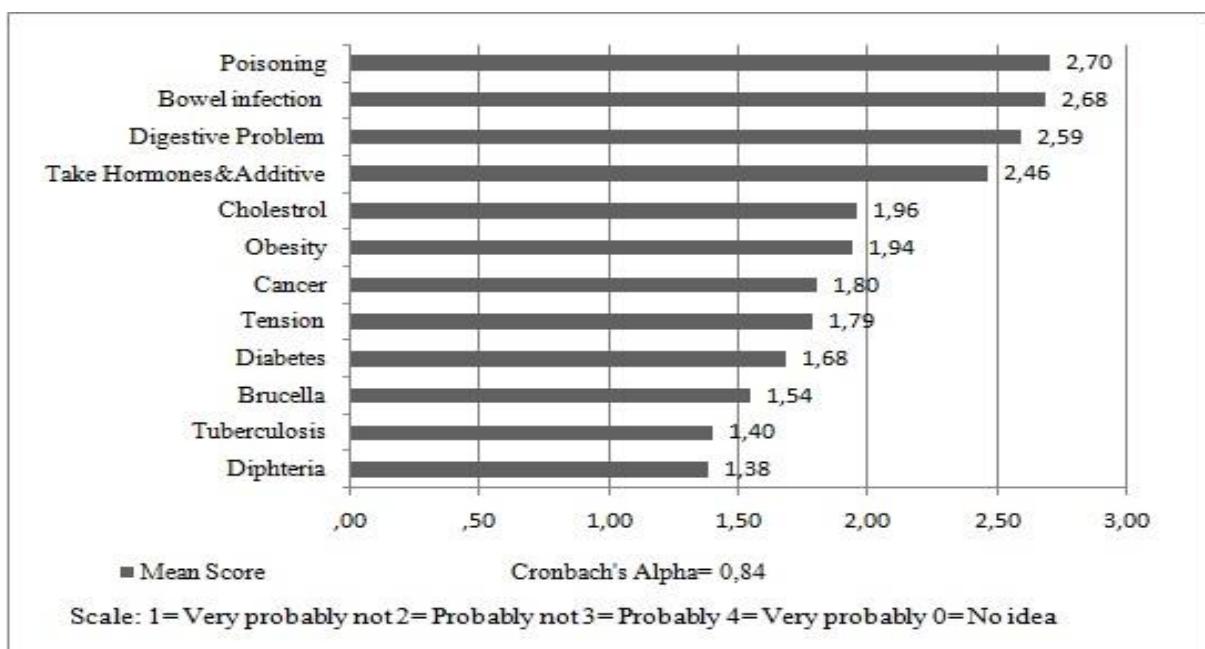


Figure 2. The possibility of health problems of milk

People require correct information about what they consume and their risks. Nowadays, false and inaccurate information (disinformation) is a very big problem not only in Turkey but also in all over the world. Turkish Food Safety Association (2015) declared that unfortunately misinformation has been disseminated by persons that hold no expertise in food. At this part of the research respondents were asked to rate trust of their information sources when they face health risks about milk consumption (Figure 3). As seen from the Figure 3, luckily our respondents obtained information mainly from the doctors and scientists. Consumer organizations also rated as an important information source. Eventhough mass media and internet use very high in our decade at this point respondents indicated that they did not trust when it comes to health risks about milk. There was no relationship between education level and the trust to doctors and scientists. For each educational level doctors and scientists were the most trustworthy sources.

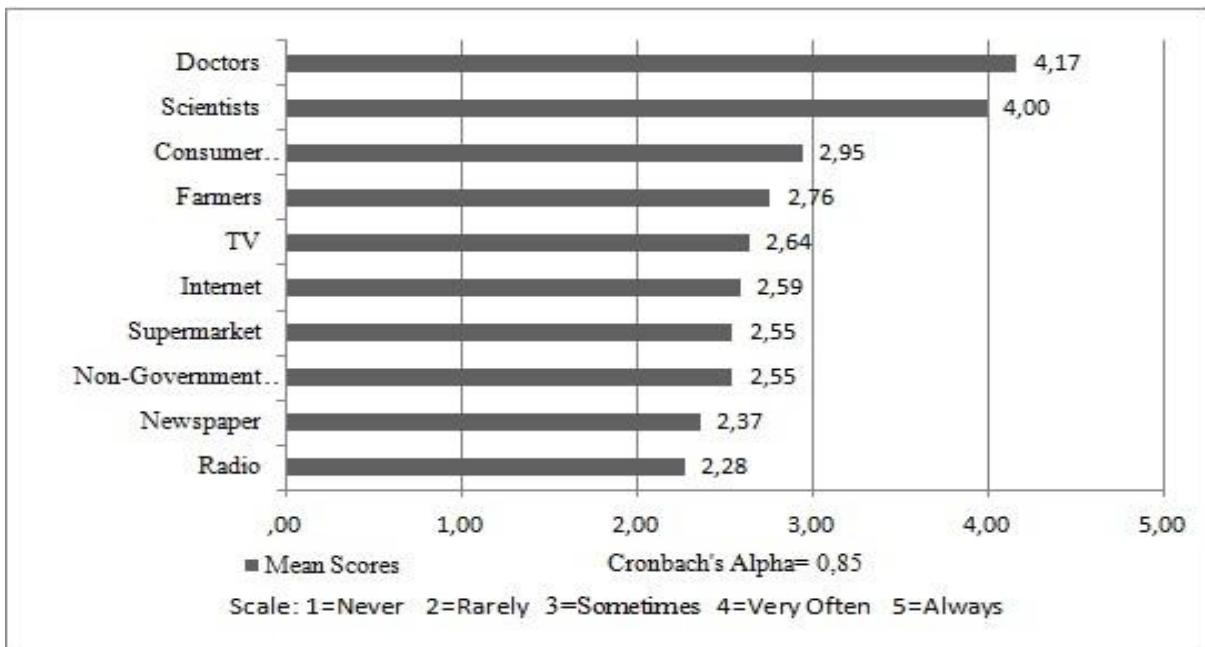


Figure 3. Use of information sources about health risks of milk

Consumers are looking for more and more information about food and require reliable advice from information sources. They do not know which information to trust. They can face false and misleading information with every source. When they battle with misinformation they use different sources at the same time. The questionnaire also

included questions to use of information sources depend on milk process, market conditions and also curiosity. As seen from the Figure 4, respondents use five different sources depend on topic. Internet, television, radio, newspaper and scientific meetings have been used at different frequency level based on topic. Fortunately, respondents' prefer to get information mainly from scientific meetings. They also use other sources. When we looked at the relationship between the use of information sources and some demographics we found that women were using internet more than men about milk illness. Negative correlation was found between education level and use of internet about the type of milk. When education level increased the level of use was decreased.

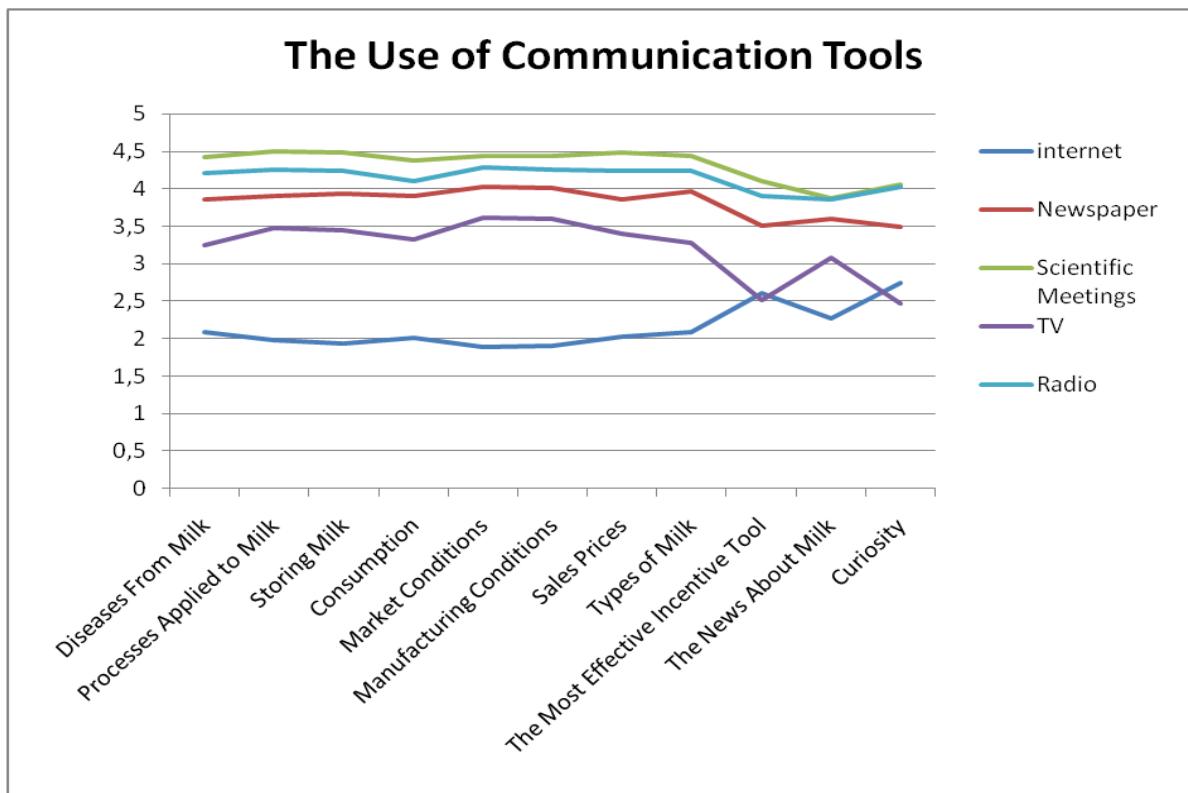


Figure 4. Use of information sources depend on topic

## CONCLUSION

According to Bozoglu et al. (2014) about half of Turkey's milk production is marketed unprocessed or under unsafe conditions by street vendors and majority of respondents' (%70) in their research, mainly purchased milk and milk products directly from farmers or at open-air markets. In this study we found that also our respondents' had mainly purchase from street or open-air markets because it is cheaper (1.50 TL) than processed fluid milk (2.50 TL). Not only street milk but also pasteurized milk can cause a variety of illness. Public should be informed about safety, nutrition and health attributes of milk. Every information source has a different effect on public. Greater volumes of information can often help people to understand issues and increase awareness about milk and milk production. But it can also expose people to misinformation.

Food is an indispensable part of human life and therefore, negative and inaccurate news disseminated in this regard create a negative influence on consumers and irrational changes in their behaviors. Combating misinformation requires the enactment of scientifically oriented legal arrangements (Turkish Food Safety Association, 2015). False and misinformation can cause unnecessary anxiety among people. Also food sector can be affected negatively because of wrong news served by information sources.

Information sources have a great effect on people behavior change. So this power should be used to educate people and behavior change on a positive way. Risk communication for consumers should be developed to provide true, accurate and timely information.

People are encouraged to use "ALO 174 Food Line" to complain damaged, unhealthy food and also disinformation. The information about the risks and treats about foods which provided by mass media should be controlled heavily and punishments should be given if they provide wrong or incomplete information. More studies should be conducted about the trustworthiness of food and health news which provided by mass media.

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## SOME APPLICATIONS OF AUTOMATED DRIP IRRIGATION SYSTEMS IN THE WORLD AND TURKEY

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### ABSTRACT

Irrigation water is applied to the root area of a crop by using different irrigation methods. In agriculture, control systems for water supply have made considerable progresses in recent years, and offering a wide range of new options. Electronic and automation have been more popular in agriculture and hence, the current trend is toward switching from a manual system to automatic operations in micro irrigation systems covering drip and sprinkler irrigation systems.

The combination of automation with micro irrigation systems ensure the proper level of water for growing up the plants all through the season, energy savings, reduced labor costs and control in fertilizer, those of which are a few major advantages in adopting automated techniques in micro irrigation systems. With the development of technology, automatic irrigation and also using renewable energy resources such as solar and wind energy have been more popular in agriculture

In Turkey, the energy has been mostly supplied from the coal and fossil fuels which often serves greenhouse gasses. It is very important to use the renewable energy sources in agriculture, since the conventional energy sources are expensive. . Using wind and solar energy in agriculture have also offered a number of distinct advantages in off-grid areas.

In this study, recent developments on irrigation automation in micro irrigation systems both in the World and in Turkey are being presented with some examples.

**Keywords:** Automation, drip irrigation, micro irrigation

### 1. INTRODUCTION

Freshwater resources are mostly allocated to agricultural sector around 70% especially for irrigations and increasing domestic and industrial water demands (Akuzum, et al.,2010). The water saving in agriculture has an important key role for dealing with the water shortage, since water use in agriculture is higher than industrial and urban uses (Zeng et al.,2009). Automated irrigation systems provide high crop yield, save water compared to conventional systems (Mulas, 1986), facilitate high frequency and low volume irrigation (Abraham et al., 2000) and also reduce human error (Castanon, 1992). There exists many ways to start irrigation automatically such as time based, volume based, and real time feedback system. Automation has been more popular in agriculture and many studies on this issue have been carried out in all around the World.

Draper (2006) developed an irrigation scheduling computer program, using the relationship between soil texture, soil water holding capacity and the soil matrix potential. Cuming (1990) controlled the common lines of various irrigation systems by using a soil moisture sensor. Phene (1996) used automated evaporation pan systems to schedule irrigation for trees. Quesenberry et al.(1996) used the climatologic data taken from weather stations for irrigation scheduling in an automated system.

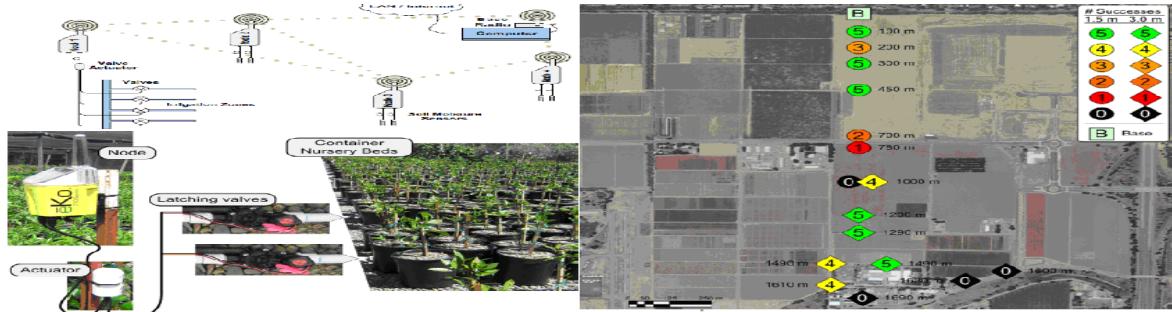
In agriculture, energy can be supplied by either grid connected electricity or off-grid systems by the solar or wind energy. Nowadays, automation is connected with the renewable energy sources to save energy in agriculture. Therefore, the objective of this article is to provide information about the use of automation in micro irrigation systems.

### 2. AUTOMATION in MICRO IRRIGATION SYSTEMS

Automated irrigation as an outdoor applications have been applied in all around the world, a few examples are given as follows; Coates et al.(2013) used a wireless networks in agriculture to control irrigation valves serving to different zones by a single radio wave (line of sight) for the mesh network reached 1610 m and, irrigation was activated by soil moisture sensors and carried out successfully during the irrigation season in fig 1.

**Figure 1. Wireless mesh network and number of successful network joins, Coates et al.(2013)**

In Turkey, a private enterprise has an agricultural area of 1185 hectares and irrigate almost 454 ha by using automation system for crop production. The reason of using the automation in that area was the topography , since it was very hard to reach the 16 submersible pumps located in the different points in that area. Therefore, the agricultural enterprise, namely AKSA-inanlı, uses GSM module and hardware component that allows the capability to send and receive SMS to and from the system in order to control these pumps in this location. This system creates a great opportunity to save time and energy to reach 11 pump stations given in fig 2.



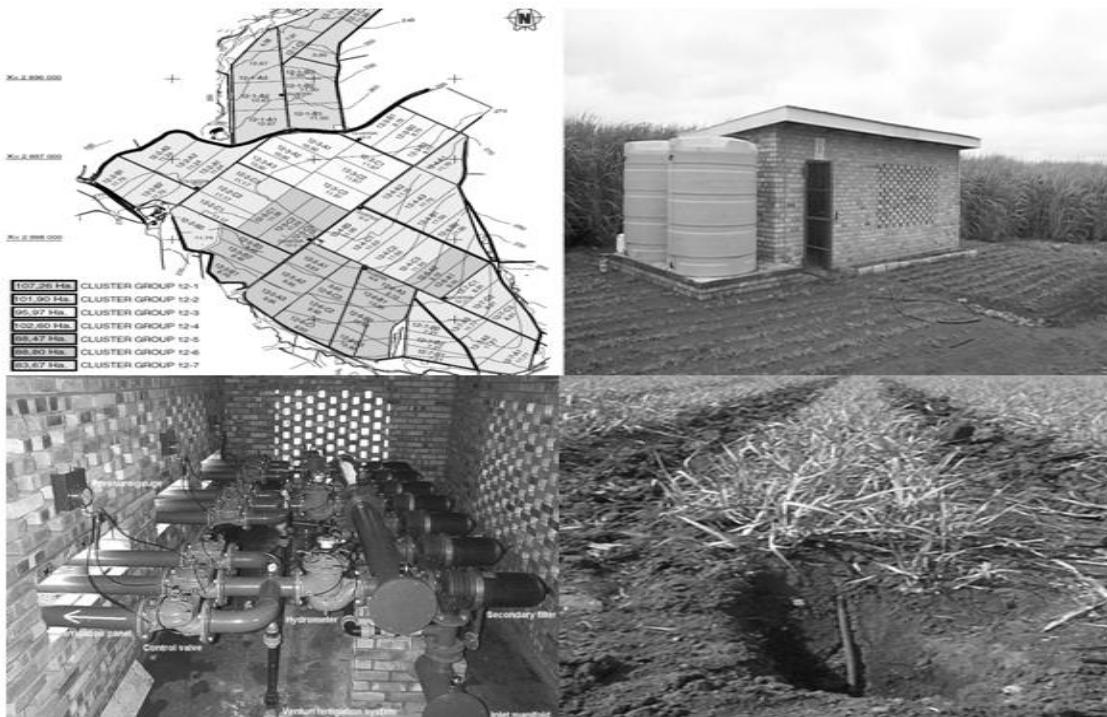
**Figure 2. Sixteen submersible pumps are controlled automatically by GSM system (Grundfos, 2011)**

Merry (2003) converted the irrigation systems to use water and fertilizer efficiently from sprinkler and surface irrigation to drip irrigation systems. In this wide area to ensure the automation, total area was divided into small segments in 100 hectares of lands. A controller house was built in one segment to control irrigation events in this area. Radio controllers were used to provide automatic operation of pumps, valves and irrigation schedules in fig 3.



**Figure 3. Automation system in 4000 hectares, designed by Merry (2003)**

Nowadays, automation has been combined with solar energy power systems, which providing a good opportunity, especially for off-grid areas. Solar-powered pumping systems are reliable, cost effective, high performance and low maintenance. Therefore, the renewable energy sources becomes an alternative for irrigation in off-grid areas. In many cases, solar power systems offer a greater cost efficiency, reliability, independence and sustainability when compared to a grid-tied power installation, as well as offering energy independence with a low environmental impact. Nowadays, investments in solar energy have been increasing in Turkey, recently. A few examples of solar-powered irrigation systems are given in fig. 4.



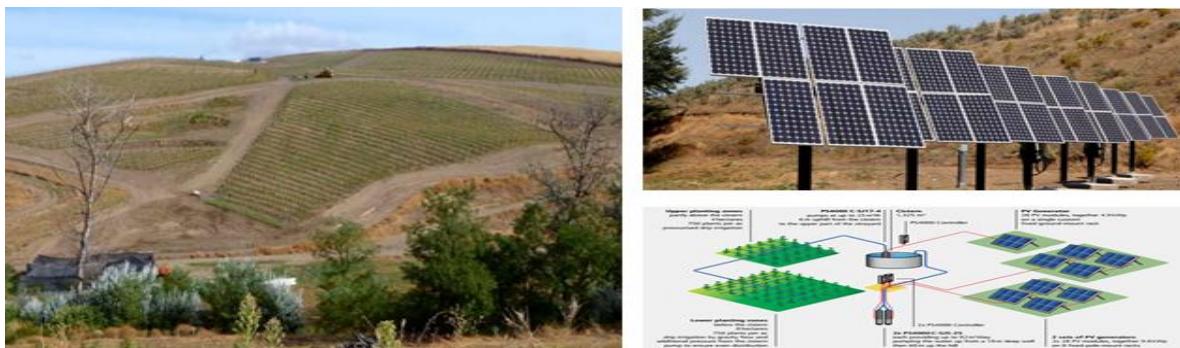
**Figure 4. Solar powered systems have been supported by the Turkish Government in some cities in Turkey**

The private enterprise, LORENTZ, set-up solar-powered water pumping systems for vineyard irrigation in 12 hectares in Dufur, Oregon in USA in fig 5. It has resulted in a greater cost efficiency and independence when compared to a grid-tied power installation.



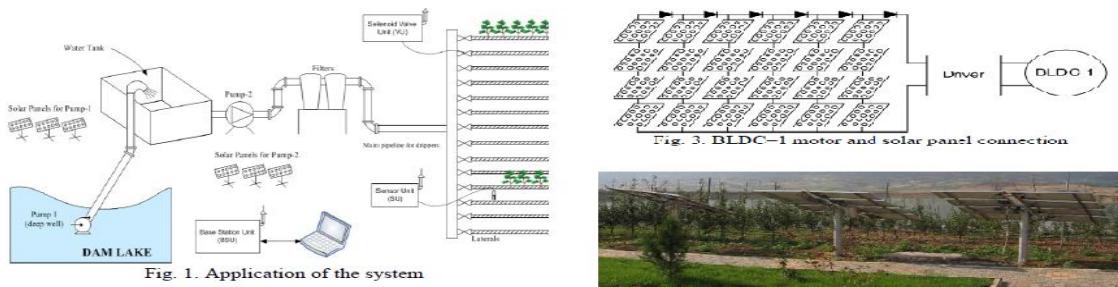
**Figure 5. Vineyard irrigation with drip irrigation system in 12 hectares in Dufur, Oregon, USA.**

In developing countries, the use of solar energy has also been increasingly widespread as follows; Dursun and Ozden (2012) established a solar powered drip irrigation system, which automatically irrigate 1000 m<sup>2</sup> of cherry trees in 8 decades (0.8 hectares) in Zile, Tokat in Turkey. In this system, 24 solar panels pumped water from dam to water storage tank, near the cherry orchard and other 24 solar panels provided required energy to pump water from the storage tank to the root area of cherry trees. The authors reported that the system contributed a socio-economic development in Tokat region.



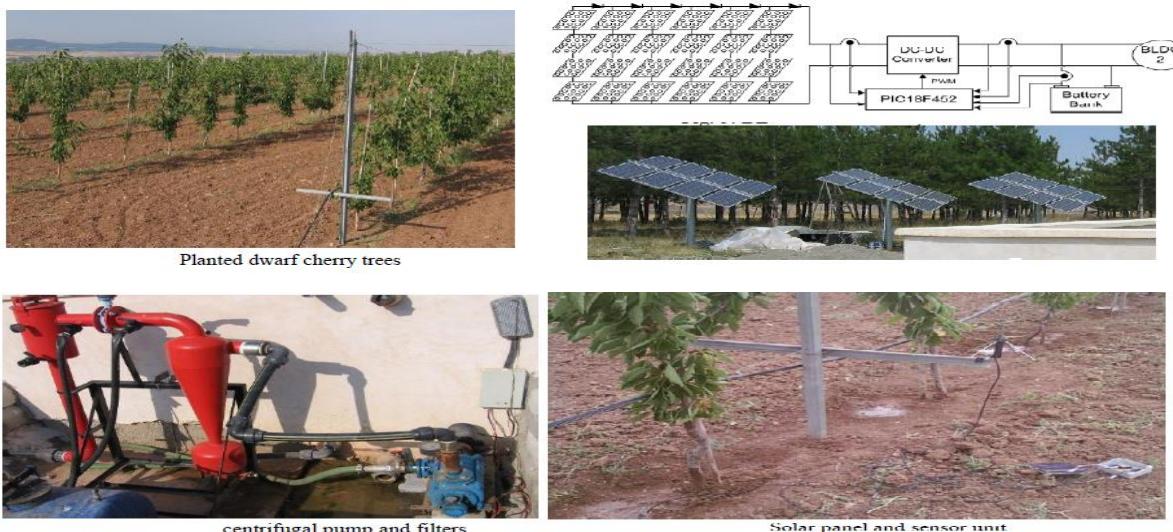
**Figure 6. Application of the solar-powered drip irrigation system in Tokat**

Agricultural Research Institute in Turkey developed a mobile and power supply providing solar energy and also has an ability of solar tracking. This system was developed to provide required energy for irrigation in agriculture. This system has an ability to pump water from the depth of 170 m to the soil surface and to irrigate the area of 400 decares (40 hectares) (Anonymous, 2012).



**Figure 7. A mobile solar powered drip irrigation system developed by GAP, Agricultural Research Intitute in Turkey**

Koksal (2012) developed a PV system, producing an electrical power of 2982.72 W. The system consisted of 12 PV panels, one of which produces the electrical power of 656.23 W and pumped water in discharge of between 21.6 and 28.3 m<sup>3</sup>/h, averagely. Therefore, pump efficiency was almost 48% when running.





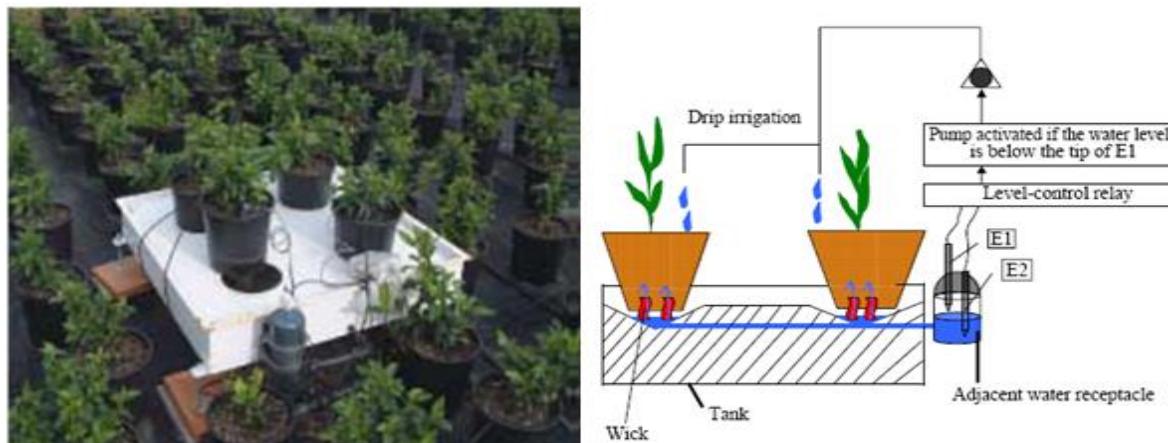
**Figure 8. A mobile solar-powered system developed by Koksal (2012)**

Using the renewable energy sources in agriculture has been increasing in both outdoor and also in greenhouses systems. Automation is very easy in closed systems especially in greenhouses as compared with outdoor conditions. few examples for greenhouse automation are given as follows; Caceres et al.(2007) designed an irrigation control tray to grow container grown plants in greenhouse. The system consisted of tank, wick and an adjacent water receptacle, contained two electrodes (Satainless-steel rods). One electrode was always submerged in water (E1). The other was placed at a depth considered to be the maximum height reached by the waer level in the tank (E2). Irrigation was triggered whenever the water level was immediately below the tip of electrode 2 (E2). Water level was sensed by the PLC. Therefore, authors reported that the irrigation control tray was an acceptable system to automatically irrigate container-grown crops.



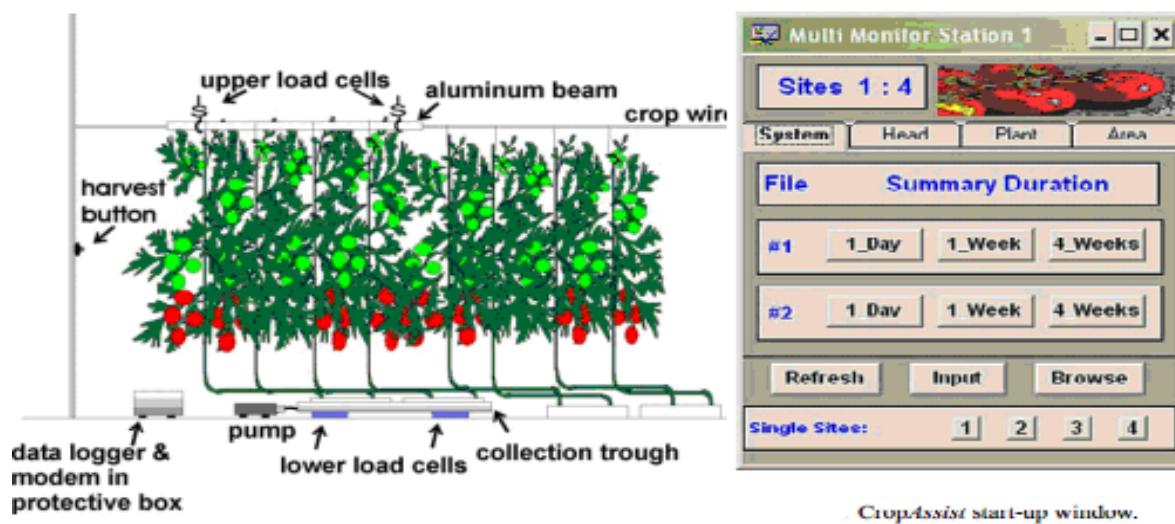
**Figure 9. The automated irrigation system running to a water level sensing apparatus and use in greenhouses (Caceres et al.2007)**

Helmer et al.(2005) developed a Crop Assist automated system. This system was a simple and reliable technology to automatically record the growth and water use of tomato crops in commercial and research greenhouses. The system consisted of two load cells. One of load cells measures the mass of the growing media in a leachate collection trough, thereby enabling measurement of crop water use. The other set is suspended from above to measure the mass of the plant canopy. Data from the load cells collected to a data logger.



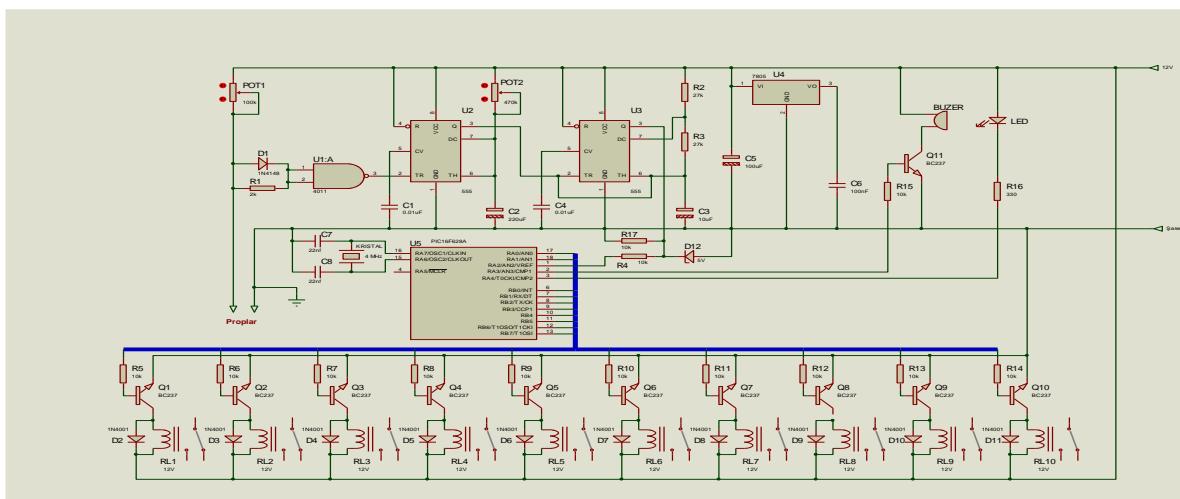
**Figure 10. An automated drip irrigation system activated by upper and lower load cells (Helmer et al.,2005)**

Yildirim and Demirel (2011) developed an automated drip irrigation system based on soil electrical conductivity. This system consisted of an electronic circuit to control irrigation and soil moisture sensor. The performance of the system was acceptable to irrigate container grown plants.



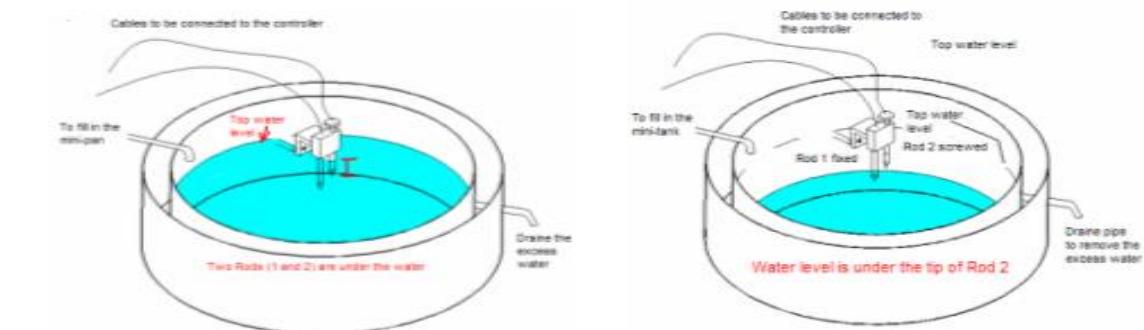
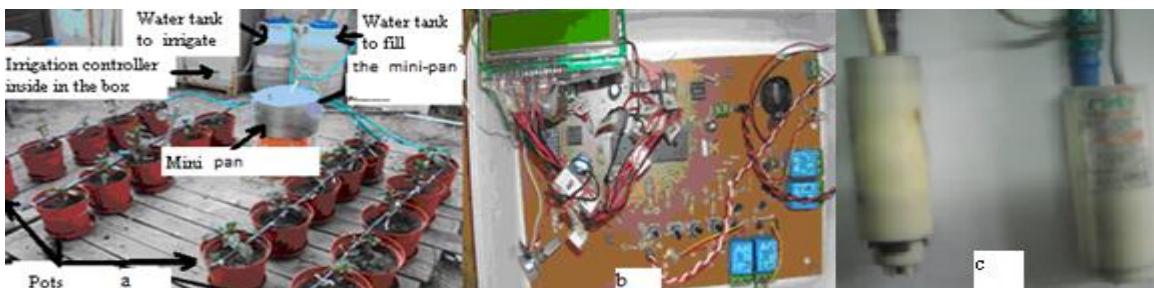
**Figure 11. Electronic circuit enables irrigation automatically (Yıldırım and Demirel, 2011)**

Yildirim (2013) developed drip irrigation system with a water level sensing system. In this system, data acquisition was performed by an electronic circuit, which processed data and then sent the data to the micro controller (PIC16F877). A closed loop control system based on sensing water level in the mini-pan was used to activate irrigation, thereby the prototype of the system started irrigation whenever water level in the mini-pan dropped to the threshold level. Nowadays, researchers have been working on using solar power systems, especially in off-grid areas.



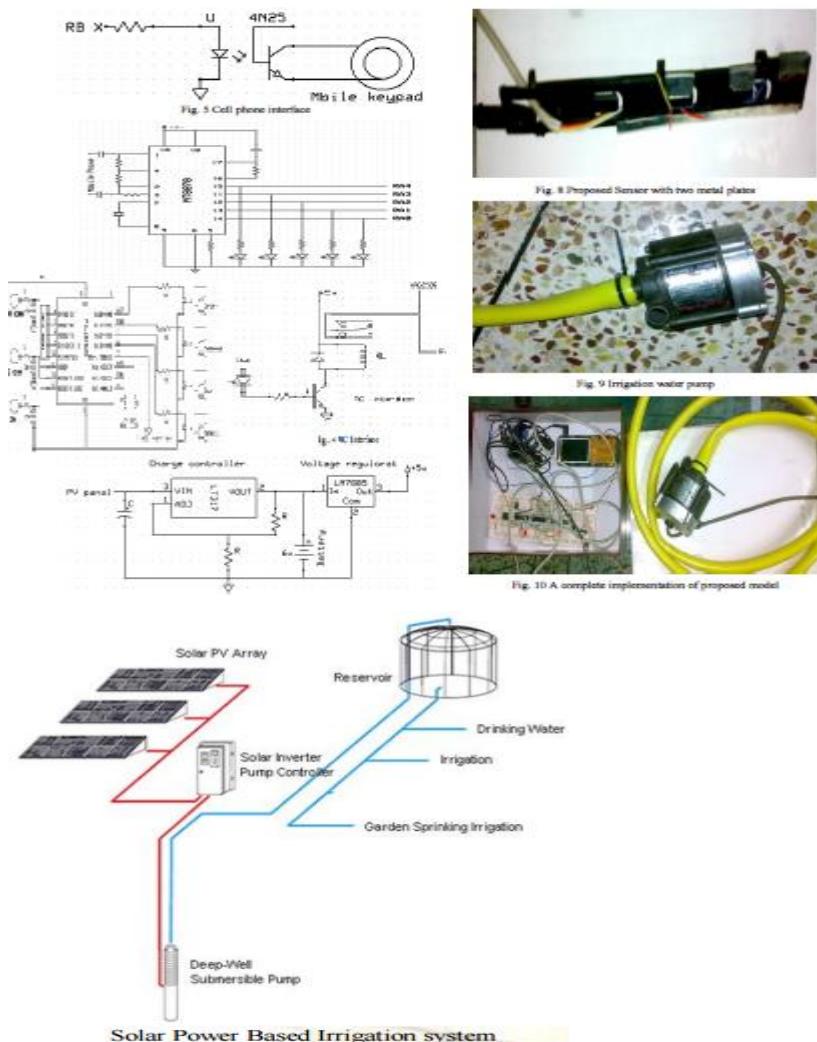
**Figure 12.**An automated drip irrigation system activated by a water level sensing system (Yildirim, 2013)

Uddin et al.(2012) proposed a model of automatic microcontroller based irrigation system, using only solar power to control the overall system. In this system, sensors are placed on the paddy field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the paddy fields, farmers can get the information about the water level.



**Figure 13.** A solar powered drip irrigation system (Uddin et al.,2012)

Yalla et al.(2013) recommended solar powered drip irrigation systems, especially for off-grid application systems, independent supply from the grid.



**Figure 14. Solar-powered drip irrigation system(Yalla et al.,2013)**

## CONCLUSION

Automation and electronic in agriculture are becoming more popular, nowadays. The automation in irrigation systems has an ability to control irrigation pumps in all topographic conditions, also can be controlled either in time based or real time feedback system within 7 days and 24 hours, continuously, this application also allows saving both time and energy. Nowadays, automation has been increasing its benefits with the combination of solar-powered system.

Automation and saving energy in solar and wind energy achieves social and economic progress of the farmers. The researches on automation and solar energy must be supported by the government so that these studies are not in the sufficient level in Turkey.

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## EVALUATION OF THE EFFECT OF SALT STRESS AND EVAPOTRANSPIRATION ON LEEK (*ALLIUM PORRUM L.*) GROWTH AND YIELD PARAMETERS WITH 3D MODELS

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### ABSTRACT

High temperature and low humidity results in high transpiration which in turn influences negatively crop water potential through low yield and growth parameters. Effect of salt stress and evapotranspiration on leek yield and quality parameters(plant height, stem weight, evapotranspiration, water use efficiency, chlorophyll content, stem length, stem diameter) as assessed using 3D models. An increase in irrigation water salinity resulted in a decline ET which had the effect of reducing crop yield. This study analyzed the effect of the changes in ET and soil salinity on leek's yield and growth parameters. In plant salinity stress determination, water consumption as a second factor may be highly reflective of the effect of various climatic conditions on crop salt tolerance.

**Keywords :** Leek, *Allium porrum L.* , soil salinity, salt stress, evapotranspiration

### 1. INTRODUCTION

Salinity is one of the major problem for agricultural in semi-arid and arid regimes. Most crops are sensitive to salinity caused by high concentration of salts in the soil. Every crop has threshold value. All plants do not show similar respond to root zone salinity; some of them can produce acceptable yields at much greater than others. Mass and Hoffman (1997) model has been used commonly for assess between soil salinity and yield. Considering to this model, yield reduction does not seem until the threshold value whereas after critical threshold value is yield decrease linearly for unit increase in soil salinity. Limited factor for the relative yield reduction based on soil salinity. Most of crops show that more tolerance to soil salinity in cold climate conditions than hot climate conditions. Since crop demand for water is less during the cooler periods, the effect of reduced water availability due to salinity is not so critical while during periods of very high ET demand under hot conditions water absorption by the plant may not be adequate due to both rapid depletion of soil water and increased salt concentration around the root zone (Ayers and Westcot, 1994).A few research studies has been carried out to characterize a threshold of leek.

Cemek et al. (2011) investigated that effect of evapotranspiration and soil salinity on some growth parameters and yield of lettuce. Researchers observed that the highest yield was obtained in low soil salinity and low evapotranspiration, while the lowest yield was obtained in high soil salinity and high evapotranspiration conditions. Researchers suggested that evaluation of soil salinity and evapotranspiration on the yield and some growth parameters of lettuce with 3-D models might be helpful for salinity management.

Ünlükara et al (2015) carried out an experiment to investigate green long pepper under different saline conditions and usability of water consumption in plant salt-tolerance. Result of 3-D model showed that between relative yields, evapotranspiration and soil salinity was found a stronger relation. They suggested that for assessment of plant salt tolerance using evapotranspiration as a second factor may be helpful for reflecting effects of different climatic conditions.

The aim of this study, effect of salt stress and evapotranspiration on leek yield and quality parameters(plant height, stem weight, evapotranspiration, water use efficiency, chlorophyll content, stem length, stem diameter) were evaluated by using 3D models

### 2. MATERIAL AND METHOD

Irrigation water salinity experiment was performed at the Ondokuz Mayıs University Agriculture Faculty Research Fields. The research was conducted in area which is only closed on the top with plastic cover. The experiment was conducted according to randomized block design with seven treatments and four replications ( $T_0=0.38$  dS/m,  $T_1=1.0$  dS/m,  $T_2=2.0$  dS/m,  $T_3=3.0$  dS/m,  $T_4=4.0$  dS/m,  $T_5=5.0$  dS/m and  $T_7=7.0$  dS/m).The plants grown in 31 cm bottom, 36 cm height and 38 cm top of size pot. A 5 kg gravel placed at the bottom of every pots to promote drainage. Each pots were filled up with 32 kg air-dry sandy clay loam. Sandy clay loam soil texture consisting of 58.4, 14.7 and 26.9% of sand, clay and silt was used for all pots, sieved through a 4 mm sieve. Three different salt types ( $\text{NaCl}$ ,  $\text{MgSO}_4$  and  $\text{CaCl}_2$ ) were mixed with tap water. For all treatments to avoid the adverse effect of sodium adsorption ratio (SAR) were kept less than 2.5 and Ca:Mg ratio of 1:1 (mmol litre<sup>-1</sup>). Before using of saline water for treatment. Each EC values were checked in the laboratory and

corrections were made if necessary. T<sub>0</sub> (0.38 dS/m) is the tap water which used as a control treatment. For preparing saline waters were used in volume of 50 liters plastic containers.

Daily meteorological data (dry bulb temperature and relative humidity) were measured by an electronic measurement and data logging device (KISTOCK KIMO Datalogger). The datalogger was placed 2 m above the ground in the middle of the research area.

Before starting to the experiment, each pots were saturated with tap water and soil surface was covered in order to prevent evaporation. After the drainage ceased, the weight of the each pot was assumed as the field capacity weight (W<sub>FC</sub>) of that pots. Each pot was weighed before each irrigation event. The amounts of irrigation water (IW) were calculated by using Equation (1) for the irrigation water salinity treatment (Cemek et al 2011; Kurunc et al 2011; Ünlükara et al 2015);

$$IW = \frac{\frac{W_{FC} - W_p}{\rho_w}}{1 - LF} \quad (1)$$

Where, LF is the leaching fraction, which was taken as (LF = 0.15), W<sub>FC</sub> is the pot weight at the field capacity (kg), W<sub>p</sub> is the pot weight just before irrigation (kg), ρ<sub>w</sub> is the unit mass of water (1 kg litre<sup>-1</sup>). Underneath of each pot was placed drain pan to collected drainage water flows from pots. During the investigation period drainage water volume was measured after each irrigation. Throughout the experiment, irrigation treatments were performed between 4 and 6 day intervals. Total crop evapotranspiration between two interval irrigations were calculated using the water balance method Eq (2) (Semiz et al 2013; Kurunç et al 2011)

$$ET = \frac{(W_n - W_{n+1})}{\rho_w} + (IW - D) \quad (2)$$

Where, ET is evapotranspiration of leek, W<sub>b</sub> and W<sub>e</sub> are the pot weights before n<sup>th</sup> and n+1<sup>th</sup> irrigation (kg), ρ<sub>w</sub> is the unit mass of water (1 kg litre<sup>-1</sup>), IW and D are amounts of applied and drainage water (liters). At the end of the experiment, soil samples were taken from 15 cm depth of each pot. Soil salinity (ECe) was determined from saturated paste extracts

At the harvest of the experiment, for each treatment plant height, stem weight, stem diameter, stem length, chlorophyll content and leaf area was determined. Multiple regression analysis of data was performed with Microsoft EXCEL according to the Gomez and Gomez (1984). The obtained data, which are from multiple regression analysis were shown on 3-D graphs using the Slide Write computer package Version 2.0.

### 3. RESULT AND DISCUSSION

**Interactions between of soil salinity and evapotranspiration on plant height (Model 1):** The plant height of leek was significantly affected from decreasing and increasing soil salinity and evapotranspiration. Increasing plant height with increasing evapotranspiration, while increasing soil salinity was caused decreasing plant height. Moreover, plant height increased curvilinearly as evapotranspiration increased at all soil salinity examined. Furthermore, plant height decreased curvilinearly with increasing soil salinity up to 2.5-3 dS/m and decreased linearly after this point. The tallest plant height of leek was determined in low soil salinity and high evapotranspiration, whereas high soil salinity and low evapotranspiration was caused lowest plant height of leek (Fig 1a). Between soil salinity and evapotranspiration on plant height was determined very strong relationship ( $r^2=0.90$ ) (Table 1).

**Interactions between soil salinity and evapotranspiration on stem weight (Model 2):** Effect of soil salinity and evapotranspiration on stem weight was shown in (Fig. 1b). Between soil salinity and stem weight was observed negative linear relationships while between evapotranspiration and stem weight was observed positive linear relationships ( $r^2=0.90$ ) (Table 1). The stem weight was significantly affected from soil salinity and evapotranspiration. The highest yield obtained from high evapotranspiration and low soil salinity whereas lowest yield was seen at low evapotranspiration and high soil salinity. At Both highest and lowest evapotranspiration conditions, decreasing in soil salinity leading to an increase in stem weight linearly.

**Interactions between soil salinity and evapotranspiration on stem length (Model 3):** Figure 1c shows the relationships between soil salinity- evapotranspiration and stem length. The obtained  $r^2$  value from model was very strongly. The taller stem lengths were found at lowest soil salinity and highest evapotranspiration while smaller stem of leeks were determined at highest soil salinity and lowest evapotranspiration. Both low and high evapotranspiration conditions increase in soil salinity caused sharply decrease in stem length of leek.

**Interactions between soil salinity and evapotranspiration on stem diameter (Model 4):** Responses of stem diameter of leek plants grown under the effect of soil salinity and evapotranspiration were illustrated in (Fig. 1d). A significantly relationships were found between soil salinity-evapotranspiration on stem diameter. The thickest stem diameter values were obtained from high evapotranspiration and low soil salinity. From figure 1d observed

that negative effects of soil salinity on stem diameter. Besides, as seen in Fig. 1d, stem diameter decreased curvilinearly with increased soil salinity up to 6.70 dS/m and declined thereafter linearly with increased soil salinity. Stem diameter increased linearly as crop water consumption increased at all soil salinity examined. Increasing salt concentration of soil caused decreasing both stem diameter and evapotranspiration. Salt concentration in root zone causes increasing the osmotic potential of soil, which reduces the availability of water to absorb by plants from soil. This situation adversely affects growth and development of plants.

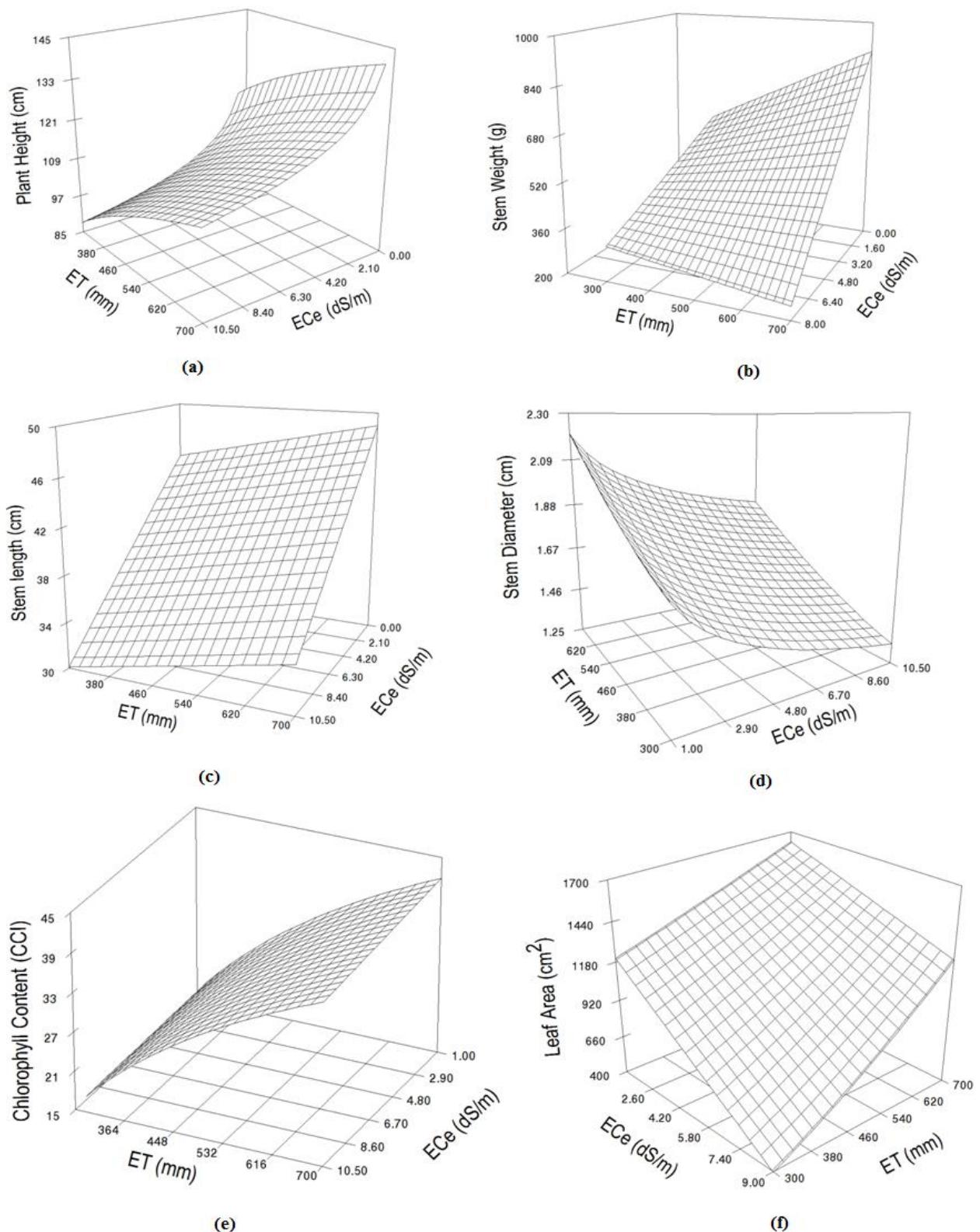
**Interactions between soil salinity and evapotranspiration on chlorophyll content (Model 5):** The relationships between crop evapotranspiration-soil salinity and chlorophyll content were shown in (Fig. 1e). From figure 1e observed that effect of the evapotranspiration on chlorophyll content had curvilinearly whereas soil salinity had linear effect on chlorophyll content. As seen in Fig. 1e, soil salinity was not as effective as evapotranspiration on chlorophyll content. The highest chlorophyll content was found at high crop water consumption and low soil salinity while the low chlorophyll content was taken from low crop water consumption and high soil salinity. Chlorophyll content increased with increasing evapotranspiration and decreasing soil salinity. A decrease of chlorophyll content depends on crop salt tolerance and salt concentration in soil (Sabbagh et al. 2014). Many researchers suggested that reduction of chlorophyll content associated with reduced water uptake of crops (Kırnak et al. 2002; Abd El Magned et al. 2015). Chlorophyll concentration also related to the leaf senescence in consequence of salt stress and ion concentration (Parida et al. 2005).

**Interactions between soil salinity and evapotranspiration on leaf area (Model 6):** The strong linearly interactions between soil salinity and evapotranspiration on leaf area were illustrated at (Fig 1f). The highest value of leaf area was obtained when crop water consumption was the highest and soil salinity was the lowest situations. In low soil salinity conditions, leaf area positive affected from increasing crop water consumption. Leaf area of plants increased with a decrease in soil salinity whereas the leaf area decreased with a further increase soil salinity. The reduction in leaf area expansion under high salinity condition resulted from premature leaf senescence or death of plants.

Table 1.Determination of the relationship between evapotranspiration-soil salinity on yield and some growth parameters for leek with multiple regression analysis

Model 1	The relationships between plant height and soil salinity-evapotranspiration	PH=-46.404+23.947xLn(ET <sup>2</sup> )-10.078xLn(ET <sup>2</sup> xEC) SE= (60.747) (2.427) <sup>***</sup> (2.897) <sup>**</sup> r <sup>2</sup> =0.90***
Model 2	The relationships between stem weight and soil salinity-evapotranspiration	SW=359.910+0.335xEC <sup>2</sup> -0.119xEcExET+0.766xET SE=(141.319) <sup>**</sup> (1.143) (0.032) <sup>***</sup> (0.210) <sup>***</sup> r <sup>2</sup> =0.90***
Model 3	The relationships between stem length and soil salinity-evapotranspiration	SL=41.88-1.40xECe+0.01xET SE=(2.914) <sup>***</sup> (0.167) <sup>***</sup> (0.004) <sup>**</sup> r <sup>2</sup> =0.96***
Model 4	The relationships between stem diameter and soil salinity-evapotranspiration	SD=3.398+0.002xET-0.170xLn(ET <sup>2</sup> xEC)-0.028xLn(ET <sup>2</sup> ) SE=(5.570) (0.002) (0.084) <sup>*</sup> (0.549) r <sup>2</sup> =0.81***
Model 5	The relationships between chlorophyll content and soil salinity-evapotranspiration	CC=-140.412+13.930xLn(ET <sup>2</sup> )-0.0003xECxET SE= (9.782) <sup>***</sup> (0.562) <sup>***</sup> (0.014) r <sup>2</sup> =0.78***
Model 6	The relationships between leaf area and soil salinity-evapotranspiration	LA=1022.53+0.00013xET <sup>2</sup> xEC+0.940xET-112.638xECe SE=(459.656) <sup>**</sup> (0.00017) (0.735) (38.808) <sup>**</sup> r <sup>2</sup> =0.89***

\*: p < 0.05. \*\*: p < 0.01, \*\*\* p < 0.001



**Figure 1.** The relationships between soil salinity and evapotranspiration 1) plant height and soil salinity-evapotranspiration 2) Stem weight and soil salinity-evapotranspiration 3) Stem length and soil salinity-evapotranspiration 4) Stem diameter and soil salinity-evapotranspiration 5) Chlorophyll content and soil salinity-evapotranspiration 6) Leaf area and soil salinity-evapotranspiration

#### 4. CONCLUSIONS

In this research, the effects of salt stress and evapotranspiration on leek (*Allium porrum L.*) grown in pot conditions on growth and yield parameters (plant height, stem length, stem weight, stem diameter, chlorophyll content and leaf area) were evaluated with 3D models. The impact of the soil salinity and evapotranspiration on leek growth and yield parameters were summarized:

- Plant height increased with increasing evapotranspiration while plant height decreased with increasing soil salinity.
- Decreasing growth rate of the leek resulted from increased soil salinity which was affected crop water uptake from soil. Therefore we suggested when saline water is used for irrigation, to protect harmful accumulation of salts in soil profile must be leached periodically with an amount of water an excess of that used by evapotranspiration.
- In plant salinity stress determination, water consumption as a second factor may be highly reflective of the effect of various climatic conditions on crop salt tolerance.
- Stem weight is the significant component of the leek. The increase in soil salinity was significantly affected to stem weight.
- Stem length and stem diameter were also affected from increase soil salinity.
- Chlorophyll content increased with increasing evapotranspiration. Soil salinity is not as effective as evapotranspiration on chlorophyll content. Therefore, soil water availability has an important role on chlorophyll content.
- Leaf area was significantly affected both evapotranspiration and soil salinity. Leaf area decreased considerably with increasing soil salt concentration whereas leaf area increased gradually with increasing evapotranspiration.
- Growth and some yield parameters of leek were correlated with soil salinity and evapotranspiration using 3D models. These models which have high determination coefficients can be used for salinity management and to predict some parameters of crop.

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## ASSESSMENT OF SPATIAL DISTRIBUTION OF PRECIPITATION WITH DIFFERENT INTERPOLATION METHODS FOR YEŞILIRMAK CATCHMENT

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### ABSTRACT

The spatial interpolation methods, including geostatistics, have been developed for and applied to various disciplines. Precipitation is a very important parameter in soil water content and irrigation research. Precipitation were taken 45 different meteorological stations for Yeşilırmak Catchment and precipitation. Precipitation data has been used the average long annual. To select the optimal method in this paper, five interpolation methods Inverse Distance Weight (IDW), Ordinary Kriging (O.K), Simple Kriging (S.K), Radial Basic Function (RBF) and CoKriging were compared, and then the optimal interpolation method was used to give spatial distribution of precipitation. Satatistical evaluation such as Root Mean Square Eror (RMSE), Mean Absolute Error (MAE) and average slope error (MBE) were performed to determine the best method. The study shows that the different interpolation methods could be successfully used in evaluation of peak and low values of point of monthly total precipitation maps.

**Keywords:** Geographic Information Methods, Precipitation, Interpolation Methods, Yesilirmak Catchment

### 1. INTRODUCTION

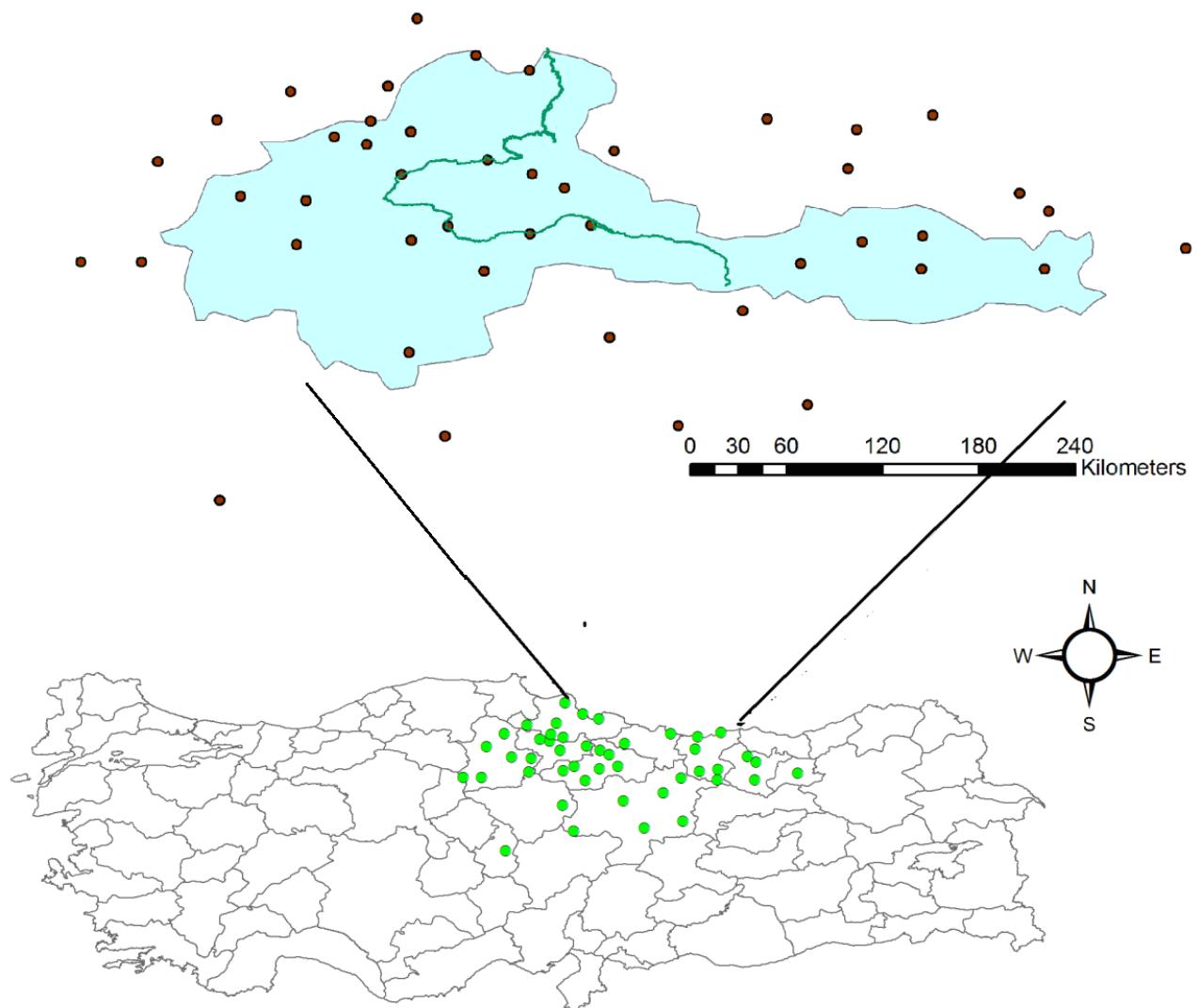
Spatial modelling of climatic variables holds an important place in agricultural studies. Hydrological studies, forecasting natural disaster such as drought and flood, forecasting the amount of surface and underground water resources, pollution of water resources and the issues associated with air pollution affect particularly precipitation variable and require a good modelling. Determining both spatial and temporal behaviour of the monthly and daily values of the average precipitation on earth is of great importance. Various instruments are used for collecting these data and the local meteorological conditions are abided by. Recently, geo-statistic techniques have been developed to reveal the spatial distribution of the climate variables (Irmak et al., 2010). Geostatistics is a technique that allows the generalization of terrain features taking advantage of the relationships between parameters with much less time, labor and money in line with the developments in computer technology (Zhang et al., 1995). Examining these climate data only with classic statistical methods is not sufficient. This is not very accurate since an unknown point is estimated benefiting from other known points and it does not take into consideration the spatial dependence (Mulla and McBratney, 2001). IDW and Spline methods are of the most used deterministic methods (Li et al., 2000; Tsanis and Gad, 2001; Diodato and Ceccarelli, 2005; Wei et al., 2005). The stochastic methods a.k.a. geo-statistical methods are basically known as Kriging method. IDW is a method to estimate the values in unknown points using the linear combinations of the values weighted by inverse functions of the target point's distances from the known points. Spline method is a method that is often used to produce maps through the known sparse points. Kriging method that is one of the most powerful methods in calculating surfaces was developed on the assumption that it includes a spatial relationship that could be used to explain the surface changes of distance or direction between the known points (Childs, 2004). Öztürk and Batuk conducted a study for the Marmara Catchment using geo-statistical techniques. Çetin and Tülüçü (1998) have done an evaluation of precipitation using geo-statistical techniques.

The most appropriate distribution has been determined using IDW, O.K., S.K., RBF and CoKriging methods in order to determine the spatial distribution of total monthly precipitation obtained from 45 stations in the Yeşilırmak Catchment. The total annual precipitation distribution map was constructed using the best method.

### 2. MATERIALS AND METHODS

#### Location of the Study Area

Yeşilırmak Catchment is located in the North Anatolia Region. It is the third largest river basin among the main river basins in Turkey and gives life to approximately 5% of the total area of Turkey. The altitude reaches to 3050 meters in the mountainous regions of the basin. In the study, we used the average precipitation data of 39 years between 1975 and 2014. A total of 45 meteorological observation stations' data were analyzed. 23 stations are located within the boundaries of Yeşilırmak Basin while others are located on the basin boundaries (Figure 1).

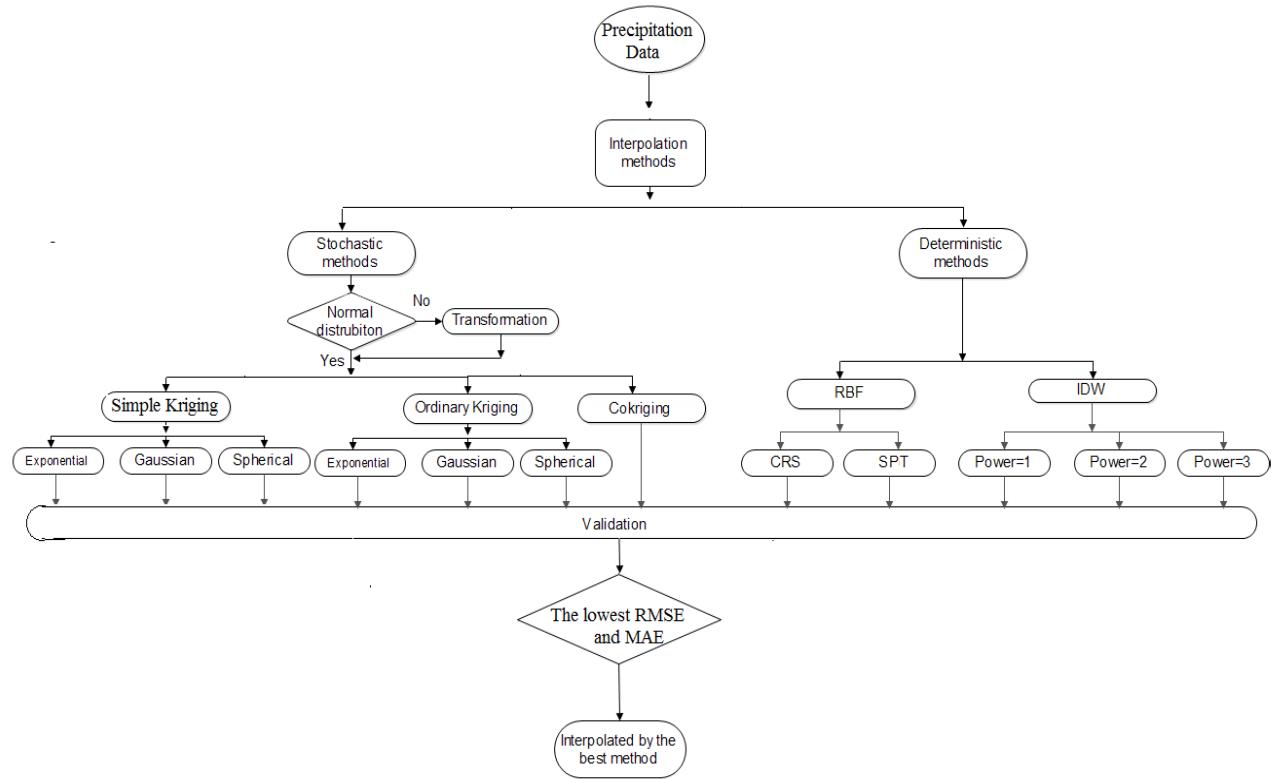


**Figure 1. Study area and sample points**

### 3. INTERPOLATION METHODS

In the study, five different interpolation methods were used to determine the spatial distribution of precipitation. Testing whether the values of the total annual precipitation displays a normal distribution, IDW and RBF (deterministic methods) and Ordinary Kriging, Simple Kriging and CoKriging methods (geo-statistic methods) were used and the spatial distribution of the total annual precipitation was determined by the most appropriate method. The height parameter was taken into consideration to determine the effect of the second variable in CoKriging method. Different functions were used for the adopted interpolation methods. The course f the study is shown in Figure 2.

**Figure 2. Flowchart of interpolation methods for the spatial distribution of the total annual precipitation**



### Evaluation of the Methods

The total annual precipitation values obtained from a total of 45 observation stations were used for the evaluation of the best results of the model in interpolation method. There are different comparison techniques to determine the relationship between the measured and estimated values. In the literature, there are different comparison methods that provides the nearest results to the measured values – in other words allows to choose the most appropriate model among the methods – in order to examine the relationship between the measured and estimated precipitation values Root mean square error (RMSE) and mean absolute error (MAE) are the most commonly used parameters. The model providing the lowest RMSE and MAE values using equation 1 and 2 was chosen as the best among forecasting methods.

$$RMSE = \sqrt{\frac{\sum_{i=1}^m (y_i - O_i)^2}{n}} \quad (1)$$

$$MAE = \left| \frac{\sum_{i=1}^n (y_i - O_i)}{n} \right|$$

(2)

n = the number of tested data

O<sub>i</sub> = estimated

y<sub>i</sub> = measured precipitation data

## Results and Discussion

### Descriptive Statistics

Basic descriptive statistical values of 45 meteorological stations are given in the Table 1. The total annual precipitation in the study area varies in a wide range between 317.9 mm and 1487.3 mm. Skewness value and Kurtosis value of the samples were respectively found 2.11 and 6.96. Doing interpolation with Kriging method, it is necessary to determine whether the data is within normal distribution or not. One-sample kolmogorov-smirnov test was carried out on the samples and the samples were found not to be within the normal distribution. Therefore, the data have been evaluated as log normal doing the spatial distribution in Kriging interpolation methods.

**Table 1. Statistics of precipitation**

	Min.	Max.	Mean	S.D.	Skewness	Kurtosis	Distrubition
<b>Annual mean precipitation (m)</b>	317.9	1487.3	532.28	258.83	2.11	6.96	Log normal

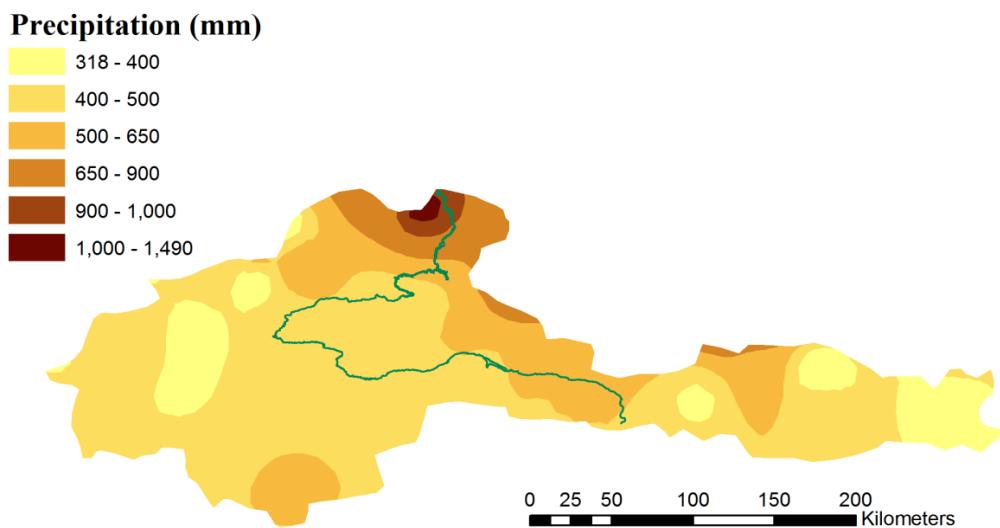
### Comparison of Interpolation Methods

Comparison results of the interpolation methods of the average precipitation data are given in Table 2. Having observed the table, it is seen that there are 12 different combinations of the five different interpolation methods. Three different weight powers have been tested in IDW that is a deterministic method while two different functions have been tested in RBF method. The power or function of each method giving the best result has been determined. We have found quite big differences between RMSE and MAE values of the functions in IDW method and the best result has been yielded from IDW 3 (RMSE=152.41; MAE=100.98). In RBF method, the lowest values of RMSE (163.72) and MAE (109.54) have been obtained from RBF-ST function.

The spatial distribution maps were created using Spherical, Exponential and Gaussian variograms in OK and SK of the geo-statistical methods and a variogram that providing the best estimate was determined for each method. RMSE and MAE values of three different variograms were very close to each other in OK method and the best result has been yielded from the Gaussian variogram. In SK method, the lowest values of RMSE and MAE have been obtained from the Gaussian variogram. In CoKriging method in which the spatial distribution map was created entering the heights of meteorological station as the second variable, the lowest values of RMSE (162.71) and MAE (103.08) have been obtained from the spherical variogram. Having analyzed all the methods, it has been found that IDW 3 provides the most accurate results; however, IDW 1 has been found to give the maximum error. Using the best method, the spatial distribution of the annual precipitation was prepared in accordance with IDW 3 method in Figure 3. It is seen in the figure that the precipitation in the northern region of the study area seems to be over 1000 mm, while it is below 400 mm in the eastern region of the study area.

**Table 2. The RMSE and MAE statistics of IDW, OK, SK, RBF and COK for precipitation**

Models	Power/Variogram Function		RMSE	MAE
	1		212.08	143.74
<b>IDW</b>	2		175.49	116.05
	<b>3</b>		<b>152.41</b>	<b>100.98</b>
<b>RBF</b>	CRS		166.89	112.49
	ST		163.72	109.54
<b>OK</b>	Spherical		166.10	104.79
	Exponential		165.59	105.69
	Gaussian		165.59	103.52
<b>SK</b>	Spherical		173.49	114.81
	Exponential		173.44	113.24
	Gaussian		169.68	110.66
<b>Cokriging</b>	Spherical		162.71	103.08



**Figure 3. Spatial distribution map of the total annual precipitation in Yeşilırmak Catchment**

#### Conclusion

In the study, five interpolation methods including IDW, RBF, OK, SK and CoK were used comparing their performances of annual precipitation estimation in Yeşilırmak Catchment. Cross validation method was used to determine the best method and the values of RMSE and MAE were determined using the values that were measured and estimated for each method. We analyzed a total of 12 different combinations of the five methods and determined the best method providing the spatial distribution of precipitation for this region. Accordingly, IDW method was determined as the best method since it provides the lowest values of RMSE and MAE with 3 weight powers functions. The worst method results were obtained from IDW 1 weight power function. The similar results were obtained from other methods.

The planning of agricultural production and watering time is very difficult in the regions that lack meteorological stations and hence the amount of annual precipitation cannot be measured. Establishing meteorological stations in each region is neither easy to operate nor cheaper. Therefore, the proper preparation of the spatial distribution maps using the data from existing meteorological stations and their use in the studies are of importance.

Turkey is a country where there are different precipitation regimes whose features and areas vary under the combined effect of climatic factors. Therefore, the precipitation should be examined by means of modern statistical techniques such as spatial interpolation and proper precipitation models should be created. In Turkey, it is required to repeatedly carry out up to date studies about precipitation change and it is necessary to reach accurate information using state-of-the-art methods.

It is important to determine the most appropriate interpolation method for the values before carrying out the spatial distribution of the values such as the climatic parameters from which the pointwise data is obtained, groundwater quality and soil properties; it is expected that the interpretation of the results through the subsequent spatial distribution using this method would provide better results.

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## AGRICULTURAL WATER USE IN TURKEY AND WATER FOOTPRINT

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### ABSTRACT

Although water resources seem to be sufficient under current conditions, Turkey is not a water-rich country. Together with increasing population, Turkey will be a country with significant water deficits by the year 2030. Therefore, water resources management and sustainable use are the most significant issues. Water footprint is a new approach in assessment of water resources management and use. Water footprint of a country directs the planners, investors and decision makers. It is a measure of consumed and/or polluted volume of water in a unit time. The water footprint of an individual, a society or a business sector is defined as the total amount of water used to produce the goods and services consumed by an individual of a society or the amount of fresh water resources used by producer to produce the goods and services. Water footprint concept is an alternative indicator for water use. It assesses the water consumption rather than water withdrawal from the system. There are three components of water footprint as of blue, green and grey water footprints. Blue water footprint represents the surface and groundwaters needed to produce a good or a service; green water footprint represents rainwater to be used in production of a good; grey water footprint is an indicator of pollution and represents the amount of fresh water to be used for the elimination of pollution loads in accordance with current water quality standards. The water used in agricultural production activities is composed of 66% green water and 20% blue water. Domestic and industrial water uses are mostly composed of grey water. In this study, agricultural water use in Turkey was assessed and the new concept "water footprint" was introduced and discussed.

**Keywords:** Water management, water footprint, water use, blue water, green water

### 1. INTRODUCTION

Although Turkey seems to have sufficient water resources under current conditions, the country is not rich in water resources. Together with increasing population, Turkey will probably be classified among the countries with water deficiency in the year 2030. Therefore, water resources management and sustainability have become significant issues.

Water footprint is a new approach to assess water resources management and water use in different industries. Identification of water footprint in a country guides planners, investors and decision-makers. Water footprint and virtual water known as embedded, embodied, exogenous or shadow water are different terms. Virtual water refers only to the water embodied in a product and used for international or interregional water flows. In other words, if a country or a region is importing a product, it also imports/exports the water virtually. The term 'water footprint' on the other hand refers not only to the volume, but also to the sort of water that was used (green, blue, grey) and to when and where the water was used. While water footprint of a product is multi-dimensional indicator, virtual water (embedded water) indicates only the amount of water used (Çakmak, 2012).

Water footprint is measured with the amount of water used (including evaporation) and/or polluted in a unit time. Water footprint of an individual, a society or a business is defined as the total amount of fresh water resources used to produce the goods and services consumed by an individual or a society or the water used by producer for the production of goods and services. Water footprint concept is an alternative indicator for water use. Water footprint assesses the amount of water consumed rather than the amount of water withdrawn.

Water footprint has three components as of green, blue and grey water representing water use and quality. Blue water footprint represents the total volume of surface and ground water resources needed for the production of goods or services and it indicates fresh water resources. Green water footprint is the amount of total precipitation water used for the production of goods or services. The precipitation water considered in green water footprint is the precipitation water held in soil over a certain period of time. Grey water footprint is an indicator for pollution and expresses the amount of fresh water to be used to mitigate or totally eliminate the pollution load based on current water quality standards.

Production water footprint in Turkey is about 139.6 billion m<sup>3</sup>/year. Of this amount, 64% is green, 19% is blue and 17% is grey water footprint. Again of this total amount, 89% is constituted by agricultural sector, 7% by domestic uses and 4% by industry. Of the water footprint in agriculture, 92% resulted from plant production activities (especially from irrigations) and 8% resulted from grazing. Considering the water footprint in plant

production, 38% was constituted by cereals and it was followed by forage crops with 31%, fruits with 13%, oil crops with 5%, vegetables and legumes with 2%. More than 66% of the water used in plant productino activities is green water. Grazing is also mostly composed of green water. High green water rates indicate the significance of precipitations in this sector. About 20% of water used in plant production is blue water. That points out irrigations and the significance of water resources sustainablity. Almost all of the water used for domestic and industrial purposes is grey water.

In this study, water in agriculture was assessed; information and discussions were provided about water footprint.

## 2. WATER RESOURCES AND USE IN TURKEY

Annual average precipitation of Turkey is 642.6 mm and such an amount corrensponds to a water resource of 501 billion m<sup>3</sup>. However, total technically and economically consumable water resources of Turkey are 112 billion m<sup>3</sup>. Of this amount, 95 billion m<sup>3</sup> comes from local rivers, 3 billion m<sup>3</sup> comes from out-boundry rivers and 14 billion m<sup>3</sup> comes from groundwaters. Annual water potential varies significantly based on basins.

Turkey has 28.05 million hectare agricultural lands and 25.75 million hectare of this amount is irrigable. The amount of land irrigable with the currently available water potential is around 8.5 million hectares. Of this amount, 5.61 million hectares have already opened for irrigation and 3.32 million hectare of irrigated lands have irrigation metworks constructed by State Hydraulic Works (DSI).

Turkey is expected to develop entire 112 billion m<sup>3</sup> economically available water resources by the year 2023. Such a case requires construction of several wastewater treatment systems for re-use of wastewaters. It is also expected to irrigate entire 8.5 million hectare land area by the year 2023. The target of Turkey is to reduce water use in irrigation by 65% hrough the use of modern irrigation techniques. In this way, 72 billion m<sup>3</sup> water will be used in agriculture. According to latest data of DSI, 44 billion m<sup>3</sup> of currently available resources are used. Such a number correspond to about 40% of 112 billion m<sup>3</sup> water potential. Of currently used water, 32 billion m<sup>3</sup> is used in irrigations, 7 billion m<sup>3</sup> is used for domestic purposes and 5 billion m<sup>3</sup> is used in industry [1]. The population of Turkey is expected to be 100 million by the year 2023. Currently 270 liter water consumption per capita will be reduced to 150 liters through reducing water losses and water savings. Tourism sector is rapidly developing in Turkey and the sector is expected to use about 5 billion m<sup>3</sup> water by the year 2023. In this way, domestic uses will reach to 18 billion m<sup>3</sup> by the year 2023. Around 4% increase is expected in industrial water use and the amount will then reach to 22 billion m<sup>3</sup> by the year 2023 (Figure 1) (DSI, 2013)

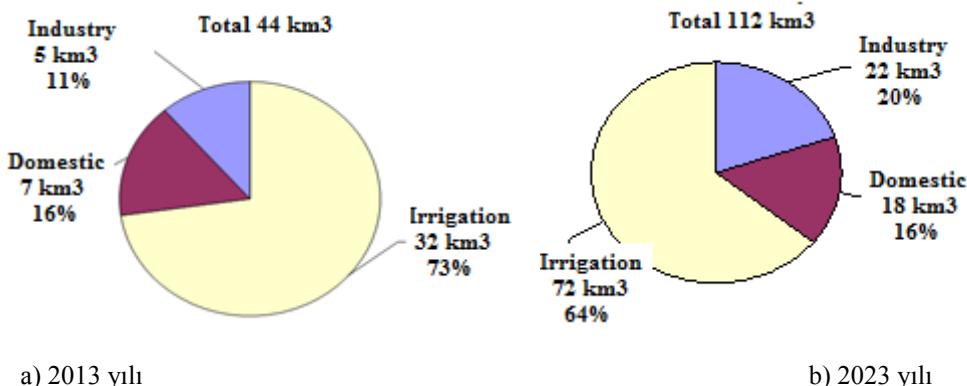


Figure 1. Sectoral water consumption in Turkey (Çakmak et al., 2013)

Water losses are significantly high when the open canal and canallettes are used in water conveyanve. Pressurized pipe systems are constructed in new irrigation networks to overcome such water losses. Only the frictional losses are observed in pipe systems. Thus, water loss is minimized and water saving is provided in these systems. Considering the irrigation methods, the greatest water is observed in surface gravity irrigatino methods (35-60%). The least water loss is observed in drip irrigation (5-20%). Widespread of sprinter and irrigation systems will provide great contributions in to reduce water losses and increase water saving. Such improvements will then provide various contributions for preservation and sustainability of the water resources (Çakmak et al., 2013).

Countries are classified based on available renewable water resources as water-poor countries (with less than 1000 m<sup>3</sup>/year per capita), the countries experiencing water deficits (1000 – 3000 m<sup>3</sup>/year per capita) and water-rich contries (with more than 10 000 m<sup>3</sup>/year per capita). The avilable renewable water resources per capita of Turkey were 1652 1652 m<sup>3</sup> in the year 2000 and the value is still decreasing with increasing country population. Population of Turkey is expected to be 100 million by the year 2030 and the available water resources per capita

will then be 1120 m<sup>3</sup>/year in 2030 (Çakmak and Gokalp, 2013a). Therefore, water resources should be well preserved and properly used in Turkey to leave sufficient and healthy sources to future generations (Çakmak and Gokalp 2013b).

### **3. WATER FOOTPRINT IN WATER USE ASSESSMENT**

Altough virtual water and water footprint are similar and complementary terms, “water footprint” is a parameter assesing direct aor indirect water use of producer and consumers together. Water footpring indicates the total water volume used by individuals, sectors or countries in production processes. However, all of the goods and services consumed in a country are not totally produced in that country. Therefore, water footprint indicates the total amount of water resources consumed in production processes of goods and services produced inside the country or imported from outside (Hoekstra and Hung, 2002).

“Self-water sufficiency” of a country is expressed as the ratio of local water footprint to total water footprint. Water sufficiency and dependency is an indicator whether or not a country is able to meet the water needed to produce local needs and services. If the water sufficiency is 100% and the water needed to pruduce goods and services is met from own sources, then that country is a water-sufficient country. However, in case the water consumption is approaching to zero, that country is a water-poor and water-dependent country at a rate of approach-to-zero and meets some of water need thorugh vittual water impot (Hoekstra, 2003).

Water footprint is calculated as the amount of water (m<sup>3</sup>) directly or indirectly consumed to produce a unit of goods or services. For instance, about 200 ml water is consumed when a cup of coffee is drunk. Considering the amount of water consumed in production processes of coffee, the amount consumed for a cup of coffee reaches to 140 liters (about 70 glasses). It is hard to calculate the amount of water consumed in production of agricultural goods. For instance, let's assess the amount of water consumed to produce a kg of beef. A cattel is raised for 3 years to get 200 kg beef. During that raising period, this animal consumes about 1300 kg cereals, 1200 kg hay, 24m<sup>3</sup> drinking water and 7 m<sup>3</sup> clerical water. Therefore, for 1 kg beef, about 6.5 kg creal, 36 kg hay, 155 liters water, about 15500 liters water is needed for entire inputs during 3 years of raising. Water footprints of some agricultural goods are provided in Table 1. Actually, water footprints of each product and each country are different from each other. Water footprints are generally lower in devloped countries, in other words, developed countries use less water for a unit production.

**Table 1. Water footprints of some agricultural goods (average world values) (Hoekstra 2008)**

Product	Unit (kg)	Global average water footprint (Liters)
Apple/Pear	1	700
Beef	1	15500
Bread (from wheat)	1	1300
Cheese	1	5000
Poultry	1	3900
Cucumber/Pumpkin	1	240
Lettuce	1	130
Maize	1	900
Olive	1	4400
Orange	1	460
Potatoe	1	250
Rice	1	3400
Sugar (from sugar cane)	1	1500
Tomatoe	1	180

Water footprint not only takes direct water use but also indirect water use into consideration. Together with water reosources, water footprint works and studies are becoming more significant issues for products, companies or commodities of private sector. Rather than the withdrawn water, amount of water used is taken into consideration in water footprint studies. With this respect, water footprint is different from traditional water use indicators (Hoekstra, 2008).

### **4. WATER FOOTPRINT OF TURKEY**

Production and consumption water footprints were considered together while assesing water footprint of Turkey (Figure 2). **Production water footprint:** It indicates the total amount of water (green, blue, grey) required for goods and services produced in a country. **Export water footprint (virtual water export):** It indicates the total amount of water (green, blue, grey) required for the goods and services exported by a country. **Import water footprint (virtual water import):** It indicates the total amount of water (green, blue, grey) required for the goods and services imported by a country. **Consumption water footprint:** It indicates the total amount of water (green, blue, grey) required for goods and services consumed in a country.

In a study to determine the water footprint of Turkey, the population was taken as 75.627.384, net available fresh water resources as 112 billion m<sup>3</sup>/year, fresh water per capita as 1.519 m<sup>3</sup>/year (WWF, 2014). Water footprint per capita was calculated as the ratio of the total amount of water used the production of goods and services consumed in a country, in other words consumption footprint to country population. While calculating production footprint, important agricultural products were determined. Then average productions (ton) were determined between the years 2006-2011. These data was gathered from FAO and TUIK records. Water footprint of main production categories were calculated by using total productions and water footprint data of WFN (Water Footprint Network) provided for each country. Consumption footprint was calculated based on WFN data per capita between the years 1996-2005. Domestic water use, grazing and industrial production were calculated by using WFN and TUIK data.

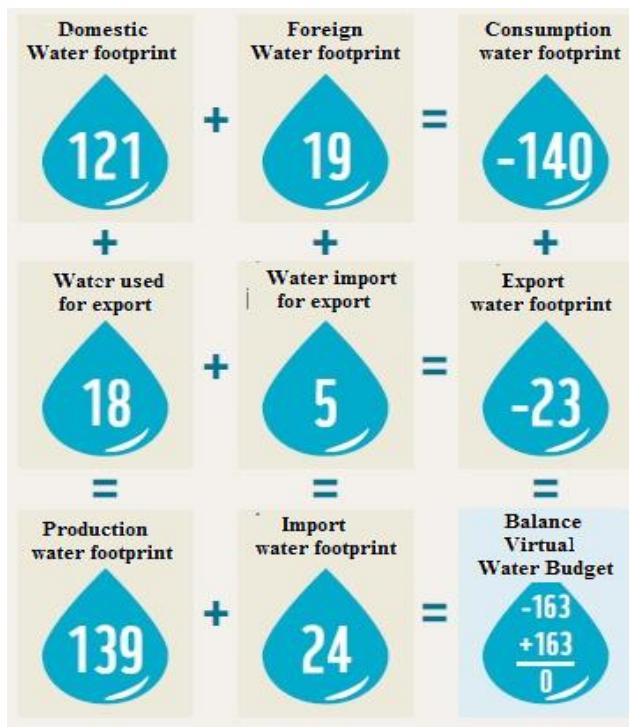


Figure 2. Water footprint of Turkey (billion m<sup>3</sup>/year, WWF 2014)

Water footprint calculations of Turkey revealed that 80% of production and consumption was met by domestic sources. Production and consumption footprints of Turkey were very close to each other. Similarly, the amount of incoming virtual water through outgoing virtual water through exports were almost equal to each other. Such a case indicates a balanced virtual water budget. Considering blue, green and grey water footprints in production and consumption of Turkey, it was observed that green water footprint had the greatest share. Such a case indicated that production and consumption of Turkey were sensitive to precipitations and climate conditions.

About 90% of production footprint of Turkey was constituted by agricultural sector. Green water footprint had the greatest share in water footprint of agricultural sector indicating the dependence to precipitations. Blue water footprint had the second place in agricultural sector indicating the significance of irrigation and efficient water use. Production footprint indicates how the water is used in a country and whether or not such uses are proper and sustainable. Production water footprint is 139,6 billion m<sup>3</sup>/year in Turkey. Of this amount, 64% is green, 19% is blue and 17% is grey water footprint (Figure 3). Sectoral production water footprint of Turkey is presented in Figure 4. Agriculture has the greatest share in water footprint (89%) and it is followed by domestic uses (7%) and industrial uses (4%).

Consumption water footprint of Turkey is 140,2 billion m<sup>3</sup>/year. Of this amount, 66% is green, 17% is blue and 17% is grey water footprint. Again agriculture has the greatest share in consumption footprint (88%) and it is followed by industrial uses (6%) and domestic uses (5%). The amount of water per capita used for domestic purposes is 216 liters in Turkey (TÜİK). Within the scope of water footprint approach, daily direct and indirect water use of person is 5.416 liters in Turkey (WWF, 2014).

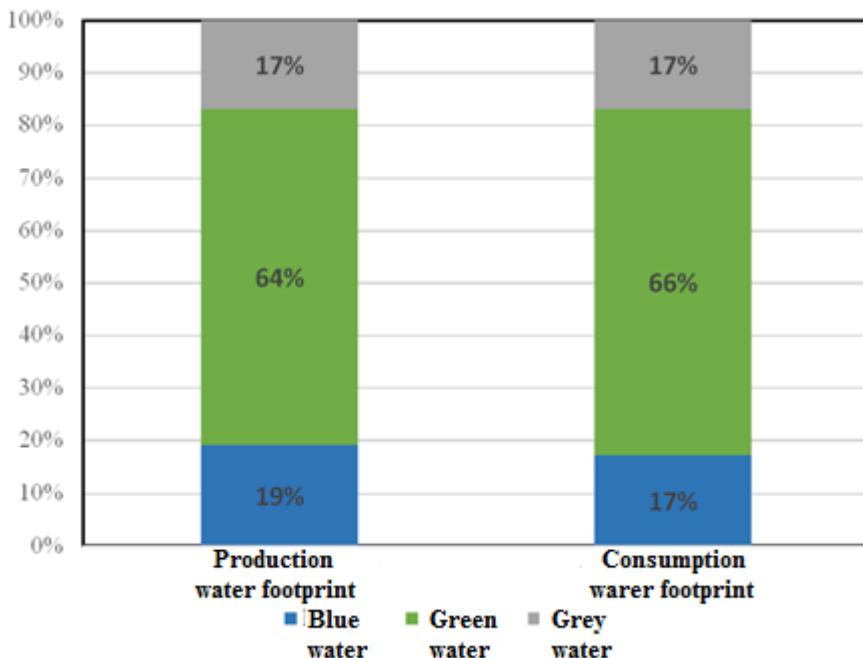


Figure 3. Production and consumption water footprints in Turkey (WFF 2014)

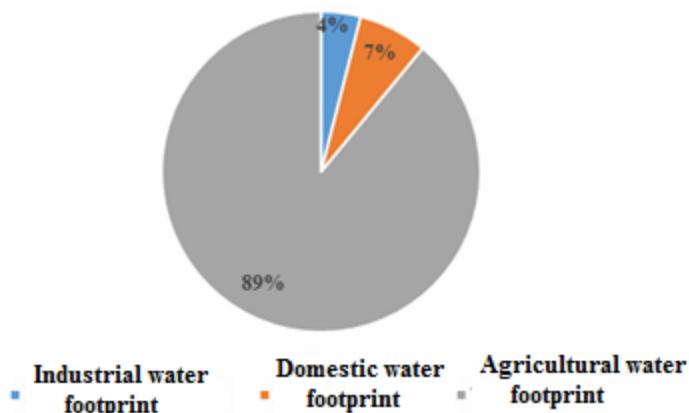


Figure 4. Sectoral water footprints in Turkey (WFF 2014)

## 5. CONCLUSION AND RECOMMENDATIONS

Increasing water demands together with increasing population necessitate the planned and efficient use of water resources. While excessive water is used in agriculture through insufficient infrastructure, unconscious utilizations and improper practices, somestic and inductive water uses are also increasing together with improved life standards of people. Such a case creates a competition among water user sectors. Efficient water use should initially be pointed out in agricultural sector with the greatest water use.

For efficient waer use in Turkey, first of all excessive water use should be prevented, pressued water saving pipe systems should be widespread, drainage, land consolidation and similar physical infrastructural services should be provided. Support policies have been implemented by the Ministry of Food Agriculture and Livestock for efficient water use in agriculture. Within the scope of these support policies, “Support Program for Rural Development Investments” was implemeted and incentives were provided to farmers. The program is still active. A monitoring-assesment system should be established in support programs and water footprint should be incorporated into this system. As a component of water management, water footprint of the regions and products should be determined.

Water resources planning and management works should be so implemented as to reduce water footprints in Turkey. In this way, both an efficient water use will be possible through water savings and more goods and services are able to be produced witj less water. Climate change has significant impacts on Turkey and droughts

and desertifications are observed in some sections of the country. Therefore, to reduce water footprints in Turkey, water-saving technologies should be used in irrigations, irrigation infrastructure should be improved, pressurized pipe systems should be wide spread, volume-based water pricing should be implemented and training programs should be provided to farmers to prevent excessive water uses in irrigations.

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## ASSESMENT OF KONYA GREENHOUSE PROJECTION

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### ABSTRACT

Konya is one of the most significant region of Turkey's agricultural character. Considerable amount of agricultural production in our country are mostly produced in Konya. One of the production method has been used in the region, became widespread in last years, is greenhouse technique. In this study, the aim was to determine the projection of Konya province greenhouse production. The projection coefficient were calculated by using last ten years data of production area and production quantity; according to its increase or decrease, Konya projection of last ten years were evaluated and compared to Turkey's dataset.

Projection coefficients were found as 20.68%, -62.41%, -50.78%, 0% for glass greenhouse, plastic greenhouse, high tunnel, low tunnel, respectively. The increase in projection coefficient caused an increase in the area of greenhouse, thus its production. The projection coefficient of glass greenhouse were found higher than Turkey's mean values.

**Keywords:** Konya, greenhouse production, projection

### INTRODUCTION

Konya province is regarded as agricultural capital of our country because of its wide agricultural lands, different agro-ecological sub regions, irrigation opportunities, geographic position. It covers total 1.904.438 ha cultivated areas, sub regions having various agro-ecological characteristics and with its geographical location. 9.5% of the cultivated agricultural area which is equal to 21.383.626 ha and 10% of irrigable agricultural areas are located in the province borders of Konya (KIGA, 2013).

Field agriculture is performed in 45.3% of the cultivated agricultural land asset in Konya. Production of fruit and vegetable species has also increased recently throughout the province in addition to field crops (TUIK, 2012). Konya province comes first in the following products by covering 7% of wheat, 11% of barley, 28% of sugar beet, 29% of dry bean, 67% of carrot and 22% of opium poppy production in Turkey. Important changes have started to seen on crop pattern in last decades due to the increased education level of the farmers and different applied new agricultural projects. The share of wheat and barley production areas in the total field lands is 82.99%. Sugar beet has a share of 5.92% in the field lands due to the production quote and the necessity of irrigation even though it is a highly preferred product. Cultivation of pulse and other field products are performed on an area of 9.54% ratio. Moreover, sunflower, potatoes and corn appear as the products increasing their weight in the product pattern of the region (KIGA, 2013).

Greenhouse production is a general definition which used for vegetable, fruit and ornamental plants production in low or high systems by providing required environmental conditions and eliminating climate factors. In these systems, glass or plastic covered high constructions are called as greenhouse and the production in the high or low tunnels is called as greenhouse cultivation (Apaydın et al., 2013). 80.975 da glass greenhouse , 298.651 da plastic greenhouse, 112.771 da high tunnels, 156.720 da low tunnels in the total of 649.118 (da) is greenhouse production area of our country in 2014. 57.5% (114 da) of the total greenhouse area of Konya province is covered by plastic, 24.7% (49 da) is by glass, 17.3% is by high tunnels and 0.5% (1 da) is by low tunnels in 2014 (TUIK, 2014).

In this study, different greenhouse techniques in the region were evaluated. Their production areas and production amounts were used to determine projection of Konya province and compared with Turkey greenhouse potential.

### MATERIAL AND METHODS

Konya province is fall into TR5 West Anatolia Region, TR522 second level and TR521 third level according to classification of statistical region units. The material of the study is provided from Turkish Statistics Institute for both Turkey and Konya province for the years between 2005 and 2014 (TUIK, 2005-2014). Last ten years undercover production areas and production amounts were taken into consideration according to techniques used, increased and decreased ratios were calculated, and average coefficients are those ratios were determined. Projection coefficients of undercover production for Turkey and Konya were calculated till 2024 by using calculated average coefficients. Positive projection coefficient refers an increase in the undercover area therefore an increase in the production while negative projection coefficient indicates a decrease in both (Demir, 2013).

## RESULTS AND DISCUSSION

When the area distribution of the greenhouses in the Konya province are reviewed, it can be seen that some of the counties are more suitable for greenhouse practices such as Meram (76.5 da), Çumra (69 da), Seydişehir (33 da), Karatay (12 da), Beyşehir (5 da), Derbent (2 da), Akşehir (1 da) than other parts of the Konya province. Meram county has the widest total greenhouse area in the Konya province. Akşehir has the lowest greenhouse area with 1 da while some counties have none such as Selçuklu, Ahırlı, Akören, Altınekin, Bozkır, Cihanbeyli, Çeltik, Derebucak, Doğanhisar, Emirgazi, Ereğli, Güneysinir, Hadim, Halkapınar, Hüyük, İlgin, Kadınhanı, Karapınar, Kulu, Sarayönü, Taşkent, Tuzlukçu, Yalihüyük ve Yunak (TUIK, 2014). Undercover areas of the glass and plastic covered and high and low tunnels, last year's variation ratios and calculated projection coefficients were given in Table 1.

The maximum value was obtained for glass greenhouse as 20.68% from yearly calculated projection coefficients (Table 1.) Compared to the previous years, having a sharp decrease in plastic greenhouse area and high tunnels area has caused negative trend in the variation ratios and the projection coefficients were resulted in negative values.

Area of glass greenhouse was 5 da in 2012 while it reached up to 49 da in 2014. It can be said that this glass greenhouse area will reach up to 321 da in 2024 by using the projection coefficient in the Table 1 as 20.68%. Although there is an increase in glass greenhouses, it is worth to notice that there is a decrease in the area of plastic greenhouses and high tunnels which caused a decrease in projection coefficients too. Calculated projection coefficients for plastic greenhouse areas and high tunnels indicates that there will be a decrease at current areas of them in coming decade while projection coefficients of low tunnels refers that their current area they will be roughly same as it is.

Calculated projection coefficients of Turkey are 2.25% for glass greenhouse area, 5.96% for plastic greenhouse area, 4.99% for high tunnel area, 0.78% for low tunnel area. The obtained projection coefficient value for glass greenhouse areas of Konya province was found higher than calculated Turkey's projection coefficient for glass greenhouse areas. According to calculated projection coefficients of Turkey, it can be said that glass and plastic greenhouse areas and high tunnel areas will increase and low tunnel areas will decrease but the increase in greenhouse production areas may refer to an increase in the agricultural production in the country.

**Table 1. Greenhouse areas and projection coefficients of Konya province**

Greenhouse Areas (decare)					
Year	Glass	Plastic	High Tunnel	Low Tunnel	
	2005	0	103	29	1
	2006	0	116	19	1
	2007	0	16	3	0
	2008	0	153	9	0
	2009	0	134	6	0
	2010	0	129	5	0
	2011	0	97	10	2
	2012	5	96	21	2
	2013	51	91	40	2
	2014	49	114	34	1
Last Year Variation Ratio	2005-2006	0	11.21	-52.63	0
	2006-2007	0	-625	-533.33	0
	2007-2008	0	89.54	66.67	0
	2008-2009	0	-14.18	-50	0
	2009-2010	0	-3.88	-20	0
	2010-2011	0	-32.99	50	100
	2011-2012	100	-1.04	52.38	0
	2012-2013	90.20	-5.49	47.50	0
	2013-2014	-4.08	20.18	-17.65	-100
Projection Coefficient (%)	<b>20.68</b>	<b>-62.41</b>	<b>-50.78</b>	<b>0</b>	

Tomato is the most common plant produced in the province with greenhouse techniques and cucumber comes after as second. Ornamental plants cultivation with greenhouse techniques is starting to practice in last years. Production amounts, last year variation ratios, and projection coefficients of the greenhouse produced cucumber, tomato, pepper, and green bean in Konya province were given in Table 2.

The biggest projection coefficient was provided from greenhouse cucumber production in Table 2. Annual cucumber production has increased 1.320 tons in 2014 while it was roughly 551 tons in 2005. It can be foreseen around 2.446 tons of production in 2024 with projection coefficient calculated as 6.36%. In the forthcoming years, tomato, pepper and green bean production is expected to increase at the ratios of 5.59%, 5.41% and 3.61% and reached the annual production of 3.742, 127 tons and 11 tons in 2024, respectively (Fig.1).

**Table 2. Greenhouse vegetable production of Konya province and projection coefficients**

Greenhouse Vegetable Production (tons)					
Year	Cucumber	Tomato	Pepper	Green bean	
	2005	551	747	9	5
	2006	546	690	11	5
	2007	434	699	12	4
	2008	491	850	16	4
	2009	473	643	10	4
	2010	378	502	7	5
	2011	706	591	0	5
	2012	741	1.120	0	5
	2013	972	2.587	0	5
	2014	1.320	2.171	75	8
Last Year Variation Ratio	2005-2006	-0.92	-8.26	18.18	0
	2006-2007	-25.81	1.29	8.33	-25
	2007-2008	11.61	17.76	25	0
	2008-2009	-3.81	-32.19	-60	0
	2009-2010	-25.13	-28.09	-42.86	20
	2010-2011	46.46	15.06	0	0
	2011-2012	4.72	47.23	0	0
	2012-2013	23.77	56.71	0	0
	2013-2014	26.36	-19.16	100	37.5
Projection Coefficient (%)		<b>6.36</b>	<b>5.59</b>	<b>5.41</b>	<b>3.61</b>



**Fig.1.** Projection of greenhouse vegetable production in Konya

## CONCLUSION

Konya province is one of the typical agricultural region of our country because of its climate and soil conditions. Practicing of the greenhouse production techniques are at the start-up phase in Konya and it is obvious that it has a potential to worth to develop. Extending the greenhouse production of fruit and ornamental plants and most notably vegetable are crucial in the region. Improved greenhouse production practices provide higher financial returns from the agricultural practices of Konya province and increases the income of the farmers in the region and develops their life standards.

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## IRRIGATION MANAGEMENT IN A GREENHAOUSE BY AN AUTOMATED IRRIGATION SYSTEM AND ITS HARDWARE AND SOFTWARE COMPONENTS

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### ABSTRACT

Irrigation in agriculture has the maximum water withdrawal within all sectors and agriculture is the primary source of livelihood for farmers. In this case, agricultural water management is the key point both in sustainable agriculture and in using water efficiently in agriculture. Nowadays, pressurized irrigation systems have been switched from manual systems to the automated systems since offering a wide range of new options such as water and labour savings and so on.

This paper proposes a model of an automatic drip irrigation system, based on a sensor sensing water level in a mini-pan and a controller. The sensors made of two electrodes were the only source of power to control the irrigation system. Sensors were placed inside in the mini-pan and continuously sense the water level and whenever water level dropped under the bottom tip of one electrode, it produced a signal going to the microprocessor (PIC16F877). Therefore, being a closed loop, the system was activated based on the water level and it pumped water and stopped the irrigation, this event continued during the whole growing season. In this paper, a complete hardware and software implementation of this proposed automated irrigation system is presented.

**Keywords :** Automation, drip irrigation, mini-pan, controller

### 1. INTRODUCTION

Pressurized irrigation systems (Sprinkler, drip and micro irrigations) are more convenient for automation in open field and also greenhouse as compared with surface irrigation. Electronics in agriculture have become more popular all around the World (Joshi and Gokhale, 2006). Significant improvements have been observed in irrigation automation. Nowadays, automation systems in agriculture have been tried to be combined with solar panels to produce their electricity themselves, these systems especially offers a great opportunity in off-grid areas. These systems have a number of advantages such as energy savings, reduced labor cost and control in fertilizer application (Yildirim and Demirel, 2011).

Manually controlled irrigation systems cannot provide a proper level of water because of the mismanagement (Salam et al., 2012). On the other hand, automated irrigation systems provide high crop yield, save water usage (Mulas, 1986), facilitate high frequency and low volume irrigation (Abraham et al., 2000) and also reduce human error (Castanon, 1992). Automatic irrigation system is usually designed for ensuring the proper level of water for growing up the plants throughout the season. Caceres et al.(2007) developed an automated irrigation control tray, activated with a water level sensing system. Yildirim and Demirel (2011) developed an irrigation controller and reported that the most important point in the automated drip irrigation system is the sensor calibration and installation of the soil moisture sensor in the pot. Coates et al.(2013) developed a wireless automatic irrigation system running by radio waves. Dursun and Ozden (2011) developed a solar powered drip irrigation system. This system was sensing soil moisture level and transferring to the microcontroller by radio waves, then the MCU decided when run and stopped the pumps according to the data sending by soil moisture sensor.

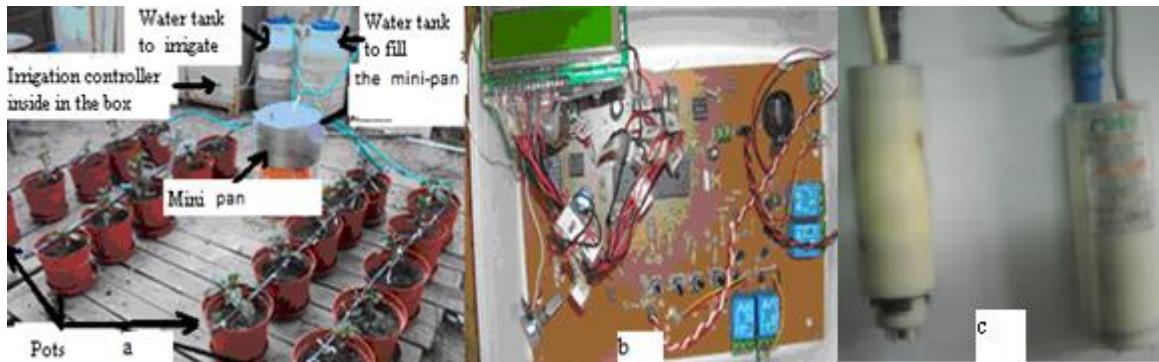
The objective of this study was to give a software and hardware of the automated system sensing water level in the mini-pan, also some specifications of the mini-pan and sensor.

### 2. MATERIALS AND METHODS

The irrigation system given in fig 1 included the following components; water storage tanks(50L); one of it was for irrigation and the another one for filling in the mini pan, submersible pump operating at 12v dc and 2.05 A in each tank, power supply was 12 v dc too. The sizes and capacity of pots were 250x210 mm, 9L, respectively. There was a pan under each of them to collect drained water, water was conveyed by Ø16 pipes with drippers (4L/h) at a spacing of 33 cm, with one dripper serving each pot, connection apparatus and also valves were used to integrate all items in the irrigation system.

**Figure 1. Layout of the experiment's components(a),irrigation controller (b) and submersible pump(c)**

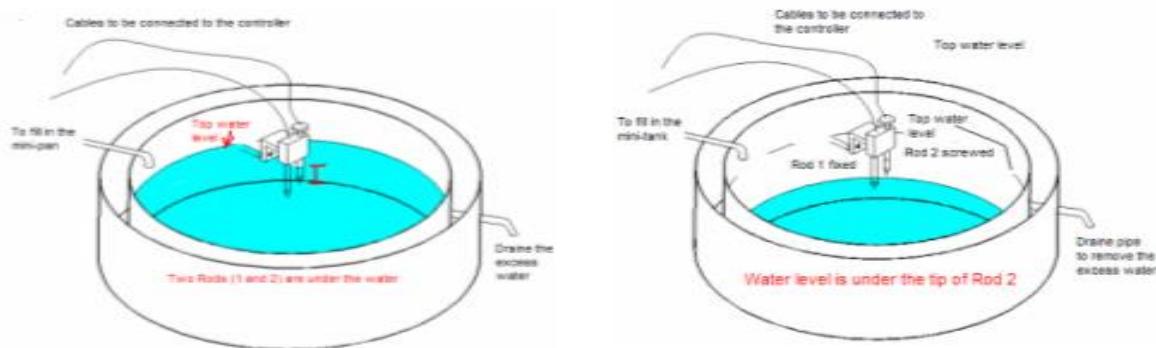
Mini-pan was formed by double rings at 20 cm height, the inner ring had a diameter of 27 cm, the outer was 32 cm in diameter. there was a notch at the bottom of the inner ring to ensure water movement between two rings.



**Figure 2. Mini-pan , its components and water level sensor connected to the pan**

The sensor determining the amount of allowable water to evaporate was installed inside in the inner ring. The top tube was welded to the upper part to fill in the mini-pan (Fig.2). The top water level in the mini-pan was at 13.5 cm, provided by a drainage pipe for conveying excess water to outside of the ini-pan so that it fixed top water level inside in it after each filling process. Whenever the allowable amount of water evaporated and water level dropped to 12 cm in the mini-pan, the MCU got the signal from the electrodes, as soon as getting the signal, water was pumped to the plant root area.

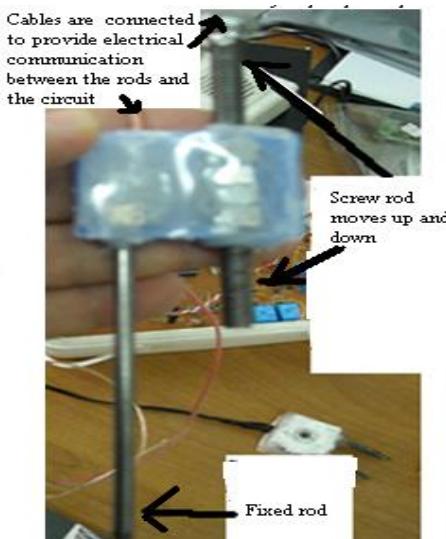
The most important an basic component of the automated irrigation system was the sensor given in figure 3. It consists of two stell rods called rod 1 and rod 2. Rod 1 was fixed and allowed to come into contact with water every time throughout the experiment. Rod 2 was moving up and down like a screw, and used to adjust the amount of water allowed to evaporate. The distance between the rods was 2.5 cm, and placed in a plastic box (weight,depth and height; 3x2x3 cm) filled with silicone. At the end of the rods, the cable was connected to provide an electrical communication between the rods and the MCU (Fig. 2-3).



**Figure 3. Sensing water level sensor**

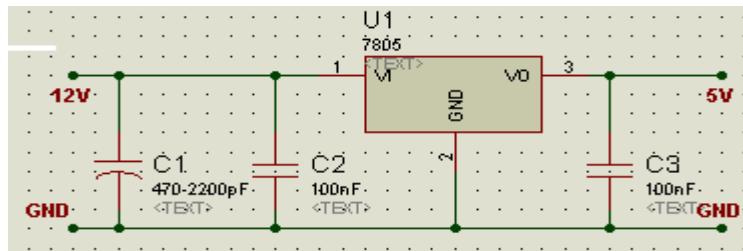
A signal coming from the water-level sensor was sent to the microcontroller unit (MCU-pic16F877) and then irrigation started and stopped according to the logic embedded in the MCU. One pin of the MCU was assigned as an input to monitor the water level in the mini-pan in each second for during the entire experiment. The circuit included both a buzzer giving a warning voice and an LCD to show some messages such as “1.pump run” or “2.pump run” etc.

Controller circuit : Main power supply was 12 V DC, providing the power to the controller. In the circuit it was reduced to 5 V DC for the microcontroller (PIC16F877) by 7805 given in fig. 4.



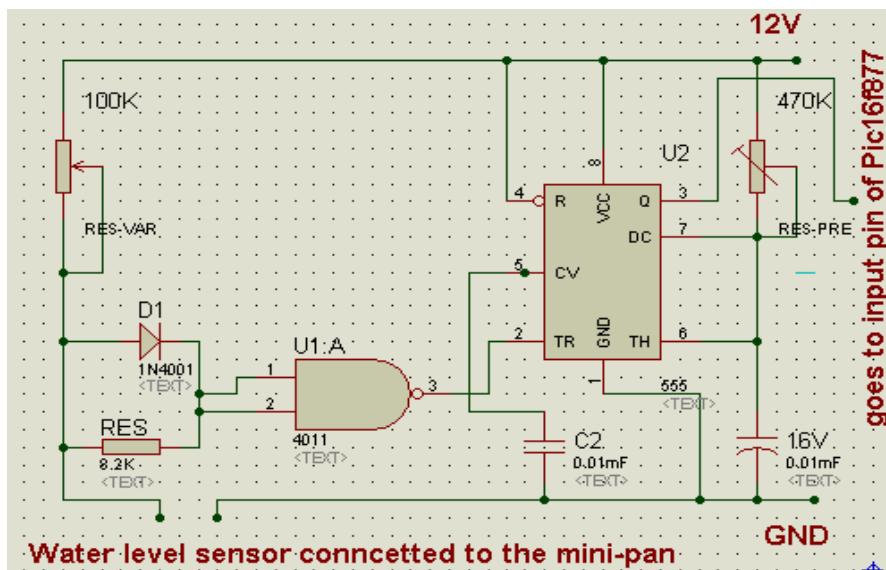
**Figure 4. Voltage regulatorfor the microcontroller (Pic16F877)**

The sensor level in the circuit is given in fig. 5. In he circuit diagram, rod 1 and rod 2 were isolated from each other by filling the box in the silicone. When the mini-pan is full with water , sensors produced logic 0 and whenever water level dropped immediately under the tip of rod 2 (fig 2), it produced logic 1 and sent to the microcontroller.



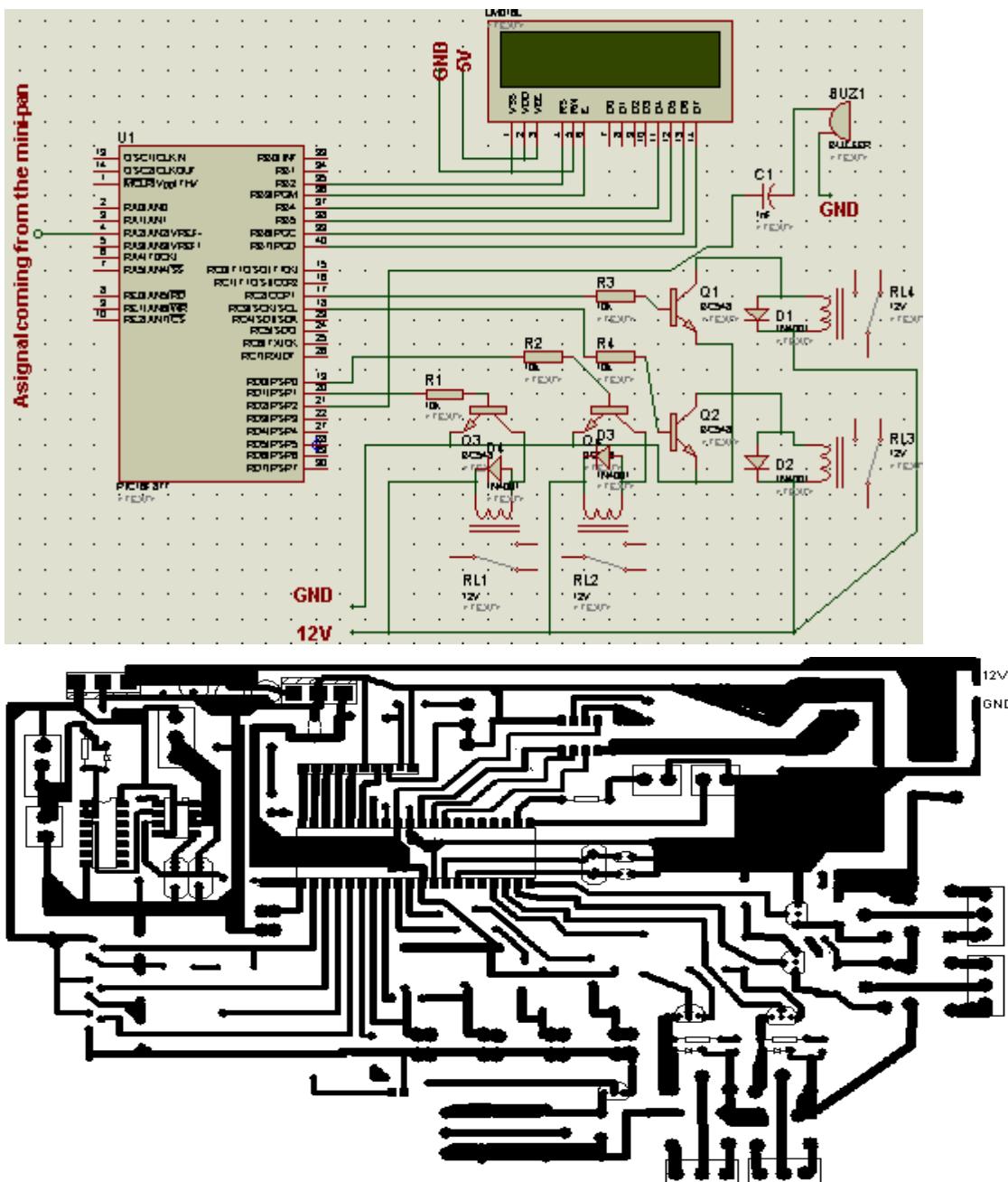
**Figure 5. The circuit sensing water level and producing a signal**

Microcontroller automatically started the pump to irrigate the plants according to the command coming from pin 3 from 555 to the RA2 as an input pin of the microcontroller in fig. 6.



**Figure 6. The microcontroller to controlthe relays and to show the messages**

Solder side of the microcontroller is given in fig.7, showing all connections between sensor, microproseccor, LCD, relays and also buttons.



**Figure 7. Solder side of the controller**

**Controller software :** the irrigation controller programme was written using the PicBasic Pro software program and the general strategy for the automated irrigation defined in the logic was loaded into the memory of the MCU. After running the system, the MCU took over and made detailed decisions on when to apply and how much water to apply. The dosage of water to be applied was determined according to the pumping time of water to refill the root zone as water level in the mini-pan dropped to the threshold level. The some part of the software controlling the MCU is given below. The top water level in the mini-pan was 13.5 cm and a signal was produced whenever the evel dropped to 12 cm, then the MCU started irrigation and run the pump for 15 minutes, secondly filled in the mini-pan. After completting these processes, the MCU checked the mini-pan if water is at the full level or not. If yes, it went back to read the sensor and if not, it sent the message “the system is out of the order, please check” on LCD.

"Program was written by Murat YILDIRIM

i var WORD

PORTA=0 : PORTB=0 : PORTC=0

TRISA=%00101111

TRISB=%00000000

TRISC=%00000000

TRISD=%11100000

TRISE=%00000111

@DEVICE PIC16F877

@DEVICE PIC16F877, WDT\_ON

@DEVICE PIC16F877, PWRT\_ON

@DEVICE PIC16F877, PROTECT\_OFF

@DEVICE XT\_OSC

'-----  
DEFINE LCD\_DREG PORTB

DEFINE LCD\_DBIT 4

DEFINE LCD\_RSREG PORTB

DEFINE LCD\_RSBIT 2

DEFINE LCD\_EREG PORTB

DEFINE LCD\_EBIT 3

DEFINE LCD\_BITS 4

DEFINE LCD\_LINES 2

DEFINE OSC 4

PAUSE 500

SYM BOL BIR=PORTC.2

SYM BOL IKI=PORTC.3

SYM BOL UC=PORTD.0

SYM BOL DORT=PORTD.1

SYM BOL SES=PORTD.2

SYM BOL SENSOR=PORTA.2

SYM BOL LED=PORTA.4

'-----PROGRAM BAŞLANGICI

LCDOUT \$FE,1 "SISTEM DEVREDE"

LCDOUT \$FE,\$C0, "SENSOR OKUNUYOR"

PAUSE 500

GOSUB GECIKME

KONTROL:

IF SENSOR=1 THEN GOTO CALISTIR 'if a signal comes from the sensor, activate the pumps'

GOSUB GECIKME

GOTO KONTROL

CALISTIR:

GOSUB MOTOR1

GOSUB MOTOR2

GOTO KONTROL2

MOTOR1:

SOUND SES, [100,10]

BIR=1

FOR i=0 TO 900

PAUSE 1000

NEXT i

BIR=0

PAUSE 1000

RETURN

MOTOR2:

SOUND SES, [100,10]

IKI=1

FOR i=0 TO 660

PAUSE 1000

NEXT i

IKI=0

PAUSE 1000

RETURN

KONTROL2:

IF SENSOR=1 THEN

GOTO ALARM

ELSE

GOTO KONTROL

ENDIF

ALARM:

\*

\*

GECIKME

\*

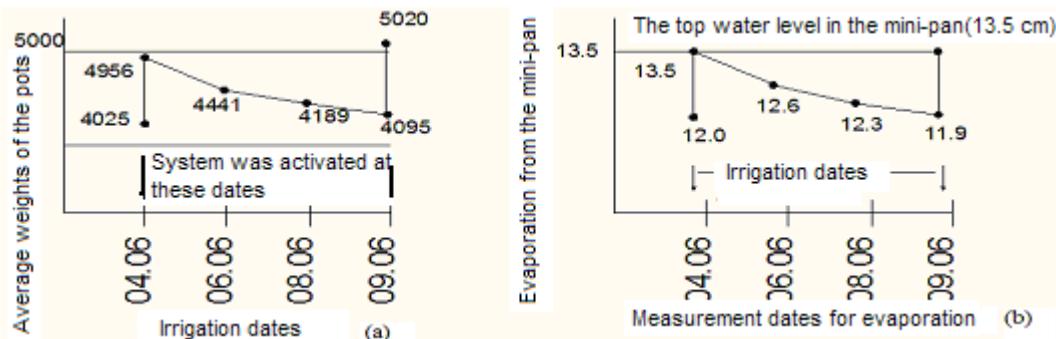
GOTO KONTROL

END

### 3. RESULTS AND DISCUSSION

Irrigation performance in a short period is given in figure 8. These values are the averages of weights of 20 pots. When the water level in the mini-pan dropped to the level of 12 cm (the date that evaporation of 15 mm occurred), the average weight of 20 pots also reached to 4025 g since plants consumed water in pots. This situation caused rods to produce a signal upon sending to the MCU. It switched on the relay to pump water to the root area for 15 minutes so that the substrate reached to field capacity after that the MCU turned off the pump and then the system run the second pump to fill in the mini-pan up to the top level of 13.5 cm. Completing all these steps, the MCU waited for the water level to drop the minimum level of 12 cm. Therefore, the system run

in terms of both hardware and predefined software. In this system the most important things is to define the threshold levels to activate the system. That's why those values determined correctly.



**Figure 8. Irrigation performance in a short time**

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## SAMSUN İLİ İÇİN BITKİ SU TÜKETİMİNİN DETERMINİSTİK MODELLE BELİRLENMESİ

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### ÖZET

Referans bitki su tüketimi hidrolojik çevrimin önemli bileşenlerinden birini oluşturmaktadır. İklim ve atmosferik olaylarla meydana gelen değişimden etkilenen bu parametrenin doğrudan belirlenmesi oldukça zaman alıcı ve pahalıdır. Bu nedenle uzun yıllar araştırmacılar referans bitki su tüketiminin belirlenmesinde kullanılan birçok empirik eşitlik geliştirmiştir. Bu eşitlikler kullanıldıkları çalışmanın amacına bağlı olarak farklı iklimsel parametreleri önemli kılarken çoklu regresyon metodu çok değişkenli istatistiksel yöntemlerden sadece bir tanesidir. Ele alınan herhangi bir konu üzerinde etkisi olan birden fazla parametrenin hangisinin etkisinin ne ölçüde olduğunu ortaya koyan bir metodolojiyi izler. Bu çalışma Penman Monteith FAO-56 ile belirlenen ET<sub>0</sub>'yı etkileyen iklimsel parametrelerin aylık olarak belirlenmesinde çoklu regresyon metodunun kullanılabilirliğini göstermektedir. Bunun için Samsun iline ait uzun yıllık (1960-2014) ortalama günlük solar radyasyon, maksimum ve minimum sıcaklık, rüzgâr hızı, ortalama bağlı nem ve basınç değerleri kullanılmıştır. Sulamanın yapıldığı aylarda her bir ay için iklimsel parametrelerin önemliliğinin değiştiği gözlenmiştir. Nisan, Mayıs aylarında solar radyasyon, sıcaklık ve bağlı nem önemli parametreler olarak belirlenirken; Haziran, Temmuz Ağustos aylarında radyasyon ve sıcaklık parametreleri; Eylül, ayında ise nem, basınç ve sıcaklık parametreleri öne çıkmıştır.

**Anahtar Kelimeler:** Referans Bitki Su Tüketimi, Çoklu Regresyon Analizi, Duyarlılık Analizi

## DETERMINATION OF EVAPOTRANSPIRATION WITH DETERMINISTIC MODELS FOR SAMSUN

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### ABSTRACT

Reference evapotranspiration is one of the important components of the hydrological cycle. Direct determination of this parameter is affected by changes in climate and atmospheric phenomena occurring is very time consuming and expensive. Therefore, for many years, researchers have developed several empirical equation used to determine the reference evapotranspiration. These equations have been created as depending on the purpose of the study according to the importance of climatic parameters. Multiple regression method is one of multivariate statistical methods. To address the uncertainties that surround the exact physical mechanisms underlying the mathematical models, it has been shown that it is possible to include in the assessment of reference evapotranspiration that is predicted by using a short historical of atmospheric conditions. This study was showed the availability of the multiple regression method to determining monthly climatic parameters affecting Eto determined by Penman Monteith FAO-56. Samsun long years (1960-2014) the average daily solar radiation, maximum and minimum temperature, wind speed, average relative humidity and pressure were used. The accuracies of the methods were evaluated by using three commonly used criteria: root mean square error (RMSE), mean absolute error (MAE) and correlation coefficient (r). Materiality level change of climatic parameters for each month were observed. Temperature, solar radiation and relative humidity were identified as important parameter at April and May. Radiation and temperature were been important at June, July and August. Pressure, relative humidity and temperature were identified at September..

**Keywords:** Reference Evapotranspiration, Multiple Regression Analysis, Sensitive Analysis

## 1. GIRİŞ

Su kaynaklarının etkin kullanımı, dünyada olduğu gibi Türkiye'de de gittikçe artan oranda önem kazanmaktadır. Bu nedenle bitki yetişiriciliğinde kullanılacak sulama suyunun, olanaklar ölçüsünde en az kayıpla sulama alanlarına iletilmesi, alan içinde dağıtılması ve bitki-su gereksinimini istenen düzeyde karşılayacak biçimde bitki kök bölgесine verilmesi bir bakıma zorunlu hale gelmiştir (Bayramoğlu, 2013).

Sınırlı su kaynaklarının sürdürülebilir bir biçimde geliştirilmesinde başvurulacak yolların başında sulama programlaması gelmektedir. Doğru sulama programının iki önemli ögesi; suyun ne zaman ve ne mikarda verilmesi gerektidir. Bu kararları verebilmek için tarla koşullarında bitki su tüketimi ile ilgili kesin bilgilere gereksinim vardır. Toprak-bitki-atmosfer ortamı içerisinde bulunan ve sulama projelerinin temelini oluşturan bitki su tüketimi, gerek tarım gerekse çok amaçlı projelerin planlanması, yapımı ve işletilmesinde vazgeçilmez bir ögedir (Akpolat, 2011; Burman ve Pochop, 1994).

Bitki su tüketim yöntemleri birçok koşula bağlı olarak değiştiğinden ve bölgeden bölgeye göre farklılık gösterdiğinden yöreye özgü eşitlikler geliştirilse bile sağlıklı sonuçlar vermemiştir. Bu amaçla bitki su tüketim miktarını belirlemeye yönelik birçok çalışma yapılmıştır (Doorenbos ve Pruitt, 1977; Jensen ve ark., 1990). Bu çalışmalar içerisinde çok sayıda araştırma iklim verilerine bağlı olarak bitki su tüketimi belirleme yöntemlerinde en başarılı yöntemin Penman-Monteith olduğu belirtilmiştir (Monteith, 1965). Kaya (2011), Smith (1996), Demirtaş vd. (2007), Ünlükara vd. (2010) yapmış oldukları çalışmalarla bitki su tüketimini belirlemeye yönelik iklim verilerine dayalı en iyi yöntemin Penman-Monteith eşitliği olduğunu belirtmişlerdir. Penman Monteith eşitliğine etki eden birden fazla değişken vardır ve bu değişkenlerin hangisinin bu eşitlik üzerinde daha fazla etkisini belirleyebilmek için bir takım analizler kullanılmaktadır. Bunlardan bir tanesi olan çoklu doğrusal regresyon modeli oldukça pratik sonuçlara yol açmaktadır. Regresyon çözümlemelerinde bir bağımlı bir bağımsız ya da bir bağımlı birden çok bağımsız değişken arasındaki ilişkiler (ilişkinin varlığı ya da yokluğu) bir takım amaçlar çerçevesinde incelenir. Bu amaçlar hemen tüm regresyon modelleri için geçerlidir. Bağımlı değişken ile bağımsız değişkenler arasındaki ilişkiyi matematiksel modellerle bağıntılar bulmak, değişkenler arasındaki karmaşık yapıyı tanımlamak ve verileri özetlemek, bağımlı değişkeni etkilediği belirlenen bağımsız değişkenler yardımıyla bağımlı değişken değerini kestirmek, bağımlı değişkeni etkilediği düşünülen bağımsız değişkenlerden hangisi ya da hangilerinin bağımlı değişkeni daha çok etkilediğini belirlemek ve diğer değişkenlerin varlığında katsayı kestiriminde bulunmak bu amaçlar içersindedir.

Bu çalışma ile Samsun'da yer alan meteorolojik istasyonlardan elde edilen 1975-2014 yıllarına ait iklimsel verilerin (ortalama günlük solar radyasyon, maksimum ve minimum sıcaklık, rüzgar hızı, ortalama bağıl nem ve basınç) aylık ortalama bazında bitki su tüketimine etki oranlarının, çoklu doğrusal regresyon modeli ile belirlenmesi hedeflenmektedir. Çalışmada, iklimsel veriler bağımsız değişken bitki su tüketimi ise bağımlı değişken olarak ele alınmıştır.

## 2. MATERİYAL VE YÖNTEM

Karadeniz sahil şeridinin orta bölümünde Yeşilırmak ve Kızılırmak nehirlerinin Karadeniz'e döküldükleri deltalar arasında yer alan Samsun ili 3,083 km<sup>2</sup>'lik bir yüz ölçümüne sahiptir. Coğrafi konum olarak 40° 50'- 41° 51' kuzey enlemleri, 37° 08' ve 34° 25' doğu boylamları arasında yer almaktadır. Kuzeyinde Karadeniz'in yer aldığı ilin komşuları, doğusunda Ordu, batısında Sinop, güneyinde Tokat ve Amasya, güney batısında ise Çorum illeri yer almaktadır. Samsun ili yeryüzü şekilleri bakımından üç ayrı özellik göstermektedir. Birincisi güneyindeki dağlık kesim, ikincisi dağlık kesimle kıyı şeridi arasında yer alan yaylalar, üçüncüsü yaylalarla Karadeniz arasındaki kıyı ovalarıdır. Kızılırmak ve Yeşilırmak akarsularının delta alanlarında oluşmuş kıyılarda, yurdumuzun tarımsal potansiyeli en yüksek ovalarından Bafra ve Çarşamba ovaları yer almaktadır (Anonim, 2015).

Samsun genellikle ılıman bir iklime sahiptir. Ancak sahil şeridi ve iç kesimlerinde iklim iki ayrı özellik gösterir. Yıllık ortalama sıcaklık 15 °C'dir. Yıllık ortalama sıcaklıklarla göre en sıcak geçen aylar Temmuz (26,5°C) ve Ağustos (27°C), en soğuk geçen aylar ise Ocak (4,2 °C) ve Şubat (3,9°C) aylarıdır. En yüksek sıcaklık ortalaması, yıllık 18,1°C, en düşük sıcaklık ortalaması ise 11 °C'dir (Çizelge 1).

**Çizelge 1. Samsun iline ait uzun yıllık iklim verileri (Anonim, 2015)**

Meteorolojik	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
<b>Solar Radyasyon (MJ m<sup>-2</sup> gün<sup>-1</sup>)</b>	5,4	7,6	10,5	14,1	17,8	20,8	20,5	17,9	13,8	9,1	6,2	4,7
<b>Maksimum Sıcaklık (°C)</b>	10,8	11	12,2	15,3	19,1	23,7	26,5	27	23,9	20,2	16,7	13,1
<b>Minimum Sıcaklık (°C)</b>	4,2	3,9	4,8	7,9	12,1	16,3	19,2	19,7	16,5	12,9	9,2	6,4
<b>Rüzgar Hızı (ms<sup>-1</sup>)</b>	2,9	2,6	2,2	1,8	1,6	1,9	2,2	2,2	2	1,9	2,2	2,8
<b>Bağlı Nem (%)</b>	66,6	69,5	74,7	78,3	79,2	74,6	72,4	72,4	73,9	74,7	69,2	65,7
<b>Basınç (hPa)</b>	101,8	101,7	101,6	101,3	101,3	101,2	101,1	101,1	101,4	101,7	101,8	101,8

\*Meteoroloji Bölge Müdürlüğü, Samsun (Uzun yıllar: 1960-2014)

Bu çalışma Orta Karadeniz’de yer alan Samsun ilinin, FAO56 Penman-Monteith ilişkisinden yararlanılarak uzun yıllık aylık bitki su tüketimlerine bağlı olarak sulamanın yapıldığı aylarda (Nisan, Mayıs, Haziran, Temmuz, Ağustos ve Eylül) ET<sub>o</sub> değerlerine birinci dereceden etki eden bağımsız değişkenleri tespit etmektedir. Çalışmada ET<sub>o</sub>’a etki eden bu bağımsız değişkenlerin belirlenmesine yönelik izlenilecek olan yöntem aşağıda açıklandığı gibidir.

Referans bitki su tüketimi hesaplanmasıında Samsun ili 1960-2014 yılları arasında Samsun Meteoroloji Bölge Müdürlüğü tarafından kaydedilen meteorolojik verilerden aylık ortalamalar olarak maksimum ve minimum sıcaklıklar, ortalama bağlı nem, solar radyasyon, rüzgâr hızı ve basınç verileri kullanılmıştır. Bitki su tüketimi ise aşağıda belirtilen eşitlik yardımıyla hesaplanmıştır:

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2(e_s - e_o)}{\Delta + \gamma(1 + 0.34u_2)} \quad (1)$$

Eşitlikte; ET<sub>o</sub>; Referans bitki su tüketimi (mm gün<sup>-1</sup>), R<sub>n</sub>; bitki yüzeyindeki net radyasyon (MJ m<sup>-2</sup> gün<sup>-1</sup>), G; toprak ısı akış yoğunluğu ((MJ m<sup>-2</sup> gün<sup>-1</sup>), T; 2 m yükseklikte ortalama günlük hava sıcaklığı (°C), u<sub>2</sub>; 2 m yükseklikte rüzgâr hızı (ms<sup>-1</sup>), e<sub>s</sub>; doygun buhar basıncı (kPa), e<sub>a</sub>; gerçek buhar basıncı (kPa), Δ; buhar basıncı eğrisinin eğimi (kPa°C<sup>-1</sup>), γ; psikometrik sabit (kPa°C<sup>-1</sup>). Samsun merkez istasyonunda gözlem süresi bounca (1960-2014) her ay için ölçülen aylık meteorolojik verilere göre, FAO56 Penman-Monteith (Eşitlik 1) eşitliğine etki eden parametreleri saptamak için çoklu doğrusal regresyon analizi kullanılmıştır. Buna bağlı olarak aylara ait değişim incelenmiştir.

## 2.1. Çoklu Doğrusal Regresyon Analizi

Çoklu doğrusal regresyonda y bağımlı değişkeni ile x<sub>1</sub>, x<sub>2</sub>, ..., x<sub>j</sub>, ..., x<sub>p</sub> bağımsız değişkenleri arasındaki ilişki gözlemler cinsinden;

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_j x_{ij} + \dots + \beta_p x_{ip} + \varepsilon_i \quad (2)$$

ile verilir. Eşitlik 2’deki denklemi sadece değişkenler dikkate alınarak,

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_j x_j + \dots + \beta_p x_p + \varepsilon \quad (3)$$

Olarak yazılabilir. Burada β<sub>0</sub>, β<sub>1</sub>, β<sub>2</sub>, ..., β<sub>j</sub>, ..., β<sub>p</sub> bilinmeyenleri regresyon katsayılarıdır. Herhangi bir β<sub>j</sub> regresyon katsayısı, diğer değişkenler sabit tutulduğunda (diğer değişkenlerin etkisi ortadan kaldırıldığında) x<sub>j</sub> değişkeninde meydana gelen bir birimlik değişmeye karşılık y değişkenindeki beklenen değişiklik miktarını verir. Diğer bir deyişle β<sub>1</sub>, β<sub>2</sub>, ..., β<sub>j</sub>, ..., β<sub>p</sub>; bağımsız değişkenlerinin y'nin kestirimine yaptıkları göreceli katkıya ilişkin ağırlıklarıdır. Bu nedenle, β<sub>j</sub> (j: 1, 2, ..., p) parametreleri genellikle kısmi regresyon katsayıları olarak

adlandırılır.  $\beta_0$  ‘a ise kesim noktası yada sabit denir ve tüm  $x_j$  değişken değerleri sıfır olduğunda bağımlı değişkenin aldığı değeri gösterir.  $\varepsilon_i$  ise hata yanılığı terimidir. Örneklemden elde edilen regresyon kestirim denklemi (gözlemler cinsinden) eşitlik 4’deki gibidir.

$$\hat{y}_i = b_o + b_1 x_{i1} + b_2 x_{i2} + \dots + b_p x_{ip} \quad (4)$$

Çoklu regresyon denklemi yardımıyla, bağımlı değişkenin belirlenmesinde “her bir bağımsız değişkenin göreceli önemi” belirlenmiş olur. Bu bağlamda, çoklu doğrusal regresyonu basit doğrusal regresyon modelinden ayıran özellik, her bir bağımsız değişken ile bağımlı değişken arasındaki ilişkilerin eşanlı olarak belirlenmesidir. i. Artık ( $e_i$ ), eşitlik 5 ile elde edilir.

$$e_i = y_i - \hat{y}_i \quad (5)$$

$e_i$  ler genellikle modelin yeterliliğini değerlendirmek ve gerekli varsayımları araştırmak için kullanılır (Alpar, 2011).

### 2.1.1. Çoklu Doğrusal Regresyon Analizindeki Varsayımdan Sımpalar

Birden fazla bağımsız değişkenli regresyon analizinde oluşturulan modellerin anlamlı sonuçlar vermesi ve aralık tahmininde kullanılabilmesi için bir takım varsayımların geçerli olması gereklidir. Bu varsayımlar;

- ✓ Tahmin hatalarının arasında otokorelasyon olmaması,
- ✓ Tahmin hatalarının varyanslarının eşit olması
- ✓ Tahmin hatalarının dağılımının normal dağılıma uygun olması
- ✓ Bağımsız değişkenler arasında çoklu doğrusal bağlantı olmaması gerekmektedir.

Bu çalışmanın bir diğer amacı da bu varsayımlardan bağımsız değişkenler arasında çoklu doğrusal bağlantı olup olmadığına araştırması yapılacaktır.

Çoklu doğrusal bağlantı bağımsız değişkenlerin sadece bağımsız değişkenler üzerinde etkisinin olması değil aynı zamanda kendileri arasında birbirleri üzerinde de etkilerinin olduğu durumlarda ortaya çıkar. Eğer bağımsız değişkenler arasındaki basit doğrusal korelasyon katsayıları 1’e yakınsa bağımsız değişkenler arasında güçlü bir ilişkinin varlığı söz konusudur. Eğer bağımsız değişkenler arasında çoklu doğrusal bağlantı varsa; bağımsız değişkenlerden birinin modele sokulmasıyla veya modelden çıkarılmasıyla kısmi regresyon katsayılarında büyük değişiklikler olur.

Bağımsız değişkenler arasında çoklu doğrusal ilişkinin saptanmasındaki yöntemlerden biri varyans artış faktörünün hesaplanmasıdır. Bu faktör bir bağımsız değişkenin diğer bir bağımsız değişken ile olan ilişkisini belirlemek için kullanılır. Varyans artış faktörü eşitlik 6’da gösterildiği gibidir.

$$VIF_k = 1/(1 - R_k^2) \quad (6)$$

Şeklinde hesaplanır. Burada  $R_k^2$ , k bağımsız değişkeninin diğer bağımsız değişkenlerle arasındaki çoklu korelasyon katsayısının karesini temsil eder. Eğer bağımsız değişkenler arasındaki korelasyon katsayısı 0 veya 0 a yakın ise VIF değerinin de 1 veya 1’e yukarı yaklaşması beklenir. VIF değeri大幅度 olarak bağımsız değişkenler arasında ciddi bir çoklu doğrusal bağlantı olduğu gösterilir.

Tolerans değeri her bir bağımsız değişken ile diğerleri arasındaki çoklu korelasyon katsayısının 1 den çıkarılması ile elde edilir.

$$Tolerans = \frac{1}{VIF_k} = (1 - R_k^2) \quad (7)$$

Çoklu doğrusal bağlantı ile ilgili olarak aynı bilgiyi veren bu iki VIF ve Tolerans değeri çoklu korelasyon olmaması durumunda bağımsız değişkenler arasındaki korelasyon katsayısi düşük olacağı için Tolerans değeri bire yaklaşacak, VIF’ler ise sıfıra yaklaşacaktır; bağımsız değişkenler arasında güçlü bir ilişkinin olması durumunda tolerans değeri sıfıra, VIF değerleri sonsuza gidecektir.

Otokorelasyonun araştırılmasında artık grafiklerinden de yararlanılabilir. Bu amaçla zamana göre artıkların grafikleri çizilir. Bu çizimlerde, benzer işaretli artıkların kümeler halinde değişmesi pozitif otokorelasyonun varlığına işaret eder. İşaretlerin gözlemden gözleme değişmesi ya da sık sık değişmesi ise negatif

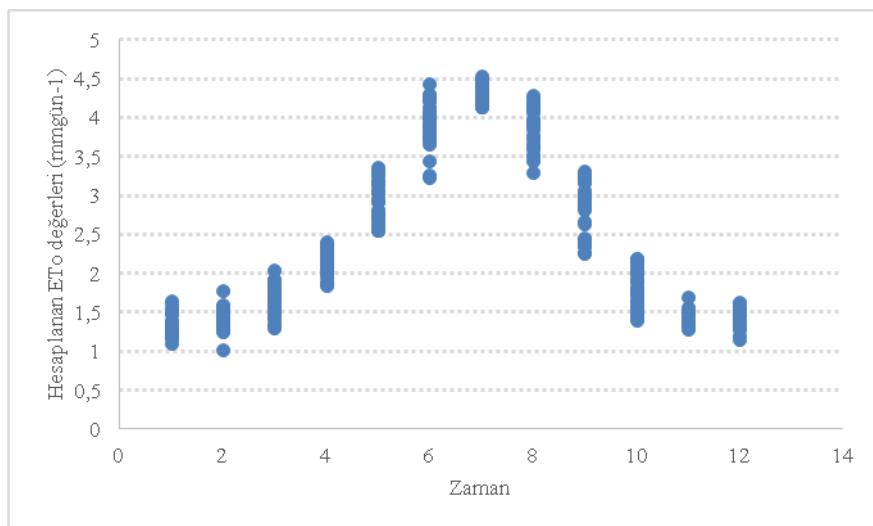
otokorelasyonun varlığına işaret eder. Bir diğer yöntemde Durbin-Watson d istatistiğidir.

$$d = \frac{\sum_{t=2}^n (e_t - e_{t-1})^2}{\sum_{t=1}^n e_t^2} \quad (8)$$

Burada  $e_t$ , ( $t=1,2,3,\dots$ );  $y_t$  ve  $x_t$  veri kümesine, en küçük kareler yönteminin uygulaması ile elde edilen ham artıklardır (Alpar, 2011).

### 3. ARAŞTIRMA BULGULARI

Samsun ili merkez meteoroloji istasyonunda 1960-2014 yıllarında ölçülen minimum ve maksimum sıcaklık, ortalama bağıl nem, rüzgâr hızı, solar radyasyon ve basınç verilerine dayanarak FAO56 Penman-Monteith ilişkisine göre hesaplanan referans bitki su tüketim değerlerinin aylara göre dağılımı Şekil 1 de gösterildiği gibidir.



**Şekil1.** Samsun Merkez Meteoroloji İstasyonu verileriyle hesaplanan Referans Bitki Su Tüketim değerlerinin aylara göre değişimi

Çizelge 2 de aylık bitki su tüketimine aylık bazda etki eden meteorolojik veriler ve istatistik bilgiler yer almaktadır. Çizelge de görüldüğü gibi uzun yıllık ortalama verilerine göre yıl içerisinde sıcaklık ve solar radyasyonun bitki su tüketimine olan etkisi diğer bağımsız değişkenlere göre daha fazla olmaktadır.

**Çizelge 2.** Aylara göre bitki su tüketimine etki eden meteorolojik değişkenler

	Meteorolojik Veriler	Min.	Mak.	Mean	Stn.Spm	Stn.Hata	Basıkkılık	Çarpıklık
Nisan	Solar Rad.	12,47	16,27	14,05	1	0,18	-0,07	0,67
	Min.Sic.	6,1	9,4	7,95	0,87	0,16	-0,78	-0,29
Mayıs	Bağıl Nem	758	81,7	78,28	1,72	0,31	-1,12	0,13
	Solar Rad.	15,66	20,22	17,83	1,35	0,24	-1,09	0
Haziran	Mak. Sic.	17	21,5	19,07	1,5	0,27	-1,42	0,01
	Solar Rad.	17,59	22,45	20,75	1,13	0,21	2,04	-1,33
Temmuz	Mak. Sic.	21,8	25,5	23,74	1,14	0,21	-1,11	-0,25
	Solar Rad.	18,56	23,01	20,54	1,11	0,2	-0,62	0,13
Ağustos	Ort.Sic.	21,75	23,75	22,89	0,68	0,12	-1,3	-0,36
	Ort.Sic.	21,9	23,95	23,33	0,52	0,09	0,91	-1,22
Eylül	Bağıl Nem	71,2	73,8	72,39	0,75	0,13	-0,66	0,19
	Basınç	101,02	101,24	101,13	0,07	0,01	-1,43	-0,07
	Mak. Sic.	21,9	25,8	23,92	1,03	0,19	-0,87	-0,02
	Bağıl Nem	71,7	76,1	73,95	1,1	0,2	-0,47	0,16
	Rüz.Hızı	1,8	2,3	2,03	0,15	0,03	-0,67	-0,07

Regresyon çözümlemesi sonucunda ulaşılan modelin doğru olduğu biliniyorsa, daha ileri bir analize gerek kalmadan çalışma sonlandırılabilir. Bununla birlikte, yine de elde edilen sonuçlar üzerinde dikkatli bir denetim yapmadan sonuç modelini kullanmamak gereklidir. Bu denetim süreci, genellikle, modelin yeterliliğinin saptanması süreci olarak bilinir. Modelin yeterliliğinin saptanmasına ilişkin çeşitli ölçülerden ve yaklaşımlardan yararlanılır. Bunlar; açıklayıcılık katsayısı, değişen varyanslılık sorununun olup olmadığı, hataların normal dağılım gösterip göstermediği, çoklu bağlantı sorununun olup olmadığı gibi önemli parametrelerdir. Aşağıda her bir ay için bu durum incelenmiş ve tablolar şeklinde verilmiştir.

**Çizelge 3.** Aylar bazında bitki su tüketimine etki eden bağımsız değişkenlerin istatistiksel detayları (Nisan, Mayıs ve Haziran)

Belirleyici	Nisan				Mayıs		Haziran	
	Min.Sic.	Mak.Sic.	Solar Rad.	Bağ.Nem	Mak.Sic.	Solar Rad.	Mak.Sic.	Solar Rad.
Korelasyon	0,867	0,845	0,866	0,295	0,898	0,858	0,916	0,795
Kısmı korelasyon Katsayısı	0,885	0,684	0,967	-0,881	0,981	0,974	0,984	0,963
Yarı Kısmı Korelasyon Katsayısı	0,208	0,103	0,414	-0,204	0,504	0,429	0,597	0,387
Tolerans Değeri	0,199	0,265	0,529	0,576	0,687	0,687	0,747	0,747
VIF	5,030	3,776	1,889	1,735	1,456	1,456	1,338	1,338

Çizelge 3'de ise Nisan, Mayıs ve Haziran için bitki su tüketimi üzerinde etkisi olan parametreler ait ilişki katsayıları yer almaktadır. Buna göre Nisan ayı için hesaplanan bitki su tüketimi üzerinde solar radyasyonun etkisi işleme alınan diğer parametreler sabit tutulduğunda açıklayıcı kısmî korelasyon katsayısı 0,967 olduğundan dolayı daha fazladır. Aynı ayda solar radyasyonun üzerinde diğer değişkenlerin etkisi kaldırıldığında bitki su tüketimi üzerinde en büyük etki sahibi solar radyasyondur ( $r_{y,x3(x1,x2,x4)} = 0,414$ ). Nisan ayında tolerans ve VIF değerlerine bakıldığından çoklu bağlantı sorununun da olmadığı görülmektedir. Mayıs ayında hesaplanan

bitki su tüketimi üzerine maksimum sıcaklığın etkisi solar radyasyon sabit tutulduğunda açıklayıcı kısmi korelasyon katsayısı 0,981 olduğundan dolayı fazladır. Maksimum sıcaklığın üzerinden solar radyasyonun etkisi kaldırıldığında bu değişkenin bitki su tüketimine olan doğrudan etkisi de fazladır ( $r_{y,x1(x2)} = 0,504$ ). Bu ayda da yine çoklu bağlantı sorunu görülmemektedir. Haziran ayında yine maksimum sıcaklık bitki su tüketimini açıklayıcı kısmı oluşturmaktadır. Yine bu ayda da çoklu bağlantı sorunu olmadığı gözlemlenmektedir. Bu durum modelin doğru değişkenlerce açıklandığını göstermektedir.

**Çizelge 4.** Aylar bazında bitki su tüketimine etki eden bağımsız değişkenlerin istatistiksel detayları (Temmuz, Ağustos ve Eylül)

Belirleyici	Temmuz			Ağustos			Eylül		
	Katsayılar	Ort. Sic.	Solar Rad.	Ort. Sic.	Basınç	Bağıl Nem	Mak.Sic.	Rüz. Hızı	Bağıl Nem
<b>Korelasyon</b>	0,825	-0,328		0,947	-0,809	-0,534	0,972	0,756	-0,640
<b>Kısmı korelasyon Katsayısı</b>	0,935	0,805		0,813	-0,561	-0,547	0,964	0,582	-0,551
<b>Yarı Kısmı Korelasyon Katsayısı</b>	0,883	0,456		0,349	-0,169	-0,163	0,566	0,111	-0,103
<b>Tolerans Değeri</b>	0,426	0,426		0,296	0,362	0,711	0,500	0,517	0,662
<b>VIF</b>	2,349	2,349		3,382	2,760	1,407	2,001	1,934	1,511

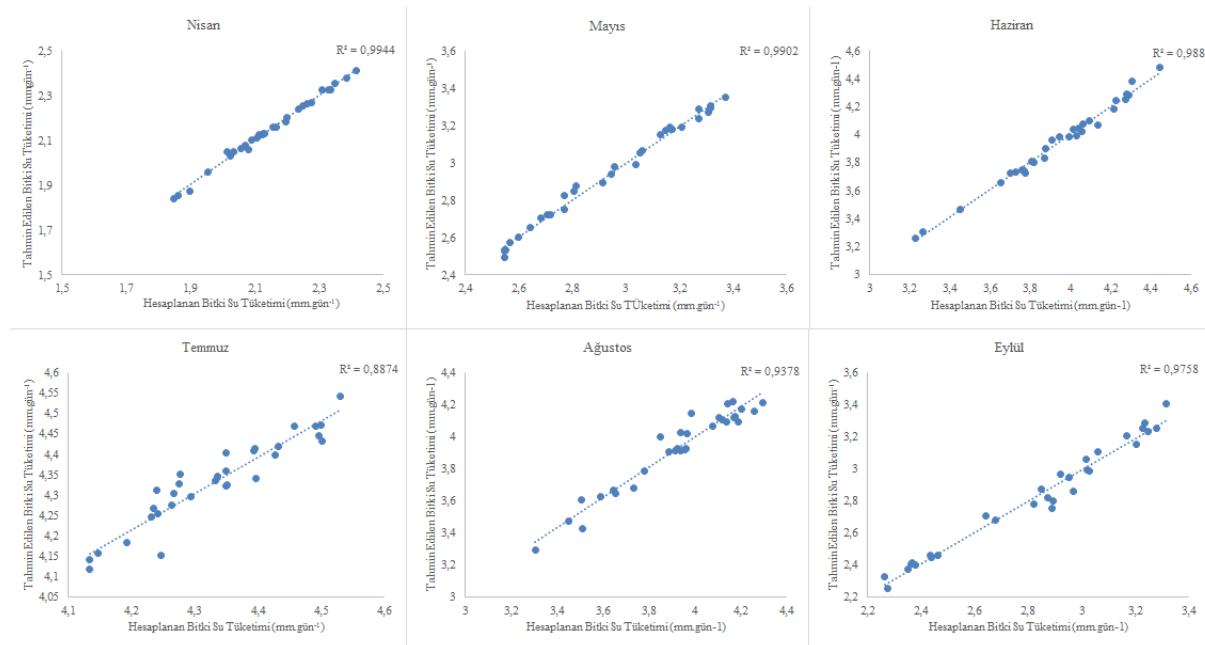
Çizelge 4'te ise Temmuz, Ağustos ve Eylül ayları için bitki su tüketimi üzerinde etkisi olan parametrelere ait ilişki katsayıları yer almaktadır. Buna göre Temmuz ayı için hesaplanan bitki su tüketimi üzerine ortalama sıcaklığın etkisi, solar radyasyonun etkisi sabit tutulduğunda açıklayıcı kısmi korelasyon katsayısı 0,935 olduğundan dolayı daha fazladır. Aynı ayda ortalama sıcaklığın üzerinde solar radyasyonun etkisi kaldırıldığında bitki su tüketimi üzerinde en büyük etki sahibi ortalama sıcaklığıdır ( $r_{y,x1(x2)} = 0,883$ ). Temmuz ayında tolerans ve VIF değerlerine bakıldığında çoklu bağlantı sorununun da olmadığı görülmektedir. Ağustos ayında ise yine ortalama sıcaklığın etkisi dikkate alınan diğer parametrelere oranla daha fazladır. Diğer parametrelerin ortalama sıcaklık üzerine etkisi kaldırıldığında da yine ortalama sıcaklığın etkisinin yüksek olduğu görülmektedir ( $r_{y,x1(x2,x3)} = 0,349$ ). Eylül ayında ise maksimum sıcaklığın etkisi görülmektedir. Bitki su tüketimi üzerine tek başına en yüksek açıklayıcılığında yine maksimum sıcaklık göstermektedir. Ağustos ve Eylül aylarında da Tolerans ve VIF değerlerine bağlı olarak çoklu bağlantının olmadığı ve modelin doğru değişkenlerle kuruşduğu görülmektedir.

**Çizelge 5.** Çoklu doğrusal regresyon modeline göre her bir ay için belirlenen modeller ve istatistik değerleri

Aylar	Model	R2	Modelin Stnd. Hatası	p	Durbin-Watson
Nisan	$Y=1,527+0,081.Tmin+0,086.Rs-0,024.RH+0,004.Tmax$	0,988	0,01786	0,000	2,278
Mayıs	$Y=-1,129+0,113.Tmax+0,0107.Rs$	0,990	0,02856	0,000	1,623
Haziran	$Y=-0,985+0,179.Tmax+0,00000357.Rs^4$	0,988	0,03316	0,000	1,998
Temmuz	$Y=-1,196+0,139.Rs+0,117.Tort$	0,887	0,03962	0,000	1,871
Ağustos	$Y=108,442+0,326.Tort-1,060.P-0,068.RH$	0,938	0,06894	0,002	1,693
Eylül	$Y=55,162+0,142.Rs-0,023.RH-0,520.P$	0,976	0,05625	0,000	1,831

Çizelge 5'de çoklu regresyon sonuçlarından anlaşılabileceği üzere çoklu regresyon modeli her ay için anlamlıdır ( $p=0,000$ ). Buna göre her bir ay için modellerde yer alan her bir değişkenin modele olan katkısı anlamlıdır. Alfa=0,05 alındığında ve katsayımlara ilişkin  $p$  değeri incelendiğinde modellerde yer alan değişkenlerin modele katkısı anlamlıdır. Burada Durbin-Watson katsayısı çoklu bağıntı sorununun olup olmadığı bir göstergesidir. Her bir ay için bu katsayıının da gözlem değerlerini de göz önünde bulundurarak 1 ve 2,5 in üzerinde değerlere sahip olmadıkları için çoklu bağıntı sorununun olmadığını göstermektedir. Yani modele katkısı olan her bir bağımsız değişkenin kendi aralarında bir ilişkisi değil bağımlı değişkenle bir ilişkisinin olduğunu tanımlar.

Aşağıdaki Şekil 2'de her bir ay için hesaplanan ve modelle tahmin edilen bitki su tüketim değerlerinin çoklu regresyonmodele göre grafikleri yer almaktadır.



**Şekil 2.** Her bir aya ait çoklu regresyon analizine göre tahmin edilen ve hesaplanan bitki su tüketimlerinin regresyon grafikleri

Şekil 2 de de görüldüğü gibi Nisan ayında çoklu doğrusal regresyon analizine göre elde edilen bitki su tüketimi ile FAO-Penman Monteith ile hesaplanan bitki su tüketimi arasında yüksek bir ilişkinin olduğu gözlemlenmektedir ( $r^2:0,988$ ;  $p:0,000$ ). Aynı şekilde diğer beş ayda da bu ilişkinin yüksek ve anlamlı olduğu görülmektedir.

#### 4. SONUÇ VE TARTIŞMA

Bilindiği üzere son yıllarda kurak ve yarı kurak iklim kuşağında yer alan ülkemiz kuraklık ve çölleşme sorunlarının küresel ısınma ile daha da artacağı dikkate alındığında sulama aynı zamanda önemli bir sorun haline gelmeye başlamıştı. Samsun ili yağışlı bölge içerisinde girmesine rağmen iklimdeki kararsızlık doğal olarak beraberinde bir takım önlemleri almayı gerektirmektedir. Aynı zamanda dünyada hala pek çok sulama projesi, kısa vadeli akılçılı olmayan planlamalar yüzünden tarım topraklarında tuzlanmaya neden olmaktadır.

Bu makalede Samsun illine ait uzun yıllık verileri kullanarak tarımsal anlamda sulamanın yapıldığı aylarda sulama için önemli olan bitki su tüketimi değerlerinin hesaplanması çoklu doğrusal regresyon analizinin kullanılabilirliğini ortaya koymaya çalışılmıştır. Bağımsız değişkenler olarak kullanılan meteorolojik verilerin (solar radyasyon, maksimum ve minimum sıcaklık, bağlı nem, rüzgar hızı, basınç) bağımlı değişken olan bitki su tüketimine etkilerini belirlemek ve bu etkinin açıklayıcılık kısmını ortaya koymak çalışmanın başlıca amaçlarından birini oluşturmaktadır. Bu makale ile tarımsal sulamanın ön planda olduğu aylarda bitki su tüketimi üzerinde çoklu regresyon modeli ile iklimsel verilerden sıcaklık ve solar radyasyonun etkisinin daya çok olduğu ortaya konulmuştur.

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## UTILIZATION OF CELLULOLYTIC ENZYMES TO IMPROVE MILK YIELD, MILK COMPOSITION, BLOOD SERUM PARAMETERS AND THE FEED EFFICIENCY AND ECONOMICAL EVALUATION OF LACTATING GOATS.

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### SUMMARY

The experiment was carried out to evaluate the effects of cellulases supplementation on milk yield, milk composition, blood serum parameters and the Feed efficiency and economical evaluation by lactating Zaraibi goats. Nine lactating Zaraibi goats after 7 days of parturition were divided into three groups, three animals each, using 3x3 Latin square designs. The first group was fed 37.5% concentrate feed mixture (CFM), 12.5% date kernel and 50% berseem hay (control diet). The second group was fed control diet supplemented with Veta-Zyme Plus® at level 15 U/kg DM ( $T_1$ ). The third group was fed control diet supplemented with Asperozyme at level 45 U/Kg DM ( $T_2$ ).

Milk yield (actual or FCM), milk fat yield, milk total solids (either as content or yield), milk solids not fat (either as content or yield), milk protein yield and milk lactose yield were significantly ( $P<0.05$ ) increased for treated groups (Asperozym and Veta-Zyme Plus®) compared with the control group. Blood serum parameters were not affected by treatments, except total protein and albumin which significantly ( $P<0.05$ ) increased for treated groups (Asperozym and Veta-Zyme Plus®) compared with the control.

Diet supplemented with Asperozym ( $T_2$ ) is more economic and efficient for feeding lactating Zaraibi goats than those supplemented with Veta-Zyme Plus® ( $T_1$ ) or control diet.

**Keywords:** Cellulases, lactating Zaraibi goats, milk, blood serum.

### INTRODUCTION

In Egypt there is an acute shortage of conventional feedstuffs for livestock feeding. The big feed gap between the requirements and the available sources forced the planners and nutritionists to look for non-conventional resources where there is no competition with human, such as agricultural by-products and agro-industrial by-products which are available around the year but not efficiently used.

Agro-industrial by-products are available in Egypt in large quantities (averaged 26 million ton as reported by El Shaer, 2004); some of these materials are characterized by high nutritive value (Youssef et al., 2006). So it can be used as supplementary feed ingredients in animal rations (Mohamed and El-Saidy, 2003). Date kernels is one of these agro-industrial by-products, it have been demonstrated by many investigators as an acceptable, cheap and rich feed ingredients for sheep and goats (Shawket et al., 2001; and Abdou, 2003).

Cellulase as one of exogenous fiberolytic enzymes was used to improve the digestibility and nutritive value of poor quality roughages. Increasing digestibility of the diet by using exogenous feed enzymes will lead to the beneficial effects on animal performance, so such treatments are likely to be greatest for ruminants in negative energy balance, such as animals in early lactation (Rode et al., 1999).

The increasing in milk production had been observed in some studies (Beauchemin et al., 1999; Rode et al. 1999; Schingoethe et al., 1999; Yang et al., 1999; Zheng et al. 2000; Titi and Lubbadeh, 2004; Kholif 2006 and Azzaz 2009) when lactating animals were fed treated fiberolytic enzyme diet than those fed the control one. This response may be attributed to the improving in nutrients digestion with enzymes supplementation by ewes and goats (Titi and Lubbadeh, 2004). Also, Azzaz (2009) observed that the production of FCM was higher ( $P < 0.05$ ) for goats fed treated fiberolytic enzyme diet than those fed the control.

### MATERIAL AND METHODS

This work was carried out at Agricultural Experimental Station, Sheep and Goat Research Unit, Faculty of Agriculture, Cairo University, Giza, Egypt. In cooperation with Dairy Science Department, National Research Center (NRC), Dokki, Giza, Egypt.

#### Collecting date kernel

Date kernels powdered were obtained from Siwa Oasis, Marsa Matrouh, Egypt

### Enzyme sources

#### Veta-Zyme Plus®

A commercial enzymes source produced by Vetagri® Consulting Inc, Canada. Each 1 gm of this enzyme contains 400 unit of cellulase, 550 unit of amylase, 2000 unit of protease, lactobacillus acidophiles 200 million colony forming unit (CFU) and carrier (calcium carbonate up to 1 gm).

#### Asperozym

Laboratory produced cellulase from Aspergillus niger. Each 1 gm contains 133 unit of cellulase.

#### Feeding and management:

Nine Zaraibi lactating goats (about 3 years old and weighing on average 30 kg) after 7 days of parturition were randomly assigned into three groups of three animals each using 3x3 Latin square design. The experimental periods were 12 weeks (84 days) and consisted of three equal periods (28 day each). The goats were fed on ration consisted of 50% concentrate and 50% roughage adlibitum. The concentrate feed mixture consisted of 33.33% yellow corn, 13.33% soybean meal, 20% wheat bran, 26.67% cotton seed meal, 4% minerals-vitamins premix and 2.67% molasses. The first group was fed on 37.5% concentrate feed mixture (CFM), 12.5% date kernels and 50% berseem hay (Control diet).The experimental enzymes were supplemented at the recommended rate from the in vitro experiment. Accordingly, the second group was fed the control diet supplemented with Veta-Zyme Plus® at 15U/kg DM. (T<sub>1</sub>), while the third group was fed the control diet supplemented with Asperozym at 45 U/kg DM (T<sub>2</sub>). The concentrate feed mixture, date kernels and berseem hay were divided into two portion then twice a day at 8.00 a.m. and 4.00 p.m. The enzymes were mixed well with the date kernels and introduced once a day to each group of animal. Fresh water was available at all times. The Chemical composition of feed ingredients used in feeding experiment (DM basis). (Table 1).

**Table 1. Chemical composition of feed ingredients used in feeding experiment (DM basis).**

Item	CFM	Berseem hay	date Kernels
DM	92.50	93.60	89.10
<b>Chemical composition, %</b>			
OM	89.70	86.70	97.16
CP	16.49	17.47	4.60
EE	3.32	1.50	6.76
CF	7.24	19.41	13.22
NFE	62.65	48.32	72.58
Ash	10.30	13.30	2.84
<b>Cell wall constituents, %</b>			
NDF	24.70	43.76	52.11
ADF	13.77	35.96	46.04
ADL	4.65	10.34	11.63
Hemicellulose	10.93	7.80	6.07
Cellulose	9.12	25.62	34.41

**Hemicellulose = NDF-ADF, Cellulose = ADF-ADL, CFM: concentrate feed mixture.**

#### Blood serum analysis:

Blood samples were taken from each animal at the last day (28<sup>th</sup> day) of each experimental period at about 4 hrs after the morning feeding. Blood samples were taken from jugular vein from all animals. Collected blood samples were centrifuged at 4000 r.p.m for 20 min. and the supernatant was stored in glass tubes and kept frozen for later analysis. Samples were analyzed for total protein was determined as described by Gornal et al (1949), albumin (Doumas 1971), urea (Fawcett and Soott 1960), serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) (Reitman and Frankel 1957), glucose (Trinder 1969), cholesterol (Flegg 1973). globulin and albumin/ globulin ratio were calculated.

**Sampling and analysis of milk:** The animals were milked twice daily at 8.00 a.m. and 4.00 p.m. during three successive days of each experimental period (22 to 24 day). Samples of milk were immediately collected from each animal after morning and evening milking. The samples of each animal were mixed to represent a mixed sample of constant percentage of the evening and morning yield. Milk samples were analyzed for total solids, fat,

true protein and lactose by infrared spectrophotometry (Foss matic 120 Milko- Scan, Foss Q3 183 Electric, Hillerød, Denmark) according to AOAC (1995) procedure. Solids not fat content of milk was calculated by the difference between total solids and fat content. Fat corrected milk (4% fat) was calculated by using the following equation according to Gaines (1928).

$$FCM = 0.4 M + 15 F$$

Where: M= milk yield (g/d), F= fat yield (amount of fat = M x fat %)

#### **Statistical analysis**

Data obtained from this study were statistically analyzed by SAS (1998) according to general linear model procedures outlined by Snedecor and Cochran (1982). These procedures were:

#### **Latin square design**

Latin square design for milk yield and composition, and blood parameters using the general linear model procedure:

$$Y_{ijk} = \mu + R_i + C_j + T_k + E_{ijk}$$

Where,  $Y_{ijk}$  is the parameter under analysis of the ijk trait,  $\mu$  is the overall mean,  $R_i$  is the effect due to the lactation period on the parameter under analysis,  $C_j$  is the effect due to the animals on the parameter under analysis,  $T_k$  is the effect due to treatment on the parameter under analysis,  $E_{ijk}$  is the experimental error for ijk on the observation, assumed to be randomly distributed ( $0^{\circ} \sigma^2$ ).

The Duncan's multiple range tests (Duncan, 1955) were used to test the significance among means for data of cellulase production trials, in vitro and in vivo experiments, milk yield, milk composition, nutrients digestibilities, rumen parameters and blood parameters.

#### **RESULTS AND DISCUSSION**

**Blood serum parameters:** Data of Table (2) clearly show that Increasing concentration of serum total protein in blood of goats fed diets treated with cellulases compared with control may be related that these goats cover their protein needs from their treated diets protein which may characterized by to higher solubility and digestibility of protein in treated diet compared with control diet. This finding is in line with the result obtained by Gado et al. (2007) who reported that biological treatment (cellulase; rumen liquor and cellumonas cellulasea) of bagasse increased blood plasma total protein., also, the diets treated with cellulases (T<sub>1</sub> and T<sub>2</sub>) significant ( $P<0.05$ ) increased serum total albumin compared with the control diet. The increase of serum albumin concentration may be due to higher CP digestibility for goats fed diets supplemented with cellulase compared with control diet Farahat (2014). The increasing of serum albumin may be explain the high content of milk protein as shown in Table (3).This result related to that serum albumin is the main source of milk protein synthesis. Results are in a good agreement with those obtained by Bader (1993) (in goats), El-Ashry et al., (1997) (in sheep) that biological treatments increased serum albumin. Also, Azzaz (2009) observed that fibrolytic enzymes treatment significantly ( $P<0.05$ ) increased plasma albumin. Serum urea concentration showed higher ( $P<0.05$ ) value by goats fed (T<sub>2</sub>) diet compared with those fed control diet but, goats fed (T<sub>1</sub>) had insignificant increase in serum urea concentration compared with goats fed control and (T<sub>2</sub>) diets. These results are in line with Ali (1999) and Gado et al. (2007) who reported that biological treatment increased serum urea concentrations. There were insignificant differences ( $P>0.05$ ) among treatments in the overall means of serum albumin: globulin (A/G) ratio, globulin, Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), cholesterol and glucose. These results indicated that adding cellulases to lactating goat's diets were not negatively affected liver activity or animal's health.

**Table 2. Blood serum parameters of the experimental lactating goats .**

Items	Experimental diets			$\pm$ SE
	Control	T <sub>1</sub>	T <sub>2</sub>	
Total protein (g/dl)	6.75 <sup>b</sup>	7.29 <sup>a</sup>	7.43 <sup>a</sup>	0.09
Albumin (g/dl)	3.08 <sup>b</sup>	3.57 <sup>a</sup>	3.61 <sup>a</sup>	0.09
Globulin (g/dl)	3.67	3.71	3.82	0.08
A/G ratio	0.85	0.99	0.96	0.04
Urea (mg/dl)	18.42 <sup>b</sup>	22.63 <sup>ab</sup>	24.08 <sup>a</sup>	1.11
AST (U/ml)	50.33	52.55	51.45	2.62
ALT (U/ml)	22.78	24.22	23.23	1.02
Glucose (mg/dl)	69.42	73.39	74.20	1.06
Cholesterol (mg/dl)	115.44	120.89	123.11	2.35

a,b,c Means designated with the same letter in the same row are not significantly different at 0.05 level of probability. SE: standard error. T<sub>1</sub>: Veta - Zyme Plus®, T<sub>2</sub>: Asperozym

**Milk yield and composition:** Milk composition was not affected by cellulases treatments, Accept milk total solids percentage and milk solid not fat percentage were significantly ( $P<0.05$ ) increased for goats fed Asperozym ( $T_2$ ) than those fed the control diet. On the other hand, goats fed diets supplemented with veta-Zyme Plus® ( $T_1$ ) showed were insignificant ( $P>0.05$ ) differences among groups in the percentage of milk total solids and milk solid not fat, While actual milk and 4% Fat Corrected Milk (FCM) yield were significantly ( $P<0.05$ ) increased for goats fed ( $T_1$ ) and ( $T_2$ ) diets than those fed the control diet. Goats fed ( $T_2$ ) diet produce more milk than those fed ( $T_1$ ) diet. (Table 3). Adding Asperozym to lactating goat's diets increased milk production by 16.35% and fat corrected milk production by 24.03%, while adding Veta - Zyme Plus® to lactating goat's diet increased milk production by 8.35% and fat corrected milk production by 13.88% compared with untreated diets (control).Our findings are in agreement with the results obtained by Yang et al. (1999), Titi and Lubbadah (2004), and Gado et al. (2007). This response may be attributed to improved nutrient digestion after cellulases supplementation by goats. Milk fat yields were higher ( $P<0.05$ ) for goats fed ( $T_1$ ) and ( $T_2$ ) diets than those fed the control diet, In this connection, milk fat increases for diets containing cellulolytic enzymes ( $T_1$ ) and ( $T_2$ ) compared with the control which may illustrate the effect of treated diets on ruminal TVFA's Farahat (2014) whereas, these diets resulted in remarkable increase in TVFA's production and might possibly cause increase of rumen acetate and acetate: propionate ratio. Rumen acetate is the main source for milk short chain fatty acids (50% of milk fatty acids) synthesis leading to increase milk fat yield. Milk solids not fat yield was significant ( $P<0.05$ ) increase with goats fed ( $T_1$ ) and ( $T_2$ ) diets than goats fed control diet , On the other hand, goats fed ( $T_2$ ) diet showed significant ( $P<0.05$ ) increase of milk total solids yield compared to those fed ( $T_1$ ) diet. These results are in a good agreement with those obtained by Lewis et al. (1999), Rode et al. (1999), Zheng et al. (2000), Dhiman et al. (2002) , Khalif (2006) and Azzaz (2009) who found that milk solids not fat yield slightly increased with enzymatic treatment compared with control.

**Table 3. Milk yield and composition of the experimental lactating goats.**

Items	Experimental diets			± SE
	control	T1	T2	
<b>Yield (g/h/d)</b>				
<b>Actual milk</b>	838 <sup>c</sup>	908 <sup>b</sup>	975 <sup>a</sup>	20.35
<b>4% FCM</b>	749 <sup>b</sup>	853 <sup>a</sup>	929 <sup>a</sup>	22.63
<b>Milk total solids</b>	92 <sup>c</sup>	105 <sup>b</sup>	115 <sup>a</sup>	2.69
<b>Milk fat</b>	28 <sup>b</sup>	33 <sup>a</sup>	39 <sup>a</sup>	1.09
<b>Milk solids not fat</b>	64 <sup>c</sup>	72 <sup>b</sup>	80 <sup>a</sup>	1.77
<b>Milk total protein</b>	25 <sup>b</sup>	29 <sup>ab</sup>	33 <sup>a</sup>	1.04
<b>Milk lactose</b>	34 <sup>c</sup>	38 <sup>b</sup>	41 <sup>a</sup>	0.92
<b>Milk ash</b>	4	5	5	0.59
<b>Milk content (%)</b>				
<b>Total solids</b>	10.99 <sup>b</sup>	11.58 <sup>ab</sup>	11.92 <sup>a</sup>	0.17
<b>Fat</b>	3.30	3.60	3.71	0.09
<b>Solids not fat</b>	7.69 <sup>b</sup>	7.98 <sup>ab</sup>	8.22 <sup>a</sup>	0.11
<b>Total protein</b>	3.04	3.19	3.46	0.10
<b>Lactose</b>	4.12	4.23	4.24	0.04
<b>Ash</b>	0.51	0.56	0.52	0.06

a,b,c Means designated with the same letter in the same row are not significantly different at 0.05 level of probability. SE: standard error.  $T_1$ : Veta - Zyme Plus®,  $T_2$ : Asperozym

Milk protein yield was significant ( $P<0.05$ ) increase for goats fed ( $T_2$ ) diet than those fed the control diet. However, goats fed ( $T_1$ ) diet had insignificant ( $P>0.05$ ) increase in milk protein yield compared with goats fed control and ( $T_2$ ) diets. Increasing milk protein with fiberolytic enzymes treatment may be due to one or more of the following reasons; 1), higher nutritive value (DCP) of treated rations Farahat (2014), 2), higher CP, OM

and CF digestibility Farahat (2014), 3) the increase of serum albumin (table, 2) because serum albumin is the main source of milk protein synthesis and 4) improve the efficiency of synthesis of microbial protein in the rumen (Jacobs and McAllan., 1992). Therefore, it is probable that improved efficiency of microbial protein synthesis is a result of enzyme action on the forage structural polysaccharides altering the rate of ruminal degradation of structural carbohydrates (Lewis et al., 1996) and the provision of a suitable ruminally degradable nitrogen source (Beauchemin et al., 1999). Milk total solid yield was higher ( $P<0.05$ ) for goats fed (T<sub>1</sub>) and (T<sub>2</sub>) diets than those fed the control diet, On the other hand, goats fed (T<sub>2</sub>) diet showed significant ( $P<0.05$ ) increase of milk total solids yield compared to those fed (T<sub>1</sub>) diet. However, yield of total solids was significantly ( $P<0.05$ ) increased due to the cumulative effect of cellulases treatment on the fat and protein concentrations as both were numerically higher for the treated groups compared to the control group. Milk lactose yield was higher ( $P<0.05$ ) for goats fed (T<sub>1</sub>) and (T<sub>2</sub>) diets than those fed the control diet, On the other hand, goats fed (T<sub>2</sub>) diet showed significant ( $P<0.05$ ) higher milk lactose yield compared to those fed (T<sub>1</sub>) diet. These results may be due to the higher milk yield of goats fed diet supplemented with Asperozym and Veta - Zyme Plus ® than those fed control diet and /or the generation of more nutrients which become available as a result of improvements in feed digestibility.

**Feed efficiency and economical evaluation of experimental diets:**

Data in Table (4) showed that there was a significant ( $P<0.05$ ) difference in feed efficiency (FCM/DMI) among goats fed diets supplemented with cellulases (T<sub>1</sub> and T<sub>2</sub>) and goats fed control diet.

**Table 4. Feed efficiency and economical evaluation of experimental diets.**

Items	Control	T1	T2
<b>Average live body weight (kg)</b>	30.40	31.10	31.45
<b>Dry matter intake (DMI/g)</b>			
<b>Concentrate feed mixture (CFM)</b>	370	378	382
<b>Date kernels</b>	128	131	132
<b>Berseem hay</b>	487	498	504
<b>Total DMI (g/h/d)</b>	985	1007	1018
<b>4% FCM yield (g/h/d)</b>	749	853	929
<b>Feed efficiency (FCM/DMI)</b>	0.76 <sup>b</sup>	0.85 <sup>ab</sup>	0.91 <sup>a</sup>
<b>Feeding cost* (L.E.)</b>			
<b>Concentrate feed mixture (CFM)</b>	0.81	0.83	0.84
<b>Date kernels</b>	0.13	0.13	0.13
<b>Berseem hay</b>	0.88	0.90	0.91
<b>Cellulases</b>	-	0.18	0.08
<b>Total cost (L.E. /day)</b>	1.82	2.04	1.96
<b>production cost of 1kg 4%FCM(L.E.)</b>	2.43	2.39	2.11

\* Based on market prices at the beginning of experiment, the prices were as follow: CFM, 2200; Berseem hay, 1800; Date kernels, 1000 (L.E. /ton).2012

**Means designated with the same letter in the same row are not significantly different at 0.05 level of probability.**

The best feed efficiency was recorded by goats fed diet supplemented with Asperozym (T<sub>2</sub>) followed by goats fed diet supplemented with Veta - Zyme Plus ® (T<sub>1</sub>) then goats fed control diet, being 0.91, 0.85 and 0.76, respectively. On the other hand, data showed that the best feed cost for production of 1 kg 4% FCM was recorded by goats fed diet supplemented with Asperozym (T<sub>2</sub>) followed by goats fed diet supplemented with Veta - Zyme Plus ® (T<sub>1</sub>) then goats fed control diet, being 2.11, 2.39 and 2.43 L.E / kg, respectively. These results mean that diet supplemented with Asperozym (T<sub>2</sub>) is more economic and efficient for feeding lactating Zaraibi goats than the other diets.

## CONCLUSION

Diets of lactating Zaraibi goats supplemented with Asperozym and Veta-Zyme Plus® increased ( $P<0.05$ ) milk yield , fat corrected milk , milk fat yield, milk total solids (either as contents or yields), milk solids not fat (either as contents or yields), milk protein yield and milk lactose yield compared with the control group. Blood serum parameters were not affected by treatments, except total protein and albumin which significantly ( $P<0.05$ ) increased for treated groups (Asperozym and Veta-Zyme Plus®) compared with the control.

Finally, the laboratory produced cellulase (Asperozym) was more economic and efficient for feeding lactating Zaraibi goats than the commercial cellulase (Veta-Zyme Plus®) diet.

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## ADOPTION AND DIFFUSION OF SILAGE MAKING FROM GRASS IN INTERIOR COAST AREAS OF RIZE<sup>9</sup>

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### ABSTRACT

The purpose of this research, attitudes and behaviours of farmers towards the silage making from harvested grass have explored in Çamlıhemşin and Kalkandere districts of Rize province. In the research, exploring attitudes and behaviours of farmers toward making silage from harvested grass silage have explored in Çamlıhemşin and Kalkandere district of Rize. According to farms' number of cattle it was divided into 2 layers and sampled farms were chose random sampling method with 76 farms. As a general, sampled farms' size are small, they have small land produced together crop and livestock production. It was found that main problem of farms are insufficient workforce numbers and lack of technical information on basic cattle husbandry. Moreover, social and economic sustainability of the farms are decreasing day by day.

On this research, silage making from grass, this technology which is the main subject of this research must be considered as an innovation for Rize on the Eastern Black Sea Region since it has not been used in the region. The region must also be considered as a disadvantaged region in terms of grass drying because the limitations of sunny days during the grass harvest season. Silage making from grass is not common not only in the region but also in other regions of the country where animal husbandry is an intensive incomes source for farmers. The first crop is being remembered for this purpose is maize. Although in developed countries silage making from grass is a valuable input for animal husbandry, because of lack of research and extension work it has not been publicized and adopted by farmers. This innovation will bring many benefits to the Eastern Black Sea Region of Turkey because of the availability of different grass varieties. On the other hand silage making from grass will ease the work of farmers and provide enormous amount of labor save. Animal husbandry in the region, the most important input to reduce the cost of fodder, they will make positive contributions to the sustainability of the company with a better quality of animal production.

**Keywords:** Adoption, diffusion, silage, grass, sustainability, Rize

### 1. INTRODUCTION

Nowadays, there has been much debate on the sources of total factor productivity increase and sustainability in all sector of the economy worldwide. Innovation and technology transfer is one of the main drivers of the total factor productivity increase and sustainability. That is why, the transfer of innovation and technology comes into agenda of policy makers in nearly all countries. Since the agriculture is mainly based on the biological process of plants and animal, transfer of innovation and technology is vital for sustainability of the agricultural activities. Many researchers, therefore, have focused on technology development and innovation transfer to increase total factor productivity and sustainability in agriculture all over the world, especially in developed country. Most developing countries have tended to import the technology and innovation from developed country ignoring the adoption capacity of the users and risks embedded into the technology to accelerate the economic development, resulting in decrease in the efficiency and total factor productivity in long term. Total factor productivity decrease and low level of sustainability in developing countries has been observed in agricultural sector comparing to other sectors due to low adoption capacity of farmers to technology and innovation. Similarly, the development of total factor productivity is nearly constant and economic sustainability is arguably in Turkish agricultural sector. It is suggested that total factor productivity increased in agriculture by contribution of the innovation and technology transfers during the time period of last 5 development plan, while the total factor productivity increase slowed down and presently stopped. Based on the findings of the report, the main reason of the slowing down in total factor productivity in Turkish agriculture were the risks of technology and low adoption capacity of the farmers. Of course, the shortcomings of the policy makers contribute the poor integration. Hence, not only the economic sustainability of the farms but also social sustainability has priority in many part of the Turkey, especially in the part where the income sources is very limited and highly depend upon small scale dairy. Ignorance of policy makers about the farmers' characteristics and their living standards during

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the innovations and technology transfer make the farmers more dependent to actors of inputs market. Nowadays farmers have tended to decrease their production cost via cost effective innovation.

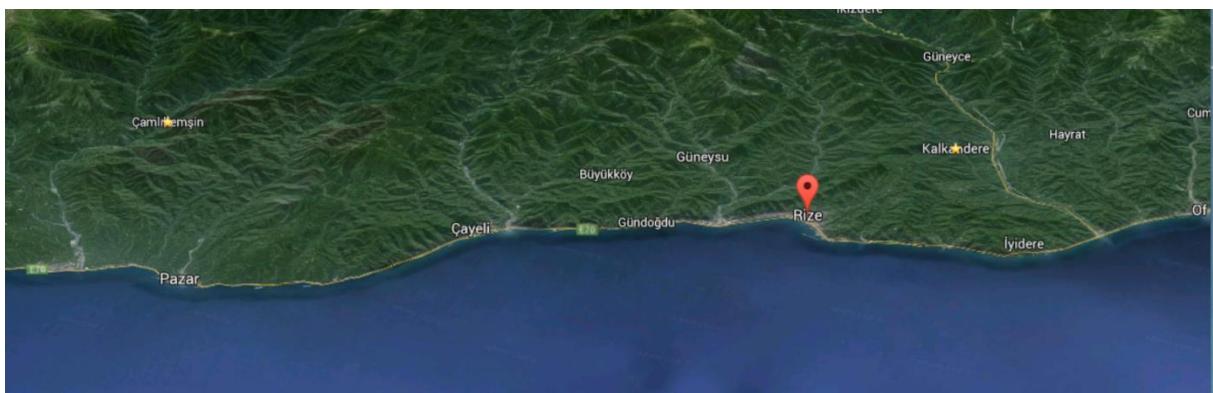
In Black Sea region of Turkey, most small scale farms face with economic shortage sourced by high feed cost due to high level of humidity and rainy days. Since the climatic conditions in this region limits the drying season, drying the pasture grass to obtain fodder for husbandry dairy has been very problematic. Therefore, alternative techniques are needed to use pasture grass to minimize feed cost and increase the sustainability of the farmers. Silage making is one of the alternative techniques to ensure coarse feed production and minimize feed cost for farms. Woodford (1984) defined silage as “the product formed when grass or other material of sufficiently high moisture content, liable to spoilage by aerobic microorganisms, is stored anaerobically”. Silage is produced by ensilage, that is, the placing of crop material inside a vessel or structure called a silo. The material may be an entire crop or only part of a crop, such as the grain portion. By placing the material inside a structure the objective is to preserve it and to prevent it rotting as in a compost heap. The crucial difference between a silo and a compost heap is that air moves relatively freely in the compost heap but not in the silo. Bilal (2009) stated that making silage was the cheapest way to meet good quality coarse feed for needs of animals, to improve the ability to digestion of feed, to maintain long-term without compromising quality, to provide space-saving in periods where there were no green fodder. The most common silage is corn silage. Grass is in the second place in terms of suitability for silage making and it is moderately compliance with silage. Making silage from grass was encouraged to handle the problem of cost minimization in this region. However, farmers have no enough knowledge about silage making techniques from pasture grass. Unfortunately, local authority has ignored the importance of the case. The reverse has been the case for developed countries. Producing hay from pasture grass by using appropriate silage technique has been common application in many developed countries having similar climatic conditions like Eastern Black Sea Region. It was evident that silage making from pasture grass by using additives based on the results of the researches conducted by Carvalho et al. (2010) and Arslan and Dinç, (2010). Similarly, Castro et al. (2010) and Genever (2013) proved the technical feasibility of silage making by using pasture grass in nature without using any additives. Since the making silage was such kinds of innovation to minimize feed cost and increase economic sustainability of farmers, the study intended to test the hypothesis of whether silage making from pasture grass was technically feasible, or not and whether silage making from pasture grass diffuses among the local farmers, or not.

Adoption process is the mental process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject and to later confirmation of this decision. Rogers (1995) suggested five stages of adoption process such as awareness, interest, evaluation, trial, adoption. Of course, the characteristics of innovation was also important during the innovation transfer. Rogers and Shoemaker (1971) stated that the adoption of the innovation depended on relative advantage, compatibility, complexity, trainability and visualize. It has been clear based on the literature that the adoption of innovation in agriculture is often optional decision, If an innovation is take an advantage compared to the previous practice, farmers can be speed up it. (Van den Ban and Hawkins, 1996; Taluğ and Tatlıdil, 1993; Özkaya, 1996; Özçatalbaş and Gürgen, 1998). In spite of the fact that silage making as an innovation has been clear alternative for farmers in developed countries, there has been no healthy information about not only technical and economic feasibility of silage making from pasture grass, but also attitudes of farmers to silage making and their adoption characteristics in Turkey. The purposes of the study, therefore, is to explore the technical and economical feasibility of silage making from pasture grass and to elicit attitudes of farmers and adoption characteristics of them in coastal areas of Rize province, Turkey.

## 2. MATERIALS and METHODS

### 2.1.RESEARCH AREA

The Black Sea Region is one of the Turkey's seven census-defined geographical regions and located on the north of Turkey. The region possesses peculiar geomorphology and climate. Rize is a province of north-east Turkey, on the eastern Black Sea coast. It is considered to be the "wettest" corner of Turkey and is the country's main tea producing region. The province is largely rural and very scenic, containing many mountain valleys and elevated yaylas (meadows).



**Figure 1.1. Map of Rize province**

Rize is differentiated by its special fauna and flora as origin of region' natural beauties. It has also a special culture built by local people in conjunction with the distinctive physical characteristics. Rize has rocky and steep coastline with rivers flowing through deep valleys into the Black Sea. Rize is permanently cloudy and receives immense amounts of rain during the year. Rize is the雨iest region of Turkey with its high amount of and evenly distributed rainfall. In the coastal region, summers are warm and humid, and winters are cool and damp. The average temperature is 20 °C in summers and 5 °C in winters. Due to the high mountains, there are big climate differences and transportation challenges between inland and the coastal region. On the contrary to coastal region, inland the summers are warm and dry and the winters are so cold.

## 2.2.DATA

In the research, Data were collected via surveys from selected farms, and were obtained from records and data of public institutions related to the subject and the review has benefited from research and thesis.

There have been 910 livestock farmers in Rize. (Anonymous, 2014). Farms are divided into two layer according to numbers of cattle (Yamane 2011). While the first layer farms consists of the number of cattle between 1 and 5, there are between 6 and 23 cattle in the second layer farms. Assuming from the average population 10% margin of error and 95% confidence limits ( $t:1645$ ) calculated sample size was found to be 76 people. Random numbers table was used to determine the farmers to be interviewed.

The variables included in the study: personal characteristics of farmers (age, education, experience, family size, the percentage of cooperative membership, etc.); farmers characteristics (size of land, farm and non-farm income, use of input and investment credit, etc.) and relationship of institutions.

Farmers' information was obtained about attitudes and behaviors related to livestock activities and grass silage making, communication behaviors.

Tables were created using descriptive statistics to perform the objectives of the research. In this figures are shown mean, frequency, percentage and standard deviation. Likert-type scale was used in survey and it was calculated total score for data of significance level measured. Starting with variable of the highest score was made importance rankings.

Partial budget analysis were used based on the data obtained from grass silage samples in the research area. Partial budgeting is a tool used to assess the costs and benefits associated with a specific change in an individual enterprise within the business operation (Horton, 1982). This tool specifically focuses on the implications of the intended change in a business operation by comparing the benefits and costs resulting from implementing the alternative with respect to the current practice, partial budget, like an enterprise budget, is based on a unit but it is different from an enterprise budget in the type of costs used (Cinemre, 2010). In this example, it was selected a cattle weight of 475 kg and daily milk produce of 15 liter . It was assumed that cattle fed in the barn 6 months along. In this period a cattle needs of silage is almost 1800 kg. In partial budget analysis, grass silage was added to the feed ration instead of the dry grass and comparing the benefits and costs of this changes. Three scenarios also were created based on the ownership of the grass chopping machine. This machine can cut roughly 900 kg grass per hour.

### **3.RESULT and DISCUSSION**

#### **3.1.GENERAL CHARACTERISTICS OF FARMS**

In the research area, farmers' average age is about 50 years old, they have approximately 35 years of agricultural experience. Average family size is 3.3 person. This value is very close in average of Turkey (Anonymous, 2015). On average, farmers have over 6 years of education. The majority of family members contributes to agricultural activities. Approximately 30.30% of farmers themselves and their close relatives have an active role in managing the village. About %32 of farmers have a cooperative membership. Almost all farmers have social security (Table 3.1).

The sampled farms, on average, have land approximately 22 daa and this land size about one-third of the the average of Turkey (Anonymous, 2014). On average, yearly per capita income is 8.153₺ and farmers obtained 51% of their total income from agriculture. On average, farms have almost 3 cattle, and livestock income of yearly per capita is 892₺. farmers have obtained 26% of their agricultural income from livestock. Almost 22% of farms have used input credit while about 13% of farms have used investment credit (table 3.1).

**Table 3.1. Characteristics of farms in Rize**

	General average	Standard deviation
Age (year)	49.76	14.72
Education (year)	6.28	3.70
Agricultural experience (year)	34.62	17.06
Social security (%)	85.50	-
Family size (person)	3.3	1.07
Land size (da)	22.09	3.75
Livestock (head)	3.08	1.95
Income (₺/year/per capita)	8153.11	4921.88
Agricultural income (₺/year/per capita)	4060.07	3142.67
Livestock income (₺/year/per capita)	892.42	796.16
Participation in village management (%)	30.30	-
Cooperative membebership (%)	31.60	-
Using input credit (%)	22.40	-
Using investment credit (%)	13.20	-

Among the sampled farms have widely used media. According to farmers, most important media tool is television. while newspapers and internet is less important than television, radio is the least used tool of media. Although approximately 57% of farmers have a good level of social relations, rest of farmers social relations' levels are poor.

About 68% of farms reproduce own livestock, approximately 25% of farms buy market place and rest of farms both reproduce own livestock and buy market place. 21% of farms can produce own roughage drying of harvested grass. Both produce own land and buy market place farms' rate is 63%, and rest of farms buy all need of roughage from the market place. Almost all farmers (92%) buy concentrate feed from market place.

The main aim farmers of animal husbandry, almost %36 of farms produce livestock for selling greater eid, about 36% of farms meet their needs like meat and milk, and rest of farms purpose is both of them. In the research area, most important information sources are, respectively, Directorate of Food Agriculture and Livestock and independent veterinarian. In general, farmers have took routine health checks of animals (%92). According to 62% of sampled farmers, range lands are protected and all farmers can benefit equal from the range land in research area. As a opinions of farmers roughly 71%, the number of livestock has decreased compared to the past. Most important reasons are insufficient family labor, high feed costs, low profitability of livestock and inadequacy of capital respectively.

In regard to sampled farmers, the most important cost factor in animal husbandry is concentrated feed, second one is roughage and last one is others (marketing cost, labor cost, etc.). All of farmers have been determined that unconscious about feed ration mixture rate, crude protein and metabolic energy value of feed.

Grass are passed through several stages to using as an animal feed during the winter. Among this stages, most difficult stage is drying, second one is harvesting grass, and third one is temporary storage in meadow. Because of the hilly land structure in the research area, use of machinery harvesting method is less than sickle and scythe. Sickle and scythe are used more commonly. It is almost 25% of loss in drying stage. It is also deterioration over 5% of dry grass.

### **3.2. THE BENEFITS OF GRASS SILAGE MAKING TECHNOLOGY**

#### **3.2.1. TECHNICAL BENEFITS**

Analysis of the silage samples taken from research area showed that this grass silage level is satisfactory<sup>13</sup> according to the fleig score<sup>14</sup> (Table 3.2)

**Table 3.2. Analysis of grass silage sample in Rize**

	DM (%)	HP (%)	NH3-N/TN (%)	pH	FS
Kalkandere	19.88	6.55	9.06	4.84	51.03
Çamlıhemşin	20.00	6.50	10.69	4.59	61.27

Grass silage samples were analyzed in terms of colour, structure and smell. According to result of this physical and sensorial analysis, score of Kalkandere district is 10.16 and score of Çamlıhemşin district is 10.75 and this score means that samples are very good<sup>15</sup> level.

In the research area, samples of the grass silage have shown that grass is suitable for silage making. Although this result, only almost 32% of farmers have informed about making silage with grass. Most important information source of farmers are television, Directorate of Food Agriculture and Livestock, neighbors and relatives respectively. Non of sampled farmers make grass silage. Primary reason is lack of technical information of farmers. Other reasons are prejudice against grass silage and small size of farm respectively. However, sampled farmers have thought that they can take an some advantage for their farms with grass silage. Especially, problems of drying stage can be overcome with using silage technology. Also, farmers opinion that it can be prevented loss of feed and livestock can be more popular activity step by step in Rize.

#### **3.2.2. ECONOMIC BENEFITS**

Partial budget analysis is used to prove economic benefits (table 3.3). According to three scenarios, if grass silage is added feed ration, it can be expected to increase in milk productivity with %10,6 (Mitsopoulos, 2015; Karaman, 2010) . Daily milk productivity of dairy has increase 1,59 liter. Firstly, the cost of dry grass is calculated. Then dry grass is removed from the daily ration. Drying losses are included in the calculation. Also, 1.07 kg fattening feed consumption of daily is reduce. There is a need a silo to storage grass silage with almost 1800 kg capacity.

According to first scenario, it is supposed that farmer buy grass chopping machine and rent to other farms. The unit cost of grass silage 0,06<sup>16</sup> ₺. 4 kg wheat straw is added to ration to meet need of a cattle dry matter. Grass chopping machine purchases with 50% capital stock and 50% credit. This machine is rent out four hours of per day during 20 days and per hour rent fee is 30 ₺ (increase income). Accordingly, grass chopping machine's

<sup>13</sup> 41<FS<60 Satisfactory

<sup>14</sup> Fleig score (FS=220+(2\*%DM of silage-15)-40\*pH of silage)

<sup>15</sup> 10-15 Score: Very good

<sup>16</sup> Included cost of labor, fuel and silo

amortisation, repair and maintenance costs and interest of credit is calculated. Finally, it is calculated interest of spending portion (price of machine) on capital stock and they are added part of reduced incomes. As a result, net change is 2464.27 ₺. This income is almost 30% of yearly total income (per capita), about 60% of yearly agricultural income (per capita) and 2.7 times higher than yearly livestock income (per capita).

**Table 3.3. Partial Budget Analysis**

	1.Scenario		2.Scenario		3.Scenario	
Positive Effects	Profit	Cash	Profit	Cash	Profit	Cash
<b>Increases in income</b>						
Increase in milk productivity 10,6% kg/head: (1.59 l / day)(1₺)(180 days)	286.2	286.2	286.2	286.2	286.2	286.2
Income from rental of grass chopping machine: (30₺ <sup>9</sup> )(4h/day)(20 days)	2400	2400				
<b>Decreases in costs</b>						
Dry grass: (21kg)(0.05₺)(180 days)	189	189	189	189	189	189
Dry grass (consumed): 12 kg						
Dry grass (loss of weight): 4 kg						
Dry grass (loss of during drying): 5 kg						
Fattening feed (1.07 kg/day)(1₺)(180 days)	192.6	192.6	192.6	192.6	192.6	192.6
Increases in incomes+Decreases in costs	3067.8	3067.8	667.8	667.8	667.8	667.8
Negative Effects	Profit	Cash	Profit	Cash	Profit	Cash
<b>Increases in costs</b>						
Grass silage(10kg/day)(0.06₺ <sup>8</sup> )(180 days)	108	108				
Grass silage (10kg/day)(0.043₺ <sup>10</sup> )(180 days)			77.4	77.4	77.4	77.4
Wheat straw (4 kg/day)(0.35₺)(180 days)	252	252	252	252	252	252
<b>Grass chopping machine (1420₺) 50% credit - 50% capital stock</b>						
Amortisation (10 years)	127.8	127.8				
Interest (7%)(5 years)	15.58	31.16				
Repair and maintenance (5%)	71	71				
Grass chopping machine rental fee (900kg/h) (2 hour) (30₺/hour)			60	60		
Grass chopping machine rental fee from cooperative (900kg/h)(2 hour)(17.39₺/h <sup>11</sup> )					34.78	34.78
<b>Decreases in income</b>						
Loss of interest (machine+silo)(710₺+18.75₺)(4%)	29.15	29.15				
Loss of interest (silo) (18.75₺)(4%)			0.75	0.75	0.75	0.75
Increases in costs+Decreases in income	603.53	619.11	390.15	390.15	364.93	364.93
Net Change (Positive effects-Negative effects)	2464.27	2448.69	277.65	277.65	302.87	302.87

With respect to second scenario, it is assumed that farmer rents a grass chopping machine for two hours. Renting cost of machine is 30₺<sup>17</sup> for an hour. The unit cost of grass silage is 0.043<sup>18</sup> ₺. Finally, it is calculated interest of spending portion (cost of silo and price of rent a machine) on capital stock and they are added part of reduced incomes. Under these conditions, the net benefit is 277.64 ₺. This income is slightly below 4% of yearly total income (per capita), about 7% of yearly agricultural income (per capita) and roughly 31% of yearly livestock income (per capita).

In accordance with third scenario, it is presumed that farmer rents grass chopping machine from cooperative for two hours. Renting price of this machine is 17.39<sup>19</sup> ₺. The unit cost of grass silage is 0,043₺<sup>10</sup>. Finally, it is calculated interest of spending portion (cost of silo) on capital stock and it is added part of reduced incomes. Consequently, it is found that net change is 302.87 ₺. This income is about 4% of yearly total income (per capita), over 7% of yearly agricultural income (per capita) and almost 34% of yearly livestock income (per capita).

#### 4.CONCLUSION

In the research, attitudes and behaviours of farmers toward making silage from harvested grass silage have explored in Çamlıhemşin and Kalkandere district of Rize. As a general, sampled farms' size are small, they have small land produced together crop and livestock production. It was found that main problem of farms are insufficient workforce numbers and lack of technical information on basic cattle husbandry. Moreover, social and economic sustainability of the farms are decreasing day by day.

To improve economic sustainability of livestock farms depend on increase in their incomes. In this context, it is great importance that using grass silage of cattle husbandry in order to reduce costs of fodder has biggest share in livestock production costs.

According to research results, it is technically possible to make silage with grass and silage for animal husbandry. If farms use this method to feed cattle, their incomes will increase. This technology is not contradict with the habits of farmers. Its practice and testing easier than drying process and this is also simple and understandable. And all, its benefit is proved with previous research.

Even if farmers invest to necessary equipment for making silage by themself, they can be increased their income and their cattle welfare. If their capital are insufficient enough to get the necessary equipment for making silage, especially for smaller farms, they can choose to rental option. The positive effect of silage making on farmers will further increase with contribution of cooperatives. But, in the research area, farmers are unaware of cooperative organizations important. They did not hitherto provide benefit as much as they want. It might be a solution for farmers and there can be many benefits from cooperatives if it is established new cooperatives or made some administrative reform of existing cooperatives. Cooperative can buy required equipments and farmer can rent it from cooperative. By the way, provided job opportunities for eager young people. That's why, input costs of farms are reduce and farmers can be self-sufficient in terms of roughage needs. At the same time, farmers will get rid of the problem of climatic drying and better quality feed will be used.

Most of farmers have informed about grass silage by means of this research. As a general, farmers have positive attitudes towards making grass silage. But, they needs technical information on silage making and cattle husbandry. For this reason, organizing farmer education programs and extension work is very important. To be successful in organized programs, technical personal of Food Agriculture and Livestock Ministry as well as independent veterinarians must be trained well in this regard. Thus, it is reduced to loss of confidence against the technician. Especially, if it is started to training and extension from leader farmers who have more animals and more technical capacity, it can be accelerated the adoption of grass silage making.

It can be provided that all farmers are informed about training and extension activities via media. Especially, television is most effective media tool in the research area. After informed stage of this new technic, it is very important that technical information provided to interested farmers to improve their technical information level. Unless it is successful this stage, adoption and diffusion of silage is failure. At this point, to use of group methods or individual methods can be more effective. In the research area, there must be technical personal who trained about silage and, also, there must be leaflets, brochures, booklets, etc. documents prepared as a professional related to silage making.

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<sup>17</sup> Included cost of labour and fuel

<sup>18</sup> Included cost of silo

<sup>19</sup> Included cost of labor and fuel (15 ₺) and cost of amortisation, repair and maintenance, etc. (2,39 ₺)

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## A SUSTAINABLE MODEL FOR CONSERVATION AND UTILIZATION OF NATIVE CHICKEN GENOTYPES OF TURKEY

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### ABSTRACT

Increased global use of highly productive breeds of farm animals has been associated with a loss of genetic diversity in most species, especially in local poultry species in most developing countries around the world. In developing countries, the effects of genetic loss have been much more severe than in developed countries. Similarly in Turkey, with its increasing urbanization, the contribution of commercial breeds to overall poultry meat and egg consumption is growing ever more rapidly. This has triggered the use of commercial hybrids and caused genetic loss in Turkish local poultry species and breeds thus recently only two registered Turkish chicken breeds are conserved in closed flocks by ministry. It is known that conservation of poultry breeds plays an important role in safeguarding farm animal biodiversity. Current conservation strategy on these two local chicken breeds has some deficiencies and needs to be update. In this context, this study has aimed to put out a sustainable conservation model for local chicken genotypes to contribute to future plans for conservation of local poultry resources in Turkey.

**Keywords:** Sustainable conservation, valorization, local chicken breeds, genetic erosion, biodiversity

### INTRODUCTION

Over the past 50 years, poultry meat and egg production from individual birds in commercial flocks of broilers and layers has increased enormously, largely owing to genetic selection in the nucleus breeding flocks of poultry breeding companies and the rapid transfer of these gains to the commercial crossbred progeny. On the other hand, current-breeding strategies for commercial poultry concentrate on specialized production lines, derived by intense selection from a few breeds and very large populations with a great genetic uniformity of the traits under selection. This has resulted in genetic erosion for the unselected local breeds, which are normally less productive than synthetic hybrids (Notter, 1999; Besbes et al., 2007).

In developing countries, the effects of genetic loss have been much more severe than in developed countries. Similarly in Turkey, with its increasing urbanization, the contribution of commercial breeds to overall poultry meat and egg consumption is growing ever more rapidly (FAO, 2004). This has triggered the use of commercial hybrids and caused genetic loss in Turkish local poultry species and breeds. Although Turkey has a great potential for biodiversity given its peculiar climate, geographical and cultural characteristics, today only two local chicken breeds, Denizli and Gerze, are registered and currently part of a General Directorate of Agricultural Research and Policy of Turkey (GDAR) conservation programme in closed flocks. This kind of conservation is however debatable, as it may cause increased homozygosity and genetic loss from the breeds, and is also potentially risky for epidemic diseases. In this perspective, a more effective conservation programme that includes different activities, such as improving knowledge of biological functions, conserving typical morphological characteristics, developing selection strategies, controlling inbreeding and, finally, agreeing valorization strategies to diffuse the breed in local production systems should be implemented (Özdemir et al., 2013). As a starting point for stopping the deterioration in poultry genetic resources and local chicken breeds of Turkey, this study has aimed to put out a sustainable conservation model for local chicken genotypes to contribute to future plans for conservation of local poultry resources in Turkey.

### MATERIAL AND METHODS

Recently, two chicken breeds, Denizli and Gerze are under conservation in limited population size and in closed flocks by Lalahan Central Livestock Research Institute since 1997 (Turkish Regulation, 2004; Ministry of Food, Agriculture and Livestock, 2011). It is known that this kind of conservation is very risky for two major threats: the first threat is the increasing homozigosity that leads to loss of genetic variability. The second threat is the transmission of epidemic diseases, and whole flocks can be lost. In addition to its risks, this kind of conservation is also most expensive method. Therefore, some urgent steps are needed to avoid these risky situations and to design a sustainable conservation scheme as listed below:

- Breeders need to be supported to act in conservation local poultry breeds. In this case, non-governmental organizations such as breeders associations need to be established. These associations would be very important for finding market for local products and also for the sustainability of the conservation.
- Breeding systems have to be changed. Institutes need to be getting rid of closed flock system. Breeds must be reared in different small flocks at different place of the region to avoid the epidemic diseases.
- A well-designed recording system is needed for poultry breeds of Turkey. This would be very important for monitoring the status of the breeds and also the data for the network among organizations.
- Phenotypic and genetic characteristics of the breeds need to be well described. For characterization, biotechnological tools would be the most beneficial instruments. In order to benefit by these techniques, specialized labor is needed that can be easily found in universities and research institutes. These instruments would be essential for determining inbreeding, heterogeneity, traceability of products, food security etc.
- Niche markets may be vital for the survival of many local breeds, which cannot compete with higher-producing exotic breeds in mass markets. To highlight the quality of products of local poultry breeds would make a contribution to sustain their conservation. In this case, with the support of government, non-governmental organizations, firms and media, it can be called attention to local products of poultry breeds.
- In addition to niche markets, some new trends like agro-tourism can be used to support breeders and conservation of breeds. This kind of activities may also be helpful to cover much new ground of the region besides supporting the conservation of breeds.
- A very comprehensive network is needed among government, non-governmental organizations, breeders, universities, research institutes and market place.
- A comprehensive government policy is needed for the conservation of poultry resources which must cover and support the breeder' needs in conservation scheme.

Denizli fowl subpopulations in breeders' stocks in Denizli and its surroundings were used as animal material of this study for designing a sustainable conservation scheme for local poultry breeds of Turkey. Although the origin of this breed is Denizli, because of its long crowing feature, interested breeders in 25 different cities of Turkey rear the breed. Because of the sufficient population size Denizli breed was selected as animal material for the study.

## RESULTS AND DISCUSSION

This study was aimed to plan and implement an effective conservation model for Denizli chicken breed with participation of breeders. For a starting point, the study was conducted in Denizli and its surroundings with 16 Denizli fowl breeders. In the beginning of the study some seminars were held in Denizli to give information to breeders about the conservation model and the importance of the study. In addition to seminars, the subject of the study was released as a documentary on Turkish national channel in 2013 (TRT, 2013). By these facilities, awareness has been created in the social sense. After the seminars in March 2013, "Denizli Fowl Breeders' Association" was founded with 41 Denizli fowl breeders from Denizli city and its surroundings. Currently, the number of the members of this association has reached to 56. By this stage, founding the Breeders' Association, the first and the most difficult step was completed.

In the study, subpopulations of Denizli fowl were selected from eight different regions of Denizli (Denizli, Acipayam, Güney, Tavas, Serinhisar, Çameli, Kale and Çal) thus epidemic disease-related losses of the whole stock flock will be prevented.

In breeders' subpopulations, phenotypically selected birds 800 birds (600 females and 200 males) were wing-banded and recorded individually. In this way the first comprehensive animal record of a Turkish native chicken breed was built up based on breeders' subpopulations. While the Denizli chicken is characterized by black plumage all around the body, breed's males have five color varieties (pamuk kir, demir kir, pekmez kefi, al and siyah) that were common characterized by a single comb, white earlobes, up-curved tail feathers and dark shanks. These phenotypic characteristics were considered in selection of subpopulations. Up to founding the breeders' association and animal selection steps, all facilities were done with the own support of researchers, breeders, local firms and local government. To complete the subsequent stages of this conservation scheme, following steps must be completed:

➤ **Breeding Practices in Selected Subpopulations**

Veneto Co.Va conservation scheme described by Özdemir et al., (2013) will be applied to selected subpopulations. According to this scheme, each subpopulation flock will consist of 30 females and 20 males; males will be divided in two distinct groups (families) based on genetic relations estimated at the beginning by using molecular markers information. Females of each subpopulation will be grouped all together. The two families that originate from the two male groups will be maintained through the years. The reproduction season will start in February and birds will be hatched from April to June. The first group of males will be used to fecundate females for a maximum period of 3 weeks; eggs will be collected and hatched. Each reproduction period will end when 90 weaning chicks per breed per flock are attained (180 chicks per subpopulation). At hatch, chicks will be individually tagged with wing tags. At the end of April the reproduction programme will finish and chicks will be placed in a unique box. In October, new males and females will be selected for using in the next season.

➤ **Genetic Monitoring**

In addition to phenotypic selection, genetic characterization of subpopulations through the use of molecular markers associated to powerful statistical approaches is needed. Microsatellite markers will be used for genetic monitoring of the subpopulations. These marker assisted applications will allow us to follow inter and intra genetic situation of subpopulations. While using this technique can help to preserve allelic diversity and the existing genetic variation, they will also be useful for genetic traceability purposes. Tracing the breed of origin of animal products represents an opportunity for the promotion of local genetic resources with benefits for local economy, breed valorisation and sustainable conservation of biodiversity.

➤ **Niche Markets and Supporting Rural Economy for Denizli Fowl Products**

Although the local poultry species cannot compete with higher-producing exotic breeds in mass markets, they are kept for as a means of sustaining or improving livelihoods in rural areas. There are a lot of studies carried out on local poultry especially chickens were found to play a very important role in the economy of rural regions of countries (Cassandro et al., 2004; FAO, 2006, 2009; Singh and Fotsa, 2011). Similarly in Denizli, breeding Denizli fowl contributes to family income in rural. Today Denizli fowl breeders can sell their long crowing Denizli roosters in high prices (250 to 2000 TL). Moreover, Denizli chickens (150 to 500 TL) and also their fecund eggs (10 to 25 TL) can find buyers at higher prices. For regulating the sales of Denizli fowls, Breeder' Association is organizing auction sales. In addition to these positive developments, niche markets are still needed to highlight the quality of products of local poultry breeds so this would make a contribution to sustain their conservation. In this case, with the support of government, universities, non-governmental organizations, companies and media, it can be called attention to local products of Denizli breed.

**CONCLUSION**

Conservation of poultry breeds plays an important role in safeguarding of farm animal biodiversity; it could have a relevant role in developing new high quality products for niche markets and also represents an important tool to preserve and support the rural economy in some marginal agricultural areas. It is clear that local poultry breeds cannot compete with high potent commercial ones with their low meat and egg production, but they are also maintained for their cultural values. Their survival will depend on future changes in rural societies; this raises the global issue of how development will be managed in countries where village chickens are still numerous (Besbes et al., 2007). Moreover, developing countries such as Turkey may consider that they should not depend on a few international companies for supplying poultry meat and eggs. Therefore Turkey needs a well-planned sustainable conservation programme for poultry breeds and species that requires a political, economic and technical support of international, national and local organizations. In this context biotechnological tools will make an advantage to the management of genetic resources. Today the first problem to overcome for Turkey is the determination of the local poultry species and breeds, their numbers and risk status. In Turkey there are poultry breeds and species which are only known by native population such as partridges breeds (Kinalı, Ur etc.), many pigeon breeds (Dolapçı, Bango, Makaracı, Tahtalı etc.), goose breeds in Kars, duck breeds (Gövel, Elmabaş etc.) but unfortunately none of them are registered and there is no information about their genetic, morphologic, physiologic or performance characteristics. The current study is the first sustainable conservation model on a local poultry breed with the participation of breeders. Consequently, it is expected that resulting of this study will serve as an important model for subsequent studies on the other poultry breeds and species of Turkey.

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## COMPARATIVE ANTHELMINTIC EFFICACY OF CHLOROFORMIC AND METHANOLIC EXTRACTS OF CORIANDRUM SATIVUM AND IVERMECTIN IN SALT RANGE SHEEP

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### ABSTRACT

The Methanolic extract (ME) and Chloroformic extract (CE) of *Coriandrum sativum* (*C. sativum*) were evaluated in comparison with ivermectin to cover the anthelmintic resistance in Salt Range sheep. A total of 60 sheep positive for nematodes were selected and randomly divided into 6 groups having 10 animals in each group. The animals of group A was kept Un-treated control. Group B was given ivermectin at the dose rate of 0.2 mg/kg body weight subcutaneously. The animals of Group C and Group D were given the CE of *C. sativum* at the dose rate of 50 mg/kg body weight and 100mg/kg body weight respectively. The Group E and Group F were given the ME of *C. sativum* at the dose rate of 50 mg/kg body weight and 100 mg/kg body weight respectively. Fecal eggs per gram (fecal EPG) tests were carried out on day 7, 14 and 28. The percent efficacy of ivermectin was 81.4%, 87.17% and 92.6% on day 7<sup>th</sup>, 14<sup>th</sup> and day 28<sup>th</sup> respectively. The percent efficacy shown by the CE at maximum dose (100 mg/kg body weight) was 10.7%, 17.72 and 24.41 on day 7<sup>th</sup>, 14<sup>th</sup> and 28<sup>th</sup> respectively. The percent efficacy of ME given to Group F was 44.76%, 56.27% and 60.69% on day 7<sup>th</sup>, 14<sup>th</sup> and day 28<sup>th</sup> respectively. From this study it was concluded that ME of *C. sativum* has maximum anthelmintic effect at the highest dose used in the study.

**Keywords:** Methanolic extract, Chloroformic Extract, *Coriandrum sativum*, anthelmintic resistance, percent efficacy

### INTRODUCTION:

Helminthiasis is one of the most important problems worldwide in reflecting heavy production losses in grazing animals. The disease is especially prevalent in developing countries in association with poor management practices and inadequate control measures (Akhtar et al. 2000). An integrated approach for the control of helminthes includes strategic use of anthelmintics and careful management of the grazing lands will be required (Maritorena-Diez et al. 2005).

The use of the anthelmintics has been practiced for many decades to obtain optimal performance in ruminant livestock production. The anthelmintic practice typically relies on the use of highly efficacious broad spectrum anthelmintics (Geary et al. 2012). A great variety of anthelmintics are available for the treatment of helminthes in sheep belonging to the tetrahydropyrimidine, benzimidazole, probenzimidazole and imidazothiazole groups (Hidalgo-Argüello et al. 2002). However, some have low efficacy against the nematodes while others have pronounced efficacy depending on the dose rate used and sometimes double or triple dose and repeated treatments are required. Benzimidazoles, imidazothiazoles and milbemycins are the most important groups of anthelmintics used for the control of helminthes in ruminant species (Entrocasso et al. 2008).

The introduction of Macolides or macrocyclic lactones i.e. ivermectin and moxidectin have resulted in a dramatic reduction in the incidence of clinical parasitic gastroenteritis and bronchitis in first year grazing cattle. Macrocylic lactones are the dose-limiting species for the current endectocide anthelmintics (Taylor et al. 2001). Ivermectin belongs to the Avermectin group of the macrocyclic lactone of that is commercially available in several formulations to treat parasitic infestations in cattle, dogs, horses and sheep. Ivermectin has wide range of activity from nemateodes to ectoparasites. Ivermectin has no activity against Platyhelminths (tapeworms and flukes). It has a broad spectrum of endectocidal activity and is widely used in many species of animals. The macrocyclic lactones i.e. ivermectin and moxidectin acts as agonists of a family of invertebrate-specific inhibitory chloride channels that are activated by glutamic acid. Moxidectin has been available as a pour on formulation and an aqueous-based injectable formulation for cattle (Maritorena-Diez et al. 2005).

Development of anthelmintic resistance to commercially available drugs has become a serious problem. In Pakistan, one of the important factors of high prevalence of nematodes in sheep may be the treatment failure with the commonly used anthelmintics. The increasing prevalence of anthelmintic resistant strains of helminthes,

drug residues in animal products and high cost of conventional anthelmintics have created an interest in studying medicinal plants as an alternative source of anthelmintics (Tariq et al. 2008). *Coriandrum sativum* which belongs to family Umbelliferae is highly reputed ayurvedic medicinal plant commonly known as the Dhanyaka. It contains monoterpenes,  $\alpha$ -pinene, limpnene,  $\gamma$ -terpinene, p-cymene, borneol, citronellol, camphor, geraniol, coriandrin, dihydrocoriandrin, coriandrons A-E, flavonoids and essential oils. Various parts of this plant such as seeds, leaves, flowers and fruits, possess diuretic, antioxidant, antidiabetic, anticonvulsant, sedative, hypnotic, antimicrobial, antimutagenic and anthelmintic activity (Pathak et al. 2011). In this study it was planned to compare the anthelmentic activity of Ivermectin (oral) and Chloroformic and Methanolic extracts of *Coriandrum sativum* whole plant against the mixed nematodal infestation in sheep.

#### MATERIALS AND METHODS:

The present study was carried out at Department of Pharmacology and Toxicology in collaboration with Barani Livestock Production Research Institute (BLPRI) Kherimurat, district Attock, Punjab. The study was completed in three months in which the anthelmintic efficacy of Choloroformic extract and Methanolic extract of *Coriandrum sativum* at different doses were evaluated in comparison with ivermectin.

#### Collection and Identification of the plant

Approximately 14kg *Corriandrum sativum* whole plant was collected from the district Okara. The whole palnt was identified from the Department of Botany, Government College and University (GCU) Lahore. The reference number (Ref. No.) allotted to the plant was Gc. Herb. Bot. 2728.

#### Drying and grinding of the plant

The collected plant leaves were shade dried for 28 days. After drying, the leaves produced a dry mass of 1.5 kg. The dried plant leaves were crushed with an electric blender machine and placed in the polythene bags to avoid any type of contamination for future use.

#### Preparation of plant extract

The Chloroformic extract of the *Coriandrum sativum* whole plant was prepared by taking the 50g powder of *Coriandrum sativum* and rinsed it with 500ml of chloroform taken in the flask within the Soxhlet apparatus at 60°C (Obame et al. 2013). The Methanolic extraction of *Coriandrum sativum* was done by using three grams (3 g) of ground spearmint plant and 150 ml of methanol as a solvent for 6 hrs (Reference) In order to evaporate the solvent, the extract was then fed into the vacuum rotary evaporator at 40°C. The final drying of the extract was done by using CO<sub>2</sub> incubater at 37°C for 24 hours (Bimakr et al. 2011).

#### Experimental design

Sixty sheep positive for nematodes were randomly selected from the Barani Livestock Production Research Institute (BLPRI) Kherimurat, District Attak (Punjab) Pakistan. Experimental animals were divided into 6 groups (A, B, C, D, E and F) having 10 sheep in each. The animals of group A were kept as un-treated control. The animals of group B was given Ivermectin (orally) at the dose rate of 0.2 mg/kg body weight. The animals of Group C and D was treated with Chloroformic extract of *Coriandrum sativum* whole plant at the dose rate of 50 and 100 mg/kg body weight respectively. The animals of Group E and F were treated with methalonic extract of *Coriandrum sativum* whole plant at the dose rate of 50 and 100 mg/kg body weight respectively.

#### Sample collection

Fecal samples were collected directly from rectum on 0, 7, 14 and 28 day post treatment.

#### McMaster egg counting technique

Fecal eggs count (eggs/g) tests were done by using the modified McMaster technique by mixing 2 gm of feces in 28 ml of saturated salt solution (Maritoren-Diez et al. 2005). The McMaster chamber was observed under the 100x magnification. The number of eggs was calculated in the chamber by performing the following calculations.

EPG = Total number of calculated eggs in one of the chamber  $\times 100$ .

EPG = Eggs per gram feces in one of the chamber.

## CALCULATIONS:

Percentage efficacy was calculated by applying the following formula:

$$\text{Percent efficacy} = \frac{a - b}{a} \times 100$$

Where,

a = EPG premedication.

and

b = EPG post medication.

## STATISTICAL ANALYSIS:

The data obtained from the experiments in eggs/gram feces were analyzed by calculating mean fecal eggs per gram of feces and ANOVA.

## RESULTS:

In this study the anthelmintic efficacies of Chloroformic and Methanolic whole plant extracts of *Coriandrum sativum* and ivermectin were evaluated. Mean EPG of the group A on day 0 was 1740.00, on day 7 was 1815, on day 14 was 2025 and on day 28 was 2220. Percent increase in EPG on day 7 was 4.13%, and on day 14 was 14.07 % and on day 28 was 21.6 %. The animals of group B were given the standard drug ivermectin drench at the dose rate of 0.2 mg/kg body weight. The mean EPG of the group B on day 0 of the treatment was 1910.00, on day 7 was 355, on day 14 was 245 and on day 28 was 140. The percent efficacy of the group B was calculated to be 81.4 %, on day 7, 87.17 % on day 14 and 92.60 % on day 28 post treatment.

The animals of group C were treated with the Chloroformic extract of the *Coriandrum sativum* whole extract at the dose rate of 50 mg/kg body weight by oral route. The mean EPG of the Group C on day 0 was 1655.00, on day 7 was 1855, on day 14 was 1930 and on day 28 was 2135. It was observed that there was increase in EPG on day 7 post treatments (10.7 %), on day 14 post treatment (14.24%) and day 28 post treatment (22.48%). The Chloroformic extract of *Coriandrum sativum* has no therapeutic effect at the dose rate of 50 mg/kg body weight.

The group D was treated with Chloroformic extract of the *Coriandrum sativum* whole extract at the dose rate of 100 mg/kg body weight. The mean EPG of the group D on day 0 was 1625.00, on day 7 was 1820 , on day 14 was 1975 and on day 28 was 2150. Percent increase in EPG on day 7 post treatment was 10.7 %, on day 14 and day 28 was 17.72 % and 24.41 % respectively. No anthelmintic effect was recorded at the dose rate of 100 mg/kg body weight.

The animals of Group E were treated with the Methanolic extract of the *Coriandrum sativum* whole extract at the dose rate of 50 mg/kg body weight orally. The mean EPG of the group E on day 0 was 2210.00, on day 7 was 1750, on day 14 was 1610 and on day 28 was 1470. Percent efficacy of Methanolic extract of *Coriandrum sativum* at the dose rate of 50 mg/kg body weight was 20.81 % on day 7, 27.14 % on day 14 and 33.48 % on day 28.

The animals of group F were treated with 100 mg/kg body weight Methanolic extract of *Coriandrum sativum* whole extract. The mean EPG on day 0 was 2150.00, on day 7 was 1080, on day 14 was 940 and on day 28 was 845. Percent efficacy of 100 mg/kg body weight Methanolic extract of *Coriandrum sativum* was 49.76 % on day 7, 56.27 % on day 14 and 60.69 % on day 28.

From the above results it was concluded that *Coriandrum sativum* whole Methanolic extract at the dose rate of 100 mg/kg body weight has maximum anthelmintic effect. Summary of all the above discussion is given in the Table 1.

**Tab. 1: Effect of medication on egg per gram (fecal EPG) on day 0, day 7, day 14 and day 28.**

Groups	Average EPG ±S.E				% change in EPG		
	Day 0	Day 7	Day 14	Day 28	Day 7	Day 14	Day 28
A	1740 ±191	1815 ±153.8	2025 ±169.8	2220 ±133.1	4.13↑	14.07↑	21.6↑
B	1910 ±210	355 ±30.2*	245 ±15.7*	140 ±16.3*	81.4↓	87.17↓	92.6↓
C	1655 ±124	1855 ±137.5	1930 ±170	2135 ±192	10.7↑	14.24↑	22.48↑
D	1625±98.6	1820 ±85.7	1975 ±79.6	2150 ±83.6	10.7↑	17.72↑	24.41↑
E	2210 ±160	1750 ±112*	1610 ±129*	1470 ±125.2*	20.81↓	27.14↓	33.48↓
F	2150 ±201	1080 ±76.4*	940 ±75.2*	845 ±83.8*	49.76↓	56.27↓	60.69↓

Superscripts (\*) with columns show the significance difference at  $p < 0.05$ .

EPG = egg per gram, S.E Standard error, ↑=increase in EPG, ↓=decrease in EPG.

By comparing the groups, no significant difference ( $P > 0.05$ ) was found between control and group C and D treated with Chloroformic extract of the *Coriandrum sativum* whole extract at the dose rate of 50 and 100 mg/kg body weight orally. A significant difference was recorded between control and Ivermectin treated group ( $P < 0.05$ ) and group E and F treated with Methanolic extract of *Coriandrum sativum* whole extract at the dose rate of 50 and 100 mg/kg body weight orally  $P < 0.05$  and  $P < 0.05$  respectively (Table-2).

## DISCUSSION:

In the present study, 100 mg/kg body weight Methanolic extract of *Coriandrum sativum* whole extract showed good antianthelmintic effect. Although 50 mg/kg body weight Methanolic *Coriandrum sativum* whole extract also showed some decrease in EPG. Similarly the hydro-alcoholic and crude aqueous *Coriandrum sativum* extract have good anti-nematodal effect along with egg hatching inhibition. One study conducted on *Zanthoxylum zanthoxiloides* leaves alcoholic extract when given at the dose rate of 2.4 mg/ml caused 30-40% control in egg hatching of *Haemonchus contortus* (Hounzangbe-Adote et al. 2005). Similarly the *Ocimum gratissimum* essential oil was used at 0.5% concentration for control of egg hatching (100%). In one of the studies, the *Coriandrum sativum* did not show any significant results against nematodes. As we know that helminthes take substance in the form of non-nutrient or non-electrolyte through cuticular diffusion method. Due to this, the oral ingestion is mainly opposed by many parasites as all the broad spectrum anthelmintics are diffused through these cuticular diffusion methods (Geary et al. 1999). In this study, it was observed that the methanolic extract of *Coriandrum sativum* to that of the standard ivermectin drug showed better results at both doses. This may be due to better trans-cuticular transport of methanolic extract than the chloroformic extract. Similarly the anthelmintic effect of hydro alcoholic extract of *Coriandrum sativum* seed was found good as compared to the aqueous extract due to the presence of non-polar organic molecules (Debella, 2002). The hydroalcoholic extract provide the good anthelmintic effect due to high lipid solubility and best anthelmintic activity as compared to aqueous extract. Lipid soluble anthelmintics have high capability of cuticular absorption as compared to water soluble substances (Geary et al. 1999).

Similarly the *Artemisia brevifolia* methanolic extract used in vitro against adult *Haemonchus contortus* at 25 mg/ml concentration provide the best results as compared to aqueous extract (Iqbal et al. 2004). In another study efficacy of aqueous extract of *Coriandrum sativum* was checked against *Haemonchus contortus*. After two days of treatment, no stronger effect was seen which may be due to high concentration of extract in early days and its effect got faded on later days (Athanasiadou et al. 2001). Higher efficacy was observed when extract was given at higher doses or given at repeated doses (Prichard et al. 1978). Same was the case in this study, when animals were treated with higher dose of *Coriandrum sativum* methanolic extract gave better results. It was concluded that methanolic extract of *Coriandrum sativum* would be the best alternative as antinematodal drug.

## CONCLUSION:

It is concluded that the Methanolic extract of the *Coriandrum sativum* whole plant have good anthelmintic effect against nematodes in sheep.

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## BRUCELLOSIS INFECTION IN LOCAL AND EXOTIC CATTLE OF PUNJAB, PAKISTAN

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### ABSTRACT

Brucellosis is major zoonotic diseases of human and animal. This disease has serious implications for animals and human health. Only limited numbers of studies are available in Pakistan which do not provide necessary information about prevalence of brucellosis and its causative agent in local and exotic cattle breeds in country. So, present study was conducted to determine prevalence and the causative agent of brucellosis in local and exotic breeds of cattle in Punjab Pakistan. Serological and molecular based techniques were used in present study. A total of 399 blood samples (250 local breeds and 149 exotic breeds) were collected from different livestock farms. Samples were initially screened for Brucella abortus antibodies using Rose Bengal plate test (RBPT). Serum samples positive in RBPT were confirmed using Serum agglutination test (SAT). Further quantitative real-time polymerase chain reaction (qRT-PCR) based molecular detection of DNA for Brucella genus (BCSP31), Brucella species specific (IS711 for Brucella abortus and Brucella melitensis) was done for seropositive serum samples. A total of 20 (5.01%) animal were found seropositive for Brucella antibodies. Seroprevalence of brucellosis was higher in exotic breeds 9 (6.04) compared to local 11(4.4%). Out of six local breeds (Achai, Cholistani, Dhani, Lohani, Red Sindhi, Sahiwal) of cattle, highest seroprevalence were found in Lohani 6 (6.12%) and lowest in Achai 0 (0.0%). In case of exotic breeds, seroprevalence was higher in Australian cattle's 5 (6.76%). Out of 20 serum samples positive in serology, 13 (65%) were positive in Brucella genus (BCSP31) and Brucella abortus (IS711) specific qRT-PCR. None of seropositive serum samples were positive for Brucella melitensis (IS711) specific qRT-PCR. The present study provides the evidence that Brucella abortus is the causative agent of cattle brucellosis in Pakistan. Results of present study can be used for development of affective brucellosis control and eradication program.

**Keywords:** Brucellosis, Cattle, Exotic, Local, Pakistan

### INTRODUCTION

Brucellosis is infectious zoonotic disease which affects both animal and human being. It is widely spread zoonotic disease in world (Poester et al., 2002; Ali et al., 2015). Brucellosis is endemic in many countries and is the major causative agent of decrease in milk production, abortion, stillbirth, metritis, retained placenta, dystocia, orchitis and epididymitis in dairy animals. Apart from animals, humans having close association with these animals also affected by brucellosis (Kumi-Diaka et al., 1980; McDermott and Arimi., 2002; Godfroid et al., 2004; Ocholi et al., 2004; Adamu, 2009; Ali et al., 2013). Although, Brucella abortus is the main causative agent of brucellosis in bovine but other Brucella species can also infect, where these dairy animal having close contact with other animals like goat etc. (Bale et al., 1982; Ocholi et al., 2004; Pandian et al., 2015). In case of animals infection mostly occurs by contaminated water, food, vaginal secretions, conjunctiva and insemination by contaminated semen and in case of human contact with animal body secretions and use of raw milk from Brucella infected animals are major causes (Nicoletti, 1980, Ali et al., 2013). Pakistan is agriculture country where most of the peoples live in rural area and livestock is major source of their food and income. In rural area, mostly local breed of cattle's are reared but for large production of milk, exotic breeds also reared. Prevalence of brucellosis in bovine based on serological tests is documented from different areas of Pakistan and great various in prevalence of brucellosis (6.92% - 10.18%) is reported (Munir et al., 2011; Shafee et al., 2011). However, little is known about the status of brucellosis in local and exotic breeds of country, which have a major share in our dairy production. Keeping in view the economic importance of cattle breeds and brucellosis as zoonotic agent, the present study was designed to determine the prevalence of brucellosis and to investigate the causative agent of brucellosis of local and exotic cattle breeds of Pakistan using serological and molecular methods.

## MATERIALS AND METHODS

### Study area and blood sampling

The present study was conducted in Potohar region, Pakistan. It is situated in northeast of country and surrounded by Jhelum River, Indus River, Kala Chitta Range/Margalla hills and Salt range from east, west, north and south, respectively. Due to arid zone, crop like wheat, tobacco, barely, sorghum, melons, legumes and onions mostly depend on rain water. The study area is situated in Punjab province and divided into five major districts including Attock, Chakwal, Jhelum, Rawalpindi and Islamabad capital territory. Livestock species like cattle, buffaloes, sheep and goats are most important here and mostly depended on grazing area. However, local cattle species are important source of food in rural areas. For present study, a total of 399 blood samples (250 local breeds and 149 exotic breeds) were collected from different livestock farms. Blood (3ml) samples were collected directly from jugular vein of animals with the help of 5ml syringe. Each blood sample was transferred into non-EDTA coated vacutainer, place a room temperature for 30 minutes, centrifuges at 4000 rpm for 15 minutes and sera was separated in 1.5 ml eppendorf and stored at -20°C, until further analysis.

### Rose Bengal plate test (RBPT)

Serum samples were screened initially using RBPT, purchased from Veterinary Research Institute (VRI), Lahore, Pakistan. Initially screening of serum samples for *Brucella abortus* antibodies was done using RBPT according to standard procedure (Alton et al., 1988). For this purpose, enough RBPT antigen and samples were kept and room temperature. About 30 µl of serum sample was taken on glass slide; add 30 µl of RBPT antigen, mixed serum and antigen thoroughly with the help of stick, rotate slide for 4 minutes and note. If any agglutination occurred then samples is positive for *Brucella abortus* antibodies and vice versa.

### Serum agglutination test (SAT)

Serum samples positive in RBPT were confirmed using Serum agglutination test (SAT) according to standard procedure (Alton et al., 1980). For this purpose, SAT antigen was purchased from Veterinary Research Institute (VRI), Lahore, Pakistan. A sample having titer 160 or above was considered as positive for *Brucella abortus* antibodies.

### DNA extraction

DNA extraction was done from seropositive serum samples using the High Pure PCR Template preparation kit (Roche Diagnostic, Germany). Purity and concentration of DNA in each sample was tested using Nano-Drop ND-1000 UV-Vis spectrophotometer (Nano-Drop technologies, USA). Finally, DNA samples were stored at -20°C until further analysis.

### Quantitative real-time polymerase chain reaction (qRT-PCR)

Further quantitative real-time polymerase chain reaction (qRT-PCR) based molecular detection of DNA for *Brucella* genus (BCSP31), *Brucella* species specific (IS711 for *Brucella abortus* and *Brucella melitensis*) was done for seropositive serum samples, as describe by Probert et al (2004). Detail of primer and probe is given in Table 1 and 2. Cut-off value of cycle threshold (Ct) for a positive sample was ≤ 40.

## RESULTS AND DISCUSSION

The current study was done in Potohar region of Punjab province, Pakistan to determine the seroprevalence of brucellosis in local and exotic cattle breeds. Moreover molecular method was also used to confirm the prevalent *Brucella* species. A total 20 (5.01%) serum samples were found positive for *Brucella abortus* antibodies using Rose Bengal plate test (Table 3). A higher seroprevalence (37%) of brucellosis was reported from northern, Nigeria. Moreover, similar higher prevalence was investigated from other countries: 40%, 42%, 56%, 63%, in Zimbabwe , Ethiopia, Uganda and Brazil, respectively (Bernard et al., 2005; Aguiar et al., 2007; Berhe et al., 2007; Matope et al., 2011). One of the possible reasons behind the large difference of seropositivity for brucellosis between Pakistani and other countries cattle was the different in geographical region and management system of the countries.

Seroprevalence of brucellosis was higher in exotic breeds 9 (6.04) compared to local 11(4.4%). Out of six local breeds (Achai, Cholistani, Dhani, Lohani, Red Sindhi, Sahiwal) of cattle, highest seroprevalence were found in Lohani 6 (6.12%) and lowest in Achai 0 (0.0%). In case of exotic breeds, seroprevalence was higher in Australian cattle's 5 (6.76%). Possible reason behind this is that exotic breed was kept for milk production in large herd, where chances for separate of brucellosis are more. Because brucellosis is called disease of herds, as herd size increases possibility of spread of disease from one animal to other animal increases. However, local cattle are kept mostly at household level and in small number, which can be easily manageable and fulfilled the milk and fuel requirement of rural peoples.

Out of 20 serum samples positive in serology, 13 (65%) were positive in *Brucella* genus (BCSP31) and *Brucella abortus* (IS711) specific qRT-PCR (Table 4). So molecular detection based study confirmed the presence of *Brucella abortus* as the causative agent of brucellosis in local and exotic cattle breeds. Similar RT-PCR based studies also provided evidences of brucellosis from different animal species world widely (Amin et al., 2001; Hamdy and Amin, 2002; Wareth et al., 2014; Wareth et al., 2015).

None of seropositive serum samples were positive for *Brucella melitensis* (IS711) specific qRT-PCR. This is another indication that in Pakistani cattle breed *Brucella melitensis* is not prevalent. Although these cattle breed have close association with sheep and goat. In a recent study, it is confirmed via serological and molecular techniques that *Brucella abortus* is also the causative agent of small ruminant brucellosis in Pakistan (Ali et al. 2015). However, this study was conducted in a limited area and small number of animals. A detailed study will be beneficial to explore the reason behind this.

In conclusion, *Brucella abortus* is prevalent in cattle breeds of Pakistan. There is dire need of effective brucellosis control and eradication program to minimize the risk of human brucellosis in the country.

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**Table 1.** Primers for *Brucella* genus and species-specific qRT-PCR

qRT-PCR	Primer	Sequence (5' to 3')	Target
Brucella genus	Forward	GCTCGGTTGCCAATATCAATGC	bcsp31
	Reverse	GGGTAAAGCGTCGCCAGAAG	
B. abortus	Forward	GCGGCTTTCTATCACGGTATT	IS711
	Reverse	CATGCGCTATGATCTGGTTACG	
B. melitensis	Forward	AACAAGCGGCACCCCTAAAA	IS711
	Reverse	CATGCGCTATGATCTGGTTACG	

**Table 2.** Probes for *Brucella* genus and species-specific qRT-PCR

qRT-PCR Type	Sequence (5' to 3')
Brucella genus	6FAMAAATCTTCCACCTTGCCCTGCCATCABHQ1
B. abortus	6FAMCGCTCATGCTGCCAGACTTCAATGBHQ1
B. melitensis	6FAMCAGGAGTTTCGGCTCAGAATAATCCACABHQ1

## EFFECTS OF SOME FARM PRACTICES ON MILK PRODUCTION IN DAIRY FARMS OF SAMSUN PROVINCE OF TURKEY

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### ABSTRACT:

Raw milk production is largely managed by small-scale farmers in Turkey. Therefore, revealing region based husbandrial applications in dairy operations can be seen a major process. The objective of this research was to determine the association of some farm practices with milk production levels of dairy farms in Samsun province of Turkey. Data including daily milk yield per milking cow (DMY), age of farmer (AF), experience in dairy farming (ED), record keeping (RK), membership to cattle breeders association (MCBA), presence of silage storage (PS), number of person in milking (NM), number of person in feeding (NF) and number of person in barn cleaning (NC) were collected by interviews with seventy-one randomly selected dairy farmers. One-way ANOVA, Kruskal-Wallis and independent samples t-test were used for evaluating the effects of ED, AF and other factors on DMY, respectively. Finally, AF and MCBA significantly ( $P<0.05$  and  $P<0.001$ ) affected DMY, and the mean DMY was estimated to be  $8.890\pm5.692$  kg/cow.

**Keywords:** Cow, milk yield, dairy husbandry, management.

### INTRODUCTION

A general rule that genotype and environment are the mainly effective components of observed phenotypic variance in the herd. In spite of high genetic merit of a dairy cow, obtained milk yield may not reach to expected production level in negative environmental conditions. That's why, managemental applications play a crucial role in the animal operations. In many countries, some studies conducted on these subjects (Afzal et al., 2007; Novak et al., 2009) purposed to reveal optimum environment for the herds. Similarly, some investigations (Atasever et al., 2012; Keskin and Atasever, 2013) have been carried out to boost production levels of the animals in suitable conditions in Turkey. However, reports on the association of environmental factors with milk production level in dairy herds are still needed. Revealing effective factors on milk yield can attribute to income of dairy operations.

This study was aimed to determine the association of some farm practices with milk yield levels of dairy farms in Samsun province of Turkey.

### MATERIALS AND METHODS

A total of 71 farms were included in the study. Farms were located in Samsun province of Turkey, Bafra and Vezirkopru districts. The study area has the highest agricultural production region of the Black Sea region, Turkey (Demiryurek et al., 2008). Interviews (using questionnaires) were applied to randomly selected dairy owners in the districts. Records from the data set included average daily milk yield per milking cow (DMY), age of farmer (AF), experience in dairy farming (ED), record keeping (RK), membership to cattle breeders association (MCBA), presence of silage storage (PS), number of person in milking (NM), number of person in feeding (NF) and number of person in barn cleaning (NC). Effects of AF and ED on DMY were examined by analysis of variance (ANOVA) and means were compared by Tukey test. The linear model was as follows:

$$y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

$y_{ijk}$  is the observation value,

$\mu$  is the overall mean,

$a_i$  is effect of AF ( $i= 1, 2$  and  $3$ ),

$b_j$  is effect of ED ( $j=1,2$  and  $3$ ) and

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$e_{ijklm}$  is random error.

Effects of RK, MCBA, PS, NM, NF and NC on reproduction traits were analyzed by t-test. All statistical analyses were applied by SPSS 17.0 for Windows at the 0.05 significance level.

## RESULTS AND DISCUSSION

Table 1. Means (SD) of effective factors on DMY

Factor	n	Mean	SD
<b>AF</b>			
1	9	10.69 <sup>a</sup>	4.02
2	42	9.73 <sup>ab</sup>	6.47
3	20	6.32 <sup>b</sup>	3.45
<b>ED</b>			
1	30	10.05	6.29
2	15	8.99	5.57
3	26	7.48	4.85
<b>RK</b>			
1	37	10.61	4.91
2	34	7.01	5.94
<b>MCBA</b>			
1	25	11.95 <sup>A</sup>	6.95
2	46	7.22 <sup>B</sup>	4.06
<b>PS</b>			
1	37	9.49	0.84
2	34	8.23	1.07
<b>NM</b>			
1	46	8.38	6.11
2	25	9.82	4.78
<b>NF</b>			
1	51	8.36	5.71
2	18	9.37	4.54
<b>NC</b>			
1	49	8.50	5.76
2	22	9.75	5.55
Total	71	8.89	5.69

Different superscript letters in the same column indicate statistically significant differences (a,b: P<0.05; A,B: P<0.001), SD: standard deviation

AF: age of farmer, ED: experience in dairy farming, RK: record keeping, MCBA: membership to cattle breeders association, PS: presence of silage storage, NM: number of person in milking, NF: number of person in feeding, NC: number of person in barn cleaning

Factors affected on DMY are presented in Table 1. As seen that relatively young farmers achieved more raw milk from their cows. DMY means were significantly ( $P<0.05$ ) different in the first and third AF groups. It's attractive that DMY tended to drop with elevated AF.

In spite of no statistical difference was determined among ED groups, experience adversely affected DMY in the dairy farms and DMY means tended to decrease with later ED groups (Table 1. Really, this case can be assumed as a harmonious finding with AF results of the present study.). Actually, younger farm owners able to manage in husbandrial goals because of developed communication devices, internet using, interests or their higher energetic structures. Ozcatalbas et al. (2010) investigated the socio-economic factors in dairy farms of Antalya province of Turkey and they also determined a relationship between ED with DMY.

In contrast to this case, Masuku and Belete (2014) emphasized that experience in dairy farming is a factor that influenced the level of economic efficiency for smallholder farmers in Switzerland. The difference of findings in two studies might be stated the cause of the different structure of the farmers in the countries.

No statistical difference was found between two RK groups (Table 1). However, DMY was calculated as more than 30% in the farms in which records have been keeping. In this point, to ensure high amount milk, keeping records on the herd may especially be advised to farm owners. Really, Rhone et al. (2008) supported to this suggestion. The researchers also revealed that dairy farms in which kept records on individual animals had higher ( $P<0.05$ ) milk fat percentages and lower bacterial scores than farms that did not.

As seen from Table 1, MCBA positively affected DMY ( $P<0.001$ ). Actually, this finding can be evaluated with RK results. It can be pronounced that keeping the records is the most important benefit for membership to CBA.

Similar to ED and RK, no difference was determined between PS groups, statistically. In normally, it can be expected that silage using stimulates milk production in cow's body.

Interestingly, similar results were obtained among NM, NF and NC means (Table 1). More staff in the husbandrial applications of the farms had an advantage by DMY, but the difference was not significant, statistically. In this context, managing cows with more staff may be offered to dairy owners.

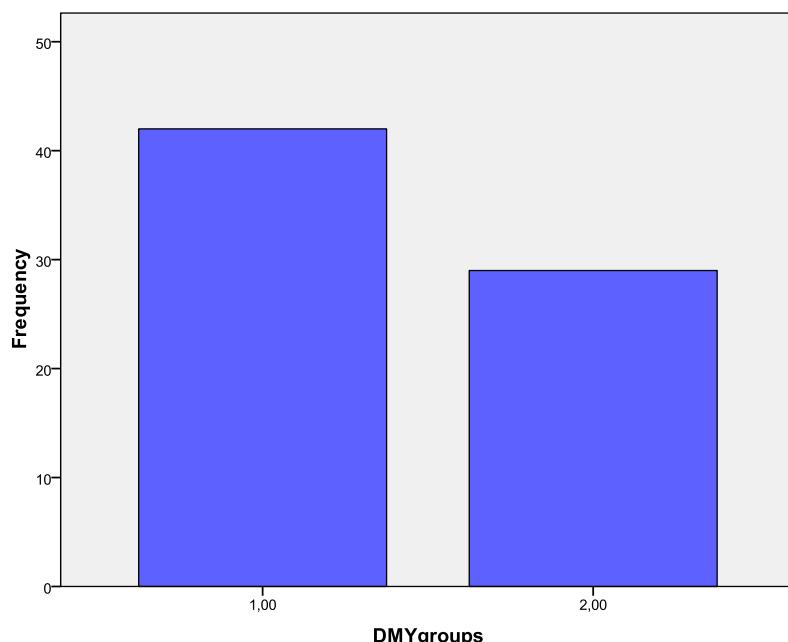


Figure 1. Distribution of DMY of cows (group 1: cows with DMY lower than 8 kg and group 2: those with DMY higher than 8 kg)

Finally, the mean DMY was estimated to be  $8.890 \pm 5.692$  kg/cow. This level might be evaluated as similar when compared to an investigation conducted on the farms of the same region (Demiryurek et al., 2008). A general distribution of cows in the investigated farms is presented in Figure 1. As seen that approximately 2/3 of the total cows had lower DMY than 8 kg per day.

## CONCLUSION

The findings of the present study revealed that relatively young dairy farmers and membership to dairy cattle organization positively affected milk production obtained from milking cows. To achieve more quantity bovine raw milk, closely observing herd's milk yield and focusing more meticulously on farm practices may be advised.

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## IMPROVING PHYTATE BOUND PHOSPHORUS BIOAVAILABILITY OF SORGHUM BY BROILERS USING PHYTASE ENZYME

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### ABSTRACT

High-density broiler production has resulted in the enormous amount of nutrients losses to soil contributing environmental pollution. Phosphorus leaching from poultry wastes due to partial digestion of phytate bound P in cereal grains has been a major concern. Feed enzymes can be used as an effective strategy to improve nutrient utilization by broilers and to keep environment safe. Targeting cereal's antinutritional factors with enzymes could enhance nutrients bioavailability. Phytase enzyme was added in three bioassay diet of sorghum (918 g/kg, sole source of protein) to observe phosphorus and nitrogen availability by broilers at day-21. Diets in mash form were prepared with (Acid insoluble ash; AIA) as an indigestible marker. Three diets, a control (PH-0) and to other were added phytase enzyme (10000 FTU/g) at level of 0.01% (PH-1) and 0.015% (PH-2). Feed, digesta and faecal samples were collected, processed and analysed using standard lab protocols for nitrogen, phosphorus and phytate. Ileal nitrogen digestibility was significantly enhanced (1.2 and 2.9 %, respectively) and faecal nitrogen loses were significantly reduced (42%) by birds in PH-2 group. Ileal phosphorus digestibility coefficient in treated groups were 0.51 (PH-1) and 0.53 (PH-2), respectively, to non-treated control group (PH-0; 0.40). Similarly enzymes supplemented groups had higher phytate digestibility (0.072 and 0.76, respectively). pH of the bedding material in phytase treated group was similar and numerically lower (6.6) to control group (7.4). These findings revealed that feed enzymes improved nutrient digestibility of sorghum and potentially can minimize nutrient losses to soil.

**Keywords:** Sorghum, broilers, phytase, nutrient digestibility

### INTRODUCTION

Poultry is a fast growing sector of Pakistan with tremendous potential to fulfil the growing demand of quality meat and eggs in the region. In the recent past poultry sector shaped on modernization however still a vast majority of poultry farming is practiced on traditional practices with haphazard expansion and lack of proper waste disposal resulting in some environmental pollution. Among other challenges faced by the poultry sector is the skyrocketing increase in poultry feed prices due increase in the prices of different of poultry feed ingredients. Sorghum grains are not potentially used in the poultry feed due to certain limitations though it can be grown effectively in dry regions with short rain fall. Replacement of expensive cereal with sorghum could be a strategy to reduce feed cost and to fully exploit its nutritive value that is almost to other cereals. It is however been frequently reported that birds fed on sorghum based diet perform poor compared to their counterpart birds feed on wheat or maize based diets (Bryden et al., 2009). The precise mechanisms causing variability in the nutrients composition and availability in sorghum are not clearly understood however, kafirin, phytate and certain polyphenols can negatively influence the nutrients digestibility of sorghum and has been reported as antinutritional factors (Bryden et al., 2009; Selle et al., 2010). Moreover sorghum protein exhibit heterogeneous nature (Duodu et al., 2003) having low digestibility. Phytate content of sorghum has been reported to be higher compared to other cereals (Selle et al., 2003) and tend to bind more nutrients and interfere enzymes action in the gastrointestinal tract. Certain processing conditions aggravate this further e.g. wet cooking and steam pelleting due to certain internal changes in bondings (Duodu et al., 2003). A number of approaches have been adopted to ameliorate the adverse effects of antinutritional factors and to maximise the nutritive value of sorghum for poultry including the application of feed enzymes. Phytase enzyme is effectively used globally to breakdown the phytate and to increase the availability of phosphorus and other phytate bound nutrients. This enzyme does not only improve nutrients utilization by birds but also assess environment due to reduced nutrients losses to soil from poultry production. Feeding sorghum in poultry diet often compromises performance of birds. This study was planned to monitor the impact of a phytase enzyme in a sorghum bioassay diet to assess the nutrients digestibility, pH of faecal material and release of phosphorus

### MATERIAL AND METHODS

All the bioassay procedures involved in present study involving birds were pre-approved by the University of Agriculture, Peshawar, Care and welfare Committee of Animals for Scientific Purposes.

Red sorghum was obtained from a commercial supplier of cereals and milled to use in all three bioassay diets. In each bioassay diet sorghum was used as the sole source of protein (918g/kg; Table1) to which phytase enzyme (10000

FTU/g) was added at two different levels i.e. 0.01% (PH-1) and 0.015% (PH-2). PH-0 served as control group. These diets were prepared in mash form by mixing the ingredients in balanced proportion in a mixer at the Poultry Research Unit of the University. Acid insoluble ash was added (20 g/kg of diet) as indigestibility marker. All assay diets were fed one week (including 3days of adaptation) from 14 to 21-days to male broiler birds in three experimental groups (4replicates/group; 10birds/Rep) in metabolic cages (3L x 3W x 2H ft) in an open sided shed. Birds had no restriction to excess water and feed. On day 21, all birds were killed humanely and lower half ileal (ilium was considered from Maeckles diverticulum to 40mm proximal ileocecal junction) contents were flushed with distilled water into cleaned plastic containers and were pooled per pen and were subsequently lyophilized. Feed intake was measured in last four days and faeces were collected, weighed during these days from trays in metabolic cages and processed. Birds in all cages were regularly monitored for any untoward incident.

### LAB PROTOCOLS

All feed, ileal and faecal samples were dried and milled in a grinder and were passed through a 0.5mm sieve prior to further lab processing. Dry matter was determined in duplicate by using 3 gram sample from all different experimental materials (feed, faeces and ileal contents) in an oven for 24 hrs at 105°C. Dry matter, organic matter, ash, crude fiber, ether extract and total nitrogen content of the grains and fecal samples were determined using standard procedures (AOAC, 2000). The N value was multiplied by 6.25 to obtain the crude protein content of the samples. Acid insoluble ash of feed and ileal digesta samples (about 2g feed, 1.2 g ileal digesta) was measured after ashing in electric furnace for 8 hrs at 500°C. After ashing, crucibles were placed in a crystallizing dish and boiled with 4N HCl. The procedure was completed as outlined by (Mollah et al., 1983). Gross energy (GE) of the diets and excreta was determined using an adiabatic bomb calorimeter standardized with benzoic acid (Sultan et al. 2014). Phytate contents of ingredients and digesta were analysed using the calorimetric method of Haug and Lantzsch (1983). Dry samples of feed and faeces were acid digested for mineral analyses as described by Sultan et al. (2014). The contents of Ca and P were determined with the help of Atomic Absorption Spectrometer.

### CALCULATIONS

$$\text{AME}_{\text{diet}} = (\text{Feed intake} \times \text{GE}_{\text{diet}}) - (\text{Excreta output} \times \text{GE}_{\text{excreta}})$$

Feed intake

### STATISTICAL ANALYSIS

Minitab (MINITAB, 1996) was used to analyse experimental data using one way analysis of variance and means were separated with LSD test.

### RESULTS and DISCUSSION

Findings obtained from this study are presented in Table2. Protein and phytate content of sorghum used in present study was 98 and 2.8 g/kg of sorghum on air dried basis. Generally utilization of all nutrients including phytate was improved both at ileal and excreta. It was however pertinent that at higher level of phytase (0.015%) the impact was more significant. Ileal protein digestibility coefficient was significantly higher 0.774 in group that had higher phytase enzyme addition. It increased 2.9% protein digestibility at ileal level followed by PH-1 (1.19%). Nitrogen losses was significantly reduced by phytase supplemented group that's worthy in term of safeguarding the environment. Both calcium and phosphorus digestibility was significantly improved in phytase added groups. Phytate digestibility was improved both at ileal (11.8%) and excreta (7.6%) level at the higher dose rate (0.015%) of phytase enzymes by broiler birds. Apparent metabolizable energy was improved significantly by birds in group PH-2 (14.52 MJ kg<sup>-1</sup> DM), however the difference between PH-1 and PH-0 groups was insignificant.

Nutrient profile of the sorghum used in present study fall in the range to those reported by Bryden et al. (2009) and Nadeem et al. (2005). Digestibility coefficients and AME content of sorghum could be coincided to those reported by Bryden et al. (2009) and Black et al. (2005). Selle et al. (2003) examined that sorghum contain higher level of phytate and found that exogenous phytase could ameliorate its adverse effects that support findings of present study. Ravindran et al. (2006) showed that phytase supplementation improved phosphorus availability as been examined in present study. It has been previously assessed by Thomas and Ravindran (2010) that addition of phytase improved the availability of calcium and phosphorus of sorghum and other cereals and is related to our findings. It was narrated that phytate chelates minerals and prevent it from available to birds. Phytase target phytate and release phytate bound nutrient that is obvious from findings of present study.

### Conclusion

Findings of present highlight the importance of inclusion exogenous phytase that significantly improved the nutrients digestibility of sorghum. It is also imperative to state that this enzyme could also be helpful to prevent nutrients losses to soil and keeping environment safe.

**Table.1: Composition (g/kg air dry basis) of the bioassay diet (according to: Bryden et al. 2009) used**

Ingredient	Amount (g/kg)
Sorghum	918
Dextrose	-
Canola oil	20
Celite	20
Dicalcium P	17
Limestone	13
Choline CL	3
Salt	2
Broiler Premix	7
Solkafloc	-
Total	1000

\*\*Each kg of premix contained: trans-retinol, 0.66mg; cholecalciferol, 0.018mg; dl- $\alpha$ -tocopherol acetate; 4mg; menadione, 0.4mg; thiamine, 0.3mg; riboflavin, 1.6mg; calcium pantothenate, 3mg; niacin, 6mg; pyridoxine, 1mg; folic acid, 0.4mg; cyanocobalamin, 3 $\mu$ g; biotin, 0.02mg; manganese, 15mg; zinc, 10mg; iron, 4mg; copper, 1mg; iodine, 0.2mg; cobalt, 0.06mg; selenium, 0.02mg; molybdenum, 0.32mg; choline chloride, 60mg, ethoxyquin, 25mg

**Table2: Effect of dietary enzymes on nutrients digestibility and apparent metabolisable energy of sorghum by 42-day-old broilers.**

Digestibility coefficients									AME (MJ/kg DM)
Protein		Phosphorous		Calcium		Phytate			
Lower ileum	Excreta	Lower ileum	Excreta	Lower ileum	Faeces	Lower ileum	excreta		
0.752 <sup>b</sup>	0.365 <sup>c</sup>	0.40 <sup>b</sup>	0.24 <sup>b</sup>	0.27 <sup>b</sup>	0.18 <sup>b</sup>	0.68 <sup>b</sup>	0.66 <sup>b</sup>	13.49 <sup>c</sup>	
0.761 <sup>ab</sup>	0.426 <sup>bc</sup>	0.51 <sup>a</sup>	0.33 <sup>a</sup>	0.41 <sup>a</sup>	0.30 <sup>a</sup>	0.72 <sup>ab</sup>	0.69 <sup>ab</sup>	14.06 <sup>ab</sup>	
0.774 <sup>a</sup>	0.521 <sup>a</sup>	0.53 <sup>a</sup>	0.35 <sup>a</sup>	0.45 <sup>a</sup>	0.34 <sup>a</sup>	0.76 <sup>a</sup>	0.71 <sup>a</sup>	14.52 <sup>a</sup>	

<sup>abcd</sup> Mean carrying dissimilar superscript are significantly different

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**EFFECT OF CURCUMA (CURCUMA ROXB XANTHORRHIZA) MEAL AS FEED ADDITIVE IN BROILER RATIONS ON PERFORMANCE AND AN ANTIBODY TITRES AGAINST ND**

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**ABSTRACT**

With the increasing public awareness of Indonesian in healthy nutrition, it is resulted in demand for animal products that are healthy and free of antibiotic residues also increased. One natural feed additive used as a substitute for antibiotic synthesis is Curcuma Roxb xanthorrhiza, which is often used by humans to increase of appetite and cure various diseases. Balitro (2008) states that ginger meal contains: 94.14% dry material, 53% starch, 9.04% fat, 9.88% protein, 2.26% fiber, essential oil 5.97%, 2% curcumin and 1.58 % xanthorizol. This content can work to improve kidney and anti-inflammatory. Another benefit of this plant rhizomes increase of appetite, anti-cholesterol, anti-inflammatory, anemia, anti-oxidants, cancer prevention, and anti-microba. The aim of this research is to determine the influence of the ginger in broiler diets to the performance, the percentage of the carcass, and abdominal fat. A Completely Randomized Design was used to analyze the data. Two hundred DOC were divided into 4 treatment groups with 5 replications and 10 DOC in each replication. Four treatment diets were control diet with 0% of curcuma meal (R0); 1% of curcuma meal (R1), 2% of curcuma meal (R2), and 3% of curcuma meal (R3). The parameters observed were feed consumption, gain of body weight, feed conversion, percentage of carcass, abdominal fat and ability as a antibody titre against ND. The results of research showed that feed consumption, gain of body weight, carcass percentage, and abdominal fat of broilers were significantly different ( $p < 0.05$ ) for all treatment diets. Feed conversion and an antibody titres against ND did not show significantly different for all treatments. This research shows that 1% of meal curcuma in diet gave the best results of the chicken's broiler compared with other dietary treatment. Because the gain of body weight and percentage of the carcass are a higher and feed conversion is low but has not been able to reduce fat abdomen. In fact, the level of 2% and 3% of curcuma meal in diet can reduce fat in the abdomen.

**Keywords :** broiler, carcass, Curcuma xanthorrhiza Roxb, fat abdomen

**INTRODUCTION**

Recently, public awareness of healthy nutrition has increased in Indonesia. This has led to increased demand for healthy animal products healthy and free of antibiotic residues. Along with the weakening of the Indonesian currency against foreign currencies, the price of feed ingredients, that mainly imported, are also increased. This situation makes the price of animal feed also increased, so it makes the farmer to think and look for new alternatives in the natural feed additive by utilizing local resources that exist in farm area. This is in line with the ban on the use of antibiotics began in 1987, due to the emergence of antibiotic resistance cases (Salyers, 1999; Spring, 1999).

Therefore, various ways had been conducted to find a new alternative antibiotics that can maintained health status, appearance and production of livestock without any additional burden to consumer and environment. Essential oils, organic acids, and phytogenic compounds such as isoflavones are among the known important antibiotic alternatives which demonstrated to enhance production of gastric secretions and reduce pathogenic bacteria (Wenk, 2000).

One alternative that can be used is curcuma (Curcuma roxb xanthorrhiza) which has been frequently used by humans to improve appetite and cure various diseases. This rhizome contains 48 to 59.64% starch, 1.6 to 2.2% from 1.48 to 1.63% curcumin and essential oils and is believed to improve kidney function and anti-inflammatory (Sidik, et al., 1995). Another benefit of the rhizome of this plant is to increases appetite, anti-cholesterol, anti-inflammatory, anemia, anti-oxidants, cancer prevention, and anti-microbial. This study aims to determine the effect of curcuma (Curcuma Roxb xanthorrhiza) as a natural feed additive in broiler rations on performance, carcass percentage and abdominal fat content.

**MATERIALS AND METHODS**

**Location and Time**

The study was conducted in the village of Balai Penelitian Ternak, Ciawi, Bogor.

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### Experimental design

The experimental design used in this research was completely randomized design (CRD) with four treatments and five replications. There was 10 (ten) broiler for each repetition. So there was 200 broilers used in this study. The ingredients that are used in the ration were corn, soybean meal, coconut meal, rice bran, fish meal, coconut oil, CaCO<sub>3</sub>, premix, methionin, lysine and starbio. The ration was based on the National Research Council/NRC (1994), and was formulated so that the ration of each treatment could meet the needs of broiler chickens. Ration prepared with 24% protein content and energy 3200kal / kg isoprotein and isocalori. Rations and water were given ad libitum.

The treatment in this study were four types of rations. Four types of treatments were: R0 (control diet, without any addition of curcuma), R1 (1% of curcuma meal), R2 (2% of curcuma meal) and R3 (3% of curcuma meal). Variables measured in this study were body weight (g/chick), feed intake (g/chick), feed conversion, carcass percentage, abdominal fat content and antibody titres against ND.

Body weights were weighed once a week at the end of the week. The ration consumption was calculated from the amount of ration consumed subtract by the amount of ration left each day in a week. Feed conversion was measured of an animal's efficiency in converting feed mass into body weight. Abdominal fat contents were taken at the end of the study by taking all the fat around chicken abdomen. Carcass percentage is calculated carcass weight (without heads, feet, and feathers) divided by the live weight and the multiplied by 100%.

Agglutination inhibition test (HI-test) was used to measure the high titre antibodies contained in the serum to describe the level of chicken immunity after being vaccinated with ND vaccine.

Data were analyzed statistically using analysis of variance (ANOVA) and if it shows a marked influence continued with Duncan test (Steel and Torrie, 1993).

### Curcuma Meal Making

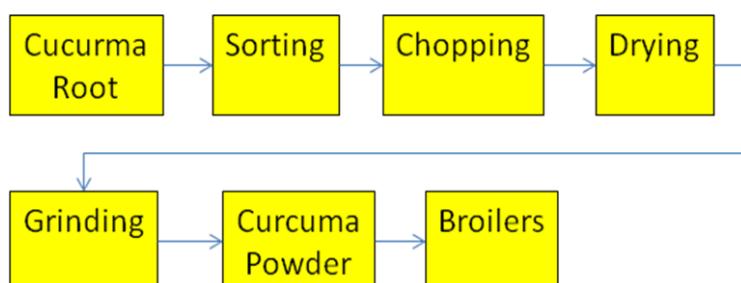


Figure 1. Process of Curcuma Meal

## RESULTS AND DISCUSSION

### Broiler Performances

The effect of curcuma meal in ration on feed consumption, weight gain and feed conversion of broilers can be seen in Table 1.

Table 1. Feed consumption, weight gain and feed conversion.

Treatments	Feed Consumption	Weight Gain	Feed Conversion
R0	1460.54 <sup>a</sup> ± 61.01	833.40 <sup>a</sup> ± 36.46	1.75 <sup>ab</sup> ± 0.08
R1	1452.74 <sup>a</sup> ± 66.11	850.02 <sup>a</sup> ± 61.52	1.71 <sup>a</sup> ± 0.07
R2	1385.93 <sup>a</sup> ± 73.20	763.69 <sup>b</sup> ± 44.82	1.82 <sup>b</sup> ± 0.03
R3	1252.42 <sup>b</sup> ± 90.01	701.44 <sup>c</sup> ± 16.15	1.78 <sup>ab</sup> ± 0.09

Note:

- Superscripts within column indicate significant differences ( $P < 0.05$ )
- Description: R0 = control diet; R1 = 1% of curcuma meal; R2 = 1% of curcuma meal; R3 = 3% of curcuma meal

The average feed consumption of broiler during research for all treatments were ranged between 1460.54 -1252.42 g /chick. Results of analysis of variance showed that the feed intake ( $P < 0.05$ ) was significantly influenced by the provision of curcuma in the ration. From Table 1, it can be seen that the provision of 1% curcuma in the ration can increase feed intake. However, with the increasing of curcuma in the ration, feed consumption became decreases. This was in accordance with research by Sinurat, A.P (2009) which moderate doses of curcuma in ration produced a higher weight gain compared to control ration. The decreasing of feed intake was caused by a bitter taste and pungent smell of curcuma so it decreased the palatability of ration.

As presented in Table 1, the highest weight gain was found in broilers with ration R1 (1% of curcuma meal), while the lowest weight gain was in broiler with ration R3 (3% of curcuma meal). Statistical analysis showed that curcuma treatments had significantly ( $P < 0.05$ ) impact in weight gain of broilers. This was due to a decrease in palatability by increasing the level of curcuma in ration. It is known that the factors that influence body weight is consumption of nutrients, digestibility of nutrients, and the quality of the ration.

Feed conversion is a measure of efficiency in the use of the ration. The lower the value is the more efficient use of feed conversion ration, because lesser feed required to produce weight gain in a given period of time. The average feed conversion of broiler chickens during research on all treatments was ranged from 1.71 to 1.82. Results of analysis of variance showed that there were significant differences ( $P < 0.05$ ) among treatments. Broilers that were subjected to R1 (1% of curcuma meal) had a better feed conversion (1.71) compared other treatments (1.75 to 1.82). So it can be concluded that the R1 had the most efficient use of ration compared to control ration and other treatments.

#### Carcass Percentage

The effect of curcuma meal to the carcass percentage can be seen in Table 2.

Table 2. Effect of curcuma meal on carcass percentage

Treatments	Carcass Percentage
R0	60.51 <sup>ab</sup> ± 0.88
R1	62.66 <sup>b</sup> ± 2.01
R2	62.33 <sup>b</sup> ± 1.73
R3	58.40 <sup>a</sup> ± 3.30

Note:

- Superscripts within column indicate significant differences ( $P < 0.05$ )
- Description: R0 = control diet; R1 = 1% of curcuma meal; R2 = 1% of curcuma meal; R3 = 1% of curcuma meal

The mean of broiler carcass percentage on all treatments was ranged 58.40 - 62.66%. Results of analysis of variance showed that the carcass percentage was significantly ( $P < 0.05$ ) influenced by the provision curcuma in the ration. From Table 1 and 2, it showed that the provision of 1% of curcuma meal in the ration increased feed consumption and resulted in a higher weight gain and a higher carcass percentage. However, along with feed consumption, the increasing of curcuma level in the ration has decreased the of carcass percentage. This might be caused by the decrease in feed consumption was resulting in lower weight gain, and resulting in lowering carcass percentage. This was consistent with research Amaefule et al. (2006) which showed that the pattern of differences in the percentage of carcasses in accordance with the differences in body weight and weight gain, so the higher the weight, the greater the percentage of carcasses.

Carcass percentage obtained in this study remained within normal limits for broiler since in this study broilers were reared only until the age of 5 weeks and rations were prepared with no antibiotics. Leeson and Summers (2001) states that broiler carcass percentage at the age of six weeks was ranged between 64.7-71.2%. So if the study reared the broilers until the age of six weeks, it was possible the carcass percentage produced in the normal range.

#### Abdominal Fat Content

The effects of curcuma meal to the abdominal fat content can be seen in Table 3.

Table 3. Effect of curcuma meal on abdominal fat

Treatments	Abdominal Fat
R0	10.90 <sup>ab</sup> ± 3.14
R1	13.40 <sup>b</sup> ± 3.20
R2	8.70 <sup>a</sup> ± 3.13
R3	8.70 <sup>a</sup> ± 3.86

Note:

- Superscripts within column indicate significant differences ( $P < 0.05$ )
- Description: R0 = control diet; R1 = 1% of curcuma meal; R2 = 1% of curcuma meal; R3 = 1% of curcuma meal

Abdominal fat content of broilers during research on all treatments were ranged from 8.70 g - 13.40 g. Results of analysis of variance showed that abdominal fat content was significantly ( $P < 0.05$ ) influenced by the provision curcuma in the ration. From Table 3, it can be seen that the provision curcuma in the diet had not been able to decrease abdominal fat content when compared to the control diet. This was similar to the results by Puastuti, W (1997) which states that supplementation of curcuma up to 1% had no effect on serum cholesterol and eggs cholesterol. This was a possibility of curcuminoid levels contained in curcuma is still too small to stimulate bile to produce anti-oxidant.

Antibody titres against ND

Effect on antibody against New Castle Disease (ND) (geometric mean of titre / GMT) for all treatments can be seen in Table 4.

Table 4. ND Antibody Titre

Treatments	ND Antibody Titre (Log2)
R0	3.85
R1	3.60
R2	5.55
R3	4.90

Note:

- Description: R0 = control diet; R1 = 1% of curcuma meal; R2 = 1% of curcuma meal; R3 = 1% of curcuma meal

The above results indicated that curcuma meal as a feed additive in feed did not give a significant impact, however, ration containing 2% and 3% of curcuma meal had a high antibody titre values compared to control ration. Based on these results, a dose of turmeric had not been able to stimulate antibodies to rise significantly. According to Butcher and Miles (1995), antibodies will reach its peak in week 2 to 3 post-vaccination.

So the level of curcuma meal has not been able to activate the lymphoid follicle in Bursa Fabricus, which function to produce lymphocytes that will be differentiate into B cells which produce antibodies. Therefore, an increase in the number of active lymphoid follicles will be able to increase the production of antibodies (Tizard, 1988; Baratawidjaja, 1996)

## CONCLUSION

Provision 1% of curcuma meal in the ration had the best result to performance of broiler. It gave high weight gain, high carcass percentage and low feed conversion.

However, curcuma meal provision had not been able to decreased abdominal fat content of broilers. Higher decreased in abdominal fat content occurred in 2 and 3% level of curcuma meal in broiler rations but it had bad impact in the performance of broiler.

Further research needs to be done with the highest dose of curcuma meal is 1% to see its impact in immunity of broilers.

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## EFFECT OF SUBSTITUTION NONI LEAF MEAL (*MORINDA CITRIFOLIA*) IN THE RATION ON PRODUCTIVITY AND QUALITY QUAIL EGGS

Tuty Maria Wardiny and Tengku Eduard Azwar Sinar<sup>22</sup>

### ABSTRACT

Quail egg is one source of animal protein in Indonesia that is cheap and easily obtained by the public, but it has a complete nutritional contents. Therefore, farmers need to improve the productivity and quality of quail eggs by utilizing an alternative feed source. One of the alternatives is noni leaf, which has advantages in nutrient content and active substances. This study aimed to evaluate the level of noni leaf meal (NLM) in the ration that can impact on productivity and quality of quail eggs. Completely Randomized Design (CRD) is used to analyze the data obtained from this study. Seventy-two female quails aged four weeks were divided into four treatments and three replications. Each replication was consisted of six quails. Four treatments applied were: control without any NLM in the ration (R0), 9% of NLM in the ration (R1), 10% of NLM in the ration (R2), and 11% of NLM in the ration (R3). Parameters measured were feed consumption, egg production, feed conversion, egg weight, yolk weight, the weight of the egg white, eggshell weight, eggshell thickness, egg yolk scores and Haugh unit. The results showed that the feed consumption, scores yolk and Haugh Unit ( $P < 0.05$ ) affected by the treatment. However treatments did not significantly have effects on feed conversion, egg weight, yolk weight, the weight of the egg white, eggshell weight and eggshell thickness. The level of 11% noni leaf meal in the ration can improve the quality of quail eggs.

**Keywords :** egg quality, noni leaf meal, quail eggs

### INTRODUCTION

*Coturnix coturnix japonica* or quail is already known as a producer of eggs in Indonesia. Quail eggs are one of source of animal protein to meet the nutritional demands of society, especially for the middle to lower income families. The nutritional value of quail eggs is not inferior compared with other poultry, so it can be used as a source of animal protein provider. Quail eggs are the best sources of protein, one hundred grams of quail egg contains 13.05 grams of protein, slightly higher than chicken eggs or duck eggs (USDA, 2007).

Enormous demand on quail eggs are causing farmers must keep their quails intensively with high feed costs to get an optimal production. So, it is necessary to find an alternative feed ingredient that are easy to find, inexpensive, not compete with human needs and the availability can be assured continuously. Noni is one of the medicinal plants a lot of interest both from the agribusiness entrepreneurs, businessmen traditional medicine industry and among scientists. This is due to that in all parts of the noni plant contained a variety of chemical compounds that can be utilized. According Wardiny, T.M. (2006), noni leaf meal contains 161 mg of beta carotene and crude protein, calcium, Fe and Zn that was better than its fruit. In addition, noni leaf has a high active substance in the form of steroids. The beta carotene form noni leaf is expected to make noni leaf meal as a source of carotene to increase egg yolk color score.

From previous research, Wardiny, T.M. (2006) proved that noni leaf meal can improve chicken egg productivity, yolk color score, vitamin A and lower egg yolk cholesterol. Therefore, this research needs to be done to evaluate the level of use noni leaf meal (NLM) in the ration of the quality of quail eggs. Noni leaf meal is expected to improve the quality of quail eggs. Besides quality of eggs, NLM can be a source of antibiotics so it does not need to use chemical antibiotics, so quail eggs consumer do not need to worry carcinogenic effect of antibiotics.

### MATERIALS AND METHODS

#### Location and Time

The study was conducted in the village of Jabon Mekar, Parung, Bogor and Faculty of Animal Husbandry, Bogor Agricultural University.

#### Noni Leaf Meal Making

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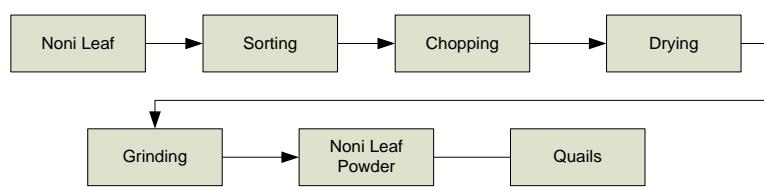


Figure 1. Process Noni Leaf Meal

#### Birds, diets and management

This study used 72 quails aged 6 weeks that divided into 4 treatments and 3 replications. Each replication was consisted of six quails. 12 colony cages were used, with dimensions of 182 cm x 100 cm x 60 cm. Each cage was filled with 6 quails. In each cage was equipped with a feed and drinking water.

Feed research used in this study is a commercial feed from Sinta Prima Feedmill. The nutrient content contained in Table 1.

**Table 1. Nutrient Feed Quail Layer**

Type	Feed Code	Nutrient (%)					
		Protein	Fat	Crude Fiber	Ash	Water	Ca
<b>Meal</b>	SP -2	20 - 22	4 - 7	Max 6	Max 14	Max 12	3.5 - 4.0
							0.6 - 0.8

The research feed content has met Indonesian National Standard (2006) on laying quail feed.

#### Experimental design

The experimental design used in this research was completely randomized design (CRD) with four treatments and three replications. There was 6 (six) quails for each repetition. The treatment in this study were four types of rations. Four types of treatments were : R0 (control diet, without addition noni leaf meal), R1 (9% of noni leaf meal), R2 (10% of noni leaf meal) and R3 (11% of noni leaf meal).

Data were analyzed statistically using analysis of variance (ANOVA) and if it shows a marked influence continued with Duncan test (Steel and Torrie, 1993).

#### Observed Variables

The parameters in this study is productivity and quality of eggs which includes hen day (%), feed consumption, feed conversion, egg weight, the weight of the egg white, egg yolk weight, egg shell weight, shell thickness, yolk color and Haugh Unit.

Hen day (%) was number of egg produced during research divided by number of quails during the research and multiply by 100%.

$$Henday(\%) = \frac{\text{No.of eggs during research}}{\text{No.of quail} \times \text{No.of days during research}} \times 100\%$$

Feed consumption (g) was obtained from the amount of rations given during a week minus the ration were not eaten at the end of the week.

Feed conversion is obtained by dividing the amount of feed consumed by the production of eggs (total weight of eggs) during the study. Egg weight (g) was obtained by weighing each egg that was grouped by each treatment of each replicate.

Yolk weights (g) was obtained by weighing the egg yolk separated from egg white. The percentage of egg yolk weight was calculated using the formula weight divided by the weight of the egg yolk multiplied by 100%.

The weight of egg white (g) was obtained from the difference between the sum of the weights of eggs with yolk weight (g) and shell weight (g). The percentage weight of the egg white was calculated by using the formula weight divided by the weight of the egg white egg multiplied by 100%.

Eggshell weights (g) was obtained by weighing the eggshell after being separated from the egg contents. Percentage weight of egg shell was calculated using the formula weight divided by the weight of egg shell eggs

multiplied by 100%.

Eggshell thickness (mm) was obtained by measuring the shell thickness was measured using a micrometer and at the blunt end, middle, and end of the taper eggs then averaged.

Score yolk color was observed by comparing the color of egg yolks with the Roche Yolk Color Fan on a scale of 1-15.

Haugh Unit (HU) was used to determine the freshness of white eggs on the relationship high logarithm egg whites (mm) with egg weight (g). High egg whites were measured using a micrometer tripoid then use the formula:

$$HU = 100 \log (H + 7.57 - 1.7 W^{0.37})$$

Where: W = weight of eggs (g) and H = height egg whites (mm)

## RESULTS AND DISCUSSION

### Productivity of quails

Effect of Noni Leaf Meal on productivity of quails can be seen in Table 2.

**Table 2 Productivity of quails during the research**

Treatments	Feed Consumption (g/quail)	Hen Day (%)	Feed Conversion (%)
R0	142,69 ± 7,04 <sup>b</sup>	78,45 ± 15,65 <sup>b</sup>	2,33 ± 0,07
R1	146,90 ± 7,30 <sup>b</sup>	75,61 ± 5,05 <sup>b</sup>	2,29 ± 0,14
R2	123,34 ± 11,36 <sup>a</sup>	47,62 ± 10,76 <sup>a</sup>	1,98 ± 0,23
R3	141,36 ± 7,60 <sup>b</sup>	76,27 ± 9,49 <sup>b</sup>	2,27 ± 0,27

Note:

- Superscripts within a column indicate significant differences (P <0.05)
- Description: R0 = control diet; R1 = 9% of NLM; R2 = 10% of NLM; R3 = 11% of NLM

The average feed consumption on this research for all treatments were ranged from 123.34 to 146.90 g/quail/week. Results of analysis of variance showed that the level of NLM in ration had significantly effect on feed consumption. From Table 2, it showed that the smallest average of feed consumption was at of 10% NLM in ration. This was not in line with previous research by Wardiny, T.M. (2006) in which layer feed intake was decreased along with the increasing level NLM in the ration. According Wardiny, T.M. (2006), this was due to NLM contained coarse fibers in high level around 11.75% (Wardiny, T.M., 2006) so that the layer felt full faster. With the increasing level of NLM, the color of rations were greener and this color was less favored by quail that prefer yellow and red ration.

Feed consumption on 10% of NLM (R2) ration was decreased. This was due to Infection Coryza disease, which caused decreased appetite and drink and have swollen quail eyes.

Based on phytochemical analysis, noni leaf meal contains saponins, which is at a certain dose saponins can cause a bitter taste in the ration so that less favored by quail. High tannin content can interfere with the digestive process so that the protein cannot be digested feed perfectly. This is in accordance with the opinion of Butler and Rogler, 1992 which stated that the consumption of feed containing a high tannin can reduce body weight, and looks very apparent digestibility and feed efficiency.

Egg production was ranged from 47.62 to 78.45%. Based on analysis of variance, it showed that the treatments in ration had significantly effect on quail egg production. Quail egg production with 10% of NLM (R2) was lower compared to control (R0) and other treatments (R1 and R3). This was along with feed consumption. Lower egg production in R2 was due to lower consumption of protein. For details can be seen in Table 2. However, quail with R1 and R3 had same feed consumption with control diet (R0) and higher than R2. The same patterns happened in egg production as well. This was due to a complete and healthy diet will force quail to produce a high egg production.

The average feed conversion in all treatments during the study ranged from 1.98 to 2.33. Results of analysis of variance showed that there were no differences between treatments. Quails treated noni leaf meal had better feed conversion than control. The best feed conversion of 2.27 produced by R3 where feed intake is consumed to produce higher egg production when compared to R2 which had the smallest the conversion. Smallest feed conversion of R2 was not followed by a high egg production but the lowest egg production. So the quail with R2 was not the best productivity.

#### Quail Egg Quality

The quality of ration can be judged from the quality of eggs produced. This analysis needs to be done to evaluate how far the level of provision of noni leaf meal gives the best results on the quality of the eggs. Results of analysis of the quality of the eggs in this study can be seen in Table 3.

Stadelman and Cotteril (1995) stated that classification and measurement of egg quality is divided into two parts, namely exterior and interior quality. Exterior quality can be seen physically with direct eye such as cleanliness eggshell, eggshell color, thick eggshell and egg weight. While interior quality can be measured after the egg is cracked, such as egg white index, egg yolk index, Haugh Unit and yolk color. Statistical analysis showed that the use of noni leaf meal had significant effect ( $P < 0.05$ ) on egg yolk color and Haugh Units, but not had significant ( $P > 0.05$ ) on egg weight, yolk weight, egg white weight, egg shell weight and thick eggshell.

**Table 3. Quail Eggs Quality**

Parameter	Treatment			
	R0	R1	R2	R3
Egg Weight (g)	9.74 ± 0.18	10.44 ± 0.26	9.64 ± 1.10	10.19 ± 0.47
Yolk weights (g)	3.51 ± 0.16	3.78 ± 0.15	3.69 ± 0.45	3.65 ± 0.22
(%)	36.04 ± 0.98	36.28 ± 2.17	38.91 ± 9.38	36.77 ± 4.35
Egg White Weights (g)	5.08 ± 0.55	5.40 ± 0.30	5.08 ± 0.74	5.39 ± 0.31
(%)	52.15 ± 0.87	51.68 ± 1.55	52.63 ± 2.39	52.83 ± 1.21
Eggshell weights (g)	1.15 ± 0.08	1.26 ± 0.12	1.19 ± 0.21	1.15 ± 0.12
(%)	11.81 ± 0.83	12.03 ± 1.01	12.34 ± 0.81	11.33 ± 0.43
Eggshell thickness (mm)	0.18 ± 0.01	0.18 ± 0.01	0.19 ± 0.02	0.20 ± 0.02
Score yolk color	5.77 ± 0.50 <sup>a</sup>	6.87 ± 0.67 <sup>b</sup>	7.13 ± 0.67 <sup>b</sup>	6.73 ± 0.25 <sup>ab</sup>
Haugh Unit	90.89 ± 0.23 <sup>b</sup>	88.23 ± 0.34 <sup>a</sup>	88.83 ± 0.76 <sup>a</sup>	90.37 ± 1.23 <sup>b</sup>

Note:

- Superscripts within a column indicate significant differences ( $P < 0.05$ )
- Description: R0 = control diet; R1 = 9% of NLM; R2 = 10% of NLM; R3 = 11% of NLP

Egg weights

The average weight of eggs during this study was 9.64 to 10.44 g of egg-1. This value was consistent with the results of research Song et al. (2000), who reported that the normal weight of quail eggs was ranged from 9.41 to 11.27 g of egg-1. However, it was slightly lower than the results Nastiti (2013) weighing 10.49 to 10.95 g of egg-1, which uses a combination of coarse wheat bran and noni leaf meal as a substitute for corn. This may be due to quails used were young quail as young as 42 days, so just entering the early period of egg production. Rasyaf (2002) states that the quail is ready to spawn when entering the age of 6 weeks. Quails in this study were still adapted to produce eggs so eggs produced still had low in weight. In line with increasing time the eggs produced weight will increase.

So substitution noni leaf meal in the ration provides quality protein and amino acids that are sufficient for quail to produce eggs with normal weight. This is in line with Kul and Seker (2004) that eggs weight was influenced by genetic structure, health condition, age of animal, feed components, differences in maintenance and livestock management.

#### Egg Yolk Weight

The average weight egg yolk in this study was 3.51 to 3.78 g egg yolk of egg-1. These results were higher than the results Song et al. (2000) of 2.85 to 3.25 g of egg-1, Nastiti (2013) of 3.21 to 3.36 g of egg-1 and were not different from the results of Kul and Seker (2004) of 2.75 - 4.40 g of egg-1. From the results it can be concluded that the increasing level of noni leaf meal in the ration will increase egg yolk weight. Egg yolk is a source of fat so that egg yolk weight is influenced in part by the fat content in the ration.

Percentage of yolk weight in this study was 36.04% - 38.91%, this result was above results by Kul and Seker (2004) amounted to 25.98% - 36.27% and Nastiti (2013) amounted to 29.99% - 30.89%. This suggests that the treatments in rations had a positive effect to egg yolk weight because noni leaf meal was not disturbing the absorption of nutrients by quails.

#### Weights White Eggs

The average egg white weight of this study was 5.08 to 5.40 g of egg-1. This was lower than the results Song et al. (2000) from 5.74 to 6.33 g of egg-1, Kul and Seker (2004) from 5.43 to 8.18 g of egg-1 and Nastiti (2013) from 5.82 to 6.13 g of egg-1. This might be caused by the egg yolk weight in this study was greater than their research.

Similarly, the percentage of egg white weight in this study was ranged from 51.68% - 52, 83%. This was lower than research by Song et al. (2000), Kul and Seker (2004) and Nastiti (2013).

#### Egg Shell

The mean of shell egg weight in this study was ranged from 1.15 to 1.26 g. This value was above the results of Song et al. (2000) ranged 0.75 to 0.76 g of egg-1 and Kul and Seker (2004) ranged 0.61 to 1.06 g of egg-1 and was not far from result by Nastiti (2013) from 1.27 to 1.33 g of egg-1. While the average percentage of quail egg shell weight is 11.33% - 12.34%. Stadellman and Cotteril (1995) stated that the basic components of the eggshell is 98.2% calcium, magnesium 0.9%, and 0.9% phosphorus.

Consumers want eggs with strong eggshell thickness so that the egg is not easily broken. Eggshell thickness averaging the results was 0.18 to 0.20 mm, not far from the results of Song et al. (2000) was 0.174 mm and Nastiti (2013) ranged 0.165 to 0.171 mm. This result showed that even noni leaf meal contains tannins but did not disturb the absorption of the minerals calcium and phosphorus. So the quail egg shell thickness increased with the increasing of level of noni leaf meal in the ration.

So the use of noni leaf meal in the ration showed a positive effect on quail egg shell thickness. One determinant of factor of egg quality is the thickness of the shell as it protects the quality of the inside of the egg.

#### Yolk Color

Esfahani et al. (2009) stated that the color of yolk was the main characteristic of egg quality because it affected the taste of eggs. Quail egg yolk color score was significantly ( $P < 0.05$ ) influenced by the treatments in ration. The higher level of noni meal in the ration resulted in increasing yolk color score. Mean scores quail egg yolk color in this study was 5.77 to 7.13. More detail can be seen in Figure 2 below.

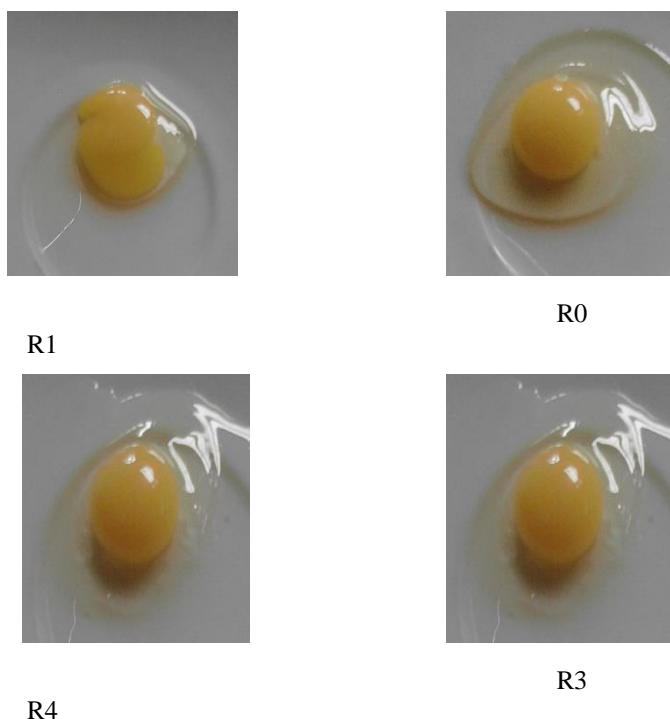


Figure 2. Yolk Color

Increased quail egg yolk color score occurred as a resulting from the use of noni leaf meal that had beta-carotene as much as 161 ppm. Carotene pigment deposition was suspected that influenced by noni leaf meal into the ration. According Wiradimadja (2007), the type and amount carotenoid consumed by laying birds is a major factor in egg yolk pigmentation. The type of carotenoid that plays an important role in coloring yolk is xanthophyll, while the type of noni leaf carotenoid is beta-carotene. This carotene has the greatest provitamin A activity.

#### Haugh Unit (HU)

Haugh Unit is one of the parameters that can be used to determine the quality of the egg white. Haugh Unit is a ratio between the egg white height and egg weight that is affected by storage time and temperature. The mean of Haugh Unit in this study was ranged 88.23 to 90.89 and this was significantly effect ( $P < 0.05$ ) by ration treatments. According to the USDA standard (2008), the quality of eggs of this research was in AA class, where the egg that has a value of more than 72 HU with characteristic skin clean, intact, and normal. The egg yolk was in the center and free patches, and the egg white was clear and thick. There was a decrease in value HU, since the measurement took place more than one day, so there was a dilution process of egg white and a high reduction of egg white height.

#### CONCLUSION

The use of noni leaf meal in ration gives good results on the quality of quail eggs. 11% of noni leaf meal in ration has a good result in productivity and quality of eggs and can increase egg yolk score.

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## Spatial Analysis of Temperature and Humidity in Broiler Houses Having Different Litter Materials

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### ABSTRACT

A key factor of broiler management is maintaining litter quality. Higher temperature and humidity negatively affect litter quality. In the present study, the spatial variability of temperature and humidity values were compared in two broiler houses having different litter materials. In House 1 (H1) sawdust was used as litter material while sawdust with zeolite was used in House 2 (H2). Twenty-one sampling positions composed grid points, where measurements were placed at 3 locations across the width of the house (3 m apart) and 7 locations down the length of the house (15 m apart). The samples measured at human and bird height on a weekly basis. Recorded data were mapped on houses' longitudinal sections by using ArcGis. The results indicated that temperature and humidity variations are more stable in H2. In H1, 'danger areas' that are characterized by heat stress coupled with high humidity were in center of the house. It was conclude that using zeolite with sawdust as litter material significantly increases litter quality of broilers.

**Keywords:** Broiler, litter, zeolite, spatial

### INTRODUCTION

In Turkey, broilers are usually floor-raised inside climate-controlled houses. Wood shavings, peanut shells and rice hulls etc. are common litter materials used in broiler houses. Bird mortality mainly depends on environmental factors such as temperature, humidity, and ammonia concentration. These parameters also affects labors' working environment. In order to maintain a sustainable production, these environmental parameters should be kept under control. There are many factors affect these parameters. One of them is litter material used in the house. Litter quality and management are very important for profitability of companies. Several studies demonstrated the importance of using different litter materials for animal and labors' welfare (Brake et al., 1992; Garcès et al., 2013; Farhadi, 2014; Hafeez et al., 2009). Addition of various chemicals to litter material can also reduce bacterial growth and litter moisture (Kaoud, 2013; Do et al., 2005; Burgess et al., 1998; Shreve et al., 1995). One of these chemicals is Zeolite. Many researchers stated that zeolite can use as supplement in litter materials due to its higher of absorption capability of ammonia and humidity (Eleroglu and Yalcin, 2005; Karamanlis et al., 2008; Loch et al., 2011; McCrory, 2001; Maurice et al., 1977), but they didn't determine stress areas (high temperature coupled with high humidity) in broiler house. These parameters can be evaluated through geostatistical analyses. This allows seeing distribution of parameters within a broiler house. Several studies determine distribution of variables using geostatistical analyses in broiler house. Ponciano et al. (2008) identified problems in heating system using geostatistics and distribution maps inside broiler house. Miragliotta et al. (2006) investigated spatial analysis of thermal, aerial and acoustic environmental conditions in a tunnel broiler house. This finding showed that the highest mortality index near the exhaust fans. Miles et al. (2011) spatially evaluated the physical and chemical properties of a litter material in a broiler house under winter and summer conditions. Therefore, the objectives of this study were to:

- show the spatial variability of temperature and humidity using geostatistical methods in two broiler houses (H1: sawdust, H2: sawdust+zeolite),
- compare the effects of different litter materials including sawdust and sawdust/zeolite mixture on humidity and temperature described above
- determine the danger areas in houses where the heat stress coupled with high humidity were observed

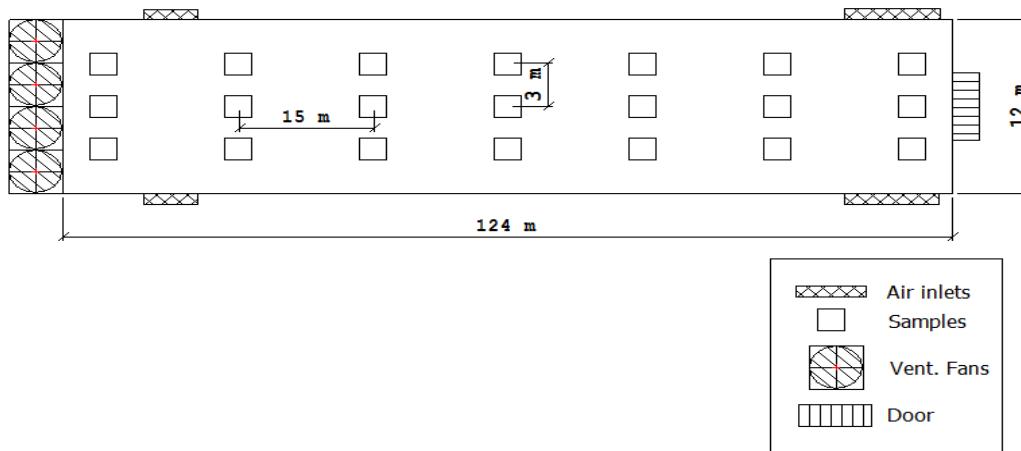
### MATERIALS AND METHODS

#### DESCRIPTION OF THE STUDY AREA

The study was carried out in two commercial broiler houses (H1:Sawdust, H2:Sawdust+Zeolite) , in Bafra, Samsun ( $41^{\circ} 31'$  latitude and  $35^{\circ} 53'$ longitude). Prevailing winds direction is South-East (SE). The broiler houses was oriented North-East (approximately 12 m wide, 124 m long and 2.4 m high). Two litter materials (Sawdust and sawdust/zeolite mixture) were used in houses. In both houses feeding, watering, lighting and ventilation are controlled automatically. The building envelope was composed of insulated roof and side walls.

Sizes of windows were 0.6 m × 3 m. They were placed Northeast and Southwest sides of the buildings. The buildings were ventilated through four exhausting fans on its north side. The birds were housed for 48 before slaughtering.

Grid samples were taken from 21 points at 7 locations down the length of the building (15 m apart) and 3 locations across the width (3 m apart) (Fig. 1). The samples measured at birds' height (0,2-0,3 m) and human height (2 m) on a weekly basis. ArcGis software was employed to temperature and humidity contour maps.



**Figure 1.** Grid samples in broiler house

## RESULTS AND DISCUSSION

Estimated values of minimum, maximum, average, standard deviation and coefficient of variation of temperature and humidity show (Table 1 and 2) that the both of variable were lower in H2 as a result of the using litter material (zeolite). Temperature gradient was decreased with bird age because of broiler rearing techniques. According to this technique, initial temperature of broiler houses should be 32-35 °C and then temperature is decreased by 1 °C every second day to 22±2 °C after 3 week of age ( Elvinger and Svensson, 1996; Nicholson et al., 2004). Humidity gradient fluctuated between weeks. These fluctuations were primarily caused by variable ventilation rates as a result of weather conditions.

**Table 1. Temperature, humidity and ammonia levels at bird height.**

Birds	House 1					House 2					
	Age (weeks)	Min.	Max.	Avg.	SD.	Cv(%)	Min.	Max.	Avg.	SD.	Cv(%)
Temperature (°C)											
1	21.70	28.70	26.28	2.03	7.72		20.90	27.10	25.27	1.60	6.33
2	19.60	26.40	22.86	1.78	7.79		18.10	25.40	22.63	2.44	10.78
3	17.00	26.40	22.56	2.83	12.54		17.20	25.12	21.99	2.10	9.55
4	17.00	25.10	21.78	2.21	10.15		17.90	24.80	21.91	2.01	9.17
Humidity (%)											
1	64.00	82.2	73.04	3.82	5.23		56.20	76.20	71.60	3.73	5.21
2	51.30	73.3	61.27	5.76	9.40		53.00	73.30	64.57	5.22	8.08
3	53.60	81.8	71.77	6.95	9.68		57.10	75.10	67.41	5.19	7.70
4	56.30	70.5	64.99	3.59	5.52		58.00	70.00	64.17	2.64	4.11

**Table 2. Temperature, humidity and ammonia levels at human height.**

Birds	House 1					House 2					
	Age (weeks)	Min.	Max.	Avg.	SD.	Cv(%)	Min.	Max.	Avg.	SD.	Cv(%)
Temperature (°C)											
1	23.00	28.70	26.56	1.80	6.78		21.50	27.20	25.50	1.65	6.47
2	19.70	26.90	22.79	1.89	8.29		17.50	25.60	22.82	2.50	10.96
3	15.70	26.50	22.31	3.07	13.76		18.50	24.00	21.55	1.62	7.52
4	17.70	25.10	21.67	2.28	10.52		18.30	24.80	21.87	2.12	9.69
Humidity (%)											
1	64.00	79.70	73.10	4.48	6.12		65.30	77.40	72.55	3.16	4.36
2	45.00	74.10	59.00	7.06	11.97		50.00	72.00	63.43	5.95	9.38
3	60.80	79.10	69.71	5.50	7.89		48.20	74.90	65.91	6.91	10.48
4	54.20	68.80	61.30	3.39	5.53		57.90	67.90	62.25	2.65	4.26

#### Vertical Fluctuation of Temperature

House 1 and 2 demonstrated similar trends in the vertical fluctuation of temperature (Fig. 4-5). Temperature gradients were slightly greater at bird level than at human level. During the rearing, temperature averaged 23.34 °C in H1 and 22.95 °C in H2 at bird height versus average of 23.30 °C in H1 and 22.90 °C at human height (Table 1-2). This was due to the cold outside air entering the sidewall inlets travels through the warm air near the ceiling before moving down to the bird levels (Fig. 2).

#### Lengthwise Fluctuation of Temperature

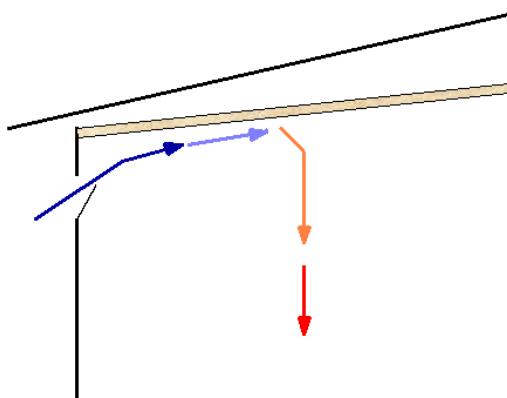
As illustrated in Figure 2, in both buildings the cooler zone (~18-20 °C) was the first 15-20 m while the warmer zone (~24-28 °C) was the center of the buildings and near the fans. The temperature of the building increased as air moves from the inlets to the fans since the fans were located at end of the building (Fig 3). The highest mean temperature occurred in the middle of H1 in the first week of breeding period, because of lower ventilation rate. The lowest temperatures were observed within the first 15-20 m length of both buildings. This was due to the air inlets that provided cooler air entering the building. The range of temperature was almost similar for both heights at approximately 17-29 °C.

#### Vertical Fluctuation of Relative Humidity

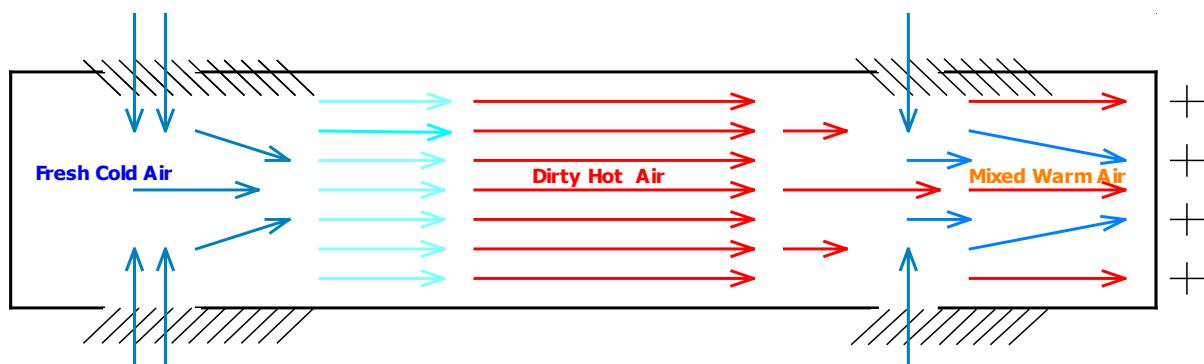
The birds continually add moisture to the air and the bedding material. So, it is expected that the relative humidity will decrease as it rises from the floor. Relative humidity gradients were greater at bird level than human level (Table 1-2). Since the temperature of air at bird level is greater than human level, the moisture holding capacity of air also increases. This means that the warmer air can absorb more moisture from the litter and carry it on out of the house.

#### Lengthwise Fluctuation of Relative Humidity

It was observed that the highest relative humidity occurred near the fans by % 75-80 (Figure 4 and 5). On the other hand, optimum relative humidity should be %65-70. In the present study, the relative humidity levels of both broiler houses were close to the optimum relative humidity levels.



**Figure 2.** Cold air is entering through inlet in the side wall.



**Figure 3.** Air flow pattern in the House 1 and House

## CONCLUSIONS

The main objective of the broiler companies is to achieve maximum product. To this end, it is important to maintain a healthy environment in the poultry house. Temperature and humidity are some of the important factors. The research demonstrated vertical and lengthwise stratification of temperature and humidity in two broiler houses having different litter materials (H1: sawdust, H2: sawdust+zeolite). Result of this experiment concluded that the suitable ventilation and better litter management are very important for birds' welfare and performance. Because of this, it is recommended to use zeolite as a litter amendment due to its property of absorbing humidity. Also, these findings showed that design of poultry house (e.g. location and size of windows, location and number of fans, litter type) is very important in terms of making optimum production.

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## REPRODUCTIVE PARAMETERS OF BEETAL DOES IN ACCELERATED AND ANNUAL KIDDING SYSTEMS

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### ABSTRACT

Pakistan possesses 25 breeds of goats, out of which Beetal goat is famous for its milk production. This breed stands at second in producing more number of kids after Teddy breed of goats, which is more prolific but produces only half liter of milk daily. Hence Beetal goat may be reared to cope per capita animal protein in the country. A study was conducted to ascertain the reproductive performance of accelerated kidding versus annual kidding system during a period of two years. The trial was comprised of 25 does which were randomly divided into two groups i.e. 25 animals. More kids may be achieved per doe by accelerated system of kidding which is more economical way as compared to annual kidding system. In order to have successful conception rate, supplementary feeding was provided. It was observed that initiation of estrus, kids' percentage and fruitful conception rate was of the order of 8, 1.33 and 10%, respectively. It was found that in accelerated system, kids born as single and triplets were 1.94 and 20%, respectively. Moreover, it was found that the twin births were reduced of the order of 11.6% in accelerated system. Services per conception were found  $1.64 \pm 0.81$  which were regarded as maximum. The litter size (LS) in accelerated kidding system was found to be  $1.66 \pm 0.71$ . It was significant ( $P < 0.05$ ) as compared to maximum  $1.19 \pm 0.04$  (SPC) with  $1.50 \pm 0.55$  (LS) in annual kidding system. The data were analyzed by complete randomized design (Steel et al., 1997) using proc GLM procedure of SAS 1995 (SAS institute, carry, NC). Further studies with larger data set are needed to explore reproductive performance in Beetal goats under accelerated kidding system for the validation of the findings of current research.

**Keywords:** Reproductive performance, services per conception, accelerated kidding system, Beetal goat, Pakistan

### INTRODUCTION

High reproductive rate has significant influence on efficiency of production, which means more animals for more meat production may be produced. Therefore, most important way for enhanced reproductive efficiency is accelerated kidding. Accelerated kidding may be defined as three kiddings in two years or five kiddings in three years. This can be applied in goats to increase the number of kids per year over once a year. An important advantage of an accelerated kidding in production programs is to fetch premium market prices during the off-season. Beetal does planned to kid thrice in two years through synchronization resulted in higher mutton production particularly during anestrus although, breeding for receiving three kiddings per two years is a feasible strategy. (Schneider and Stanko, 2005). The efficiency of Beetal goats for mutton production can be increased by adopting various methods like increasing the reproduction rate. Frequency of kidding is helpful in increasing the total number of kids produced during particular period of the year.

The kids produced through accelerated kidding may face survival issues, effects on weight gain due to severe seasons, shortage of fodder and health problems. There is need to conduct research on various reproductive parameters including conception rate, gestation length, kidding percentage, services per conception, litter size and kidding interval for the comparison of accelerated against annual kidding in Beetal goats. This study will be helpful in finalizing breeding plans for small ruminants in the country to overcome meat shortage.

**Experimantal Hypothesis:** The accelerated kidding system may be helpful in achieving more kid crop with better reproductive efficiency as compared to annual kidding system thereby reducing economic burdon.

### MATERIALS AND METHODS

In this study, a total of 50 adult Beetal goats were divided into two groups having 25 animals each viz. accelerated kidding and annual kidding. The animals of each group were kept in separate groups. The experiment was conducted at Small Ruminant Training and Research Centre, Ravi Campus Pattoki, University of Veterinary & Animal Sciences Lahore, Pakistan. The does were selected on the basis of their age, body size, weight and parity. Different breeding bucks were used for each group having similar size, weight and age. Flushing ration

was provided to the does and buck was introduced to have buck effect in does of accelerated group for the initiation of activity during out of season breeding. The annual kidding group was considered as control group, while the does were bred every eight months for accelerated kidding. Breeding of both schemes was started from October, 2009 and completed in September / October, 2011. During the whole study, the accelerated kidding group produced three crops whereas the annual breeding group produced two kid crops. The offsprings produced by both the groups were reared carefully under similar managemental conditions up to maturity. The green fodder was provided @ 10 % of body weight to all the animals. The fresh and clean water was made available to all the animals daily for twenty four hours. Enterotoxemia, Pleuropneumonia, Contagious caprine pleuropneumonia vaccines were injected to all the animals. The kids were given mother's milk till the age of 6 months.

#### **Data collection**

During the entire experiment period, the data pertaining to fertility rate, gestation length, kidding percentage, services per conception, litter size and kidding interval of both groups were recorded.

#### **Statistical analysis**

To assess the effect of treatments, the analysis of variance was performed by completely randomized design (Steel et al., 1997) using proc GLM procedure of SAS. 1995 (SAS institute, Cary, NC).

### **RESULTS AND DISCUSSION**

Reproductive performance in Beetal goats under accelerated and annual kidding systems is presented in table -1.

#### **SERVICES PER CONCEPTION**

**Trends of services per conception by different goats of accelerated and annual kidding systems are presented in figure-1.** The services per conception were found to be more by all groups of accelerated kidding system and annual kidding system. The results of present study are supported by various scientists like Hossain et al. (2004) and Chowdhary et al. (2002) who reported services per conception value as 1.2 and 1.24 in Black Bengal goats, respectively. However, the findings of this study do not agree with the findings of (Amin et al., 2001) and Kumar et al. (2005) who observed services per conception as  $1.3 \pm 0.08$  in Black Bengal and 1.44 in Angora goats. The findings of other workers regarding services per conception are in line with the findings of present study i.e.  $1.2 \pm 0.06$ ,  $1.2 \pm 0.07$  and  $1.06 \pm 0.08$  as observed in Black Bengal and Jamnapari x Black Bengal, (Faruque et al., 2002), in Jamnapari x Black Bengal (Amin et al., 2001) and Creole goats (Alexandre et al. 2001), respectively.

#### **Conception Percentage**

When comparison for conception percentage between accelerated and annual kidding was made, it was found that September 2009 goats' group of accelerated kidding system showed an increased conception rate of 60%. The highest percentage of conception among goats of accelerated kidding system was observed in September, 2009 as compared August 2010. Similarly, among goats of annual kidding system, higher percentage of conception was found in September, 2009 as compared to 2010. The results of does for fertility percentage bred during September 2009 in case of accelerated system are quite comparable with the findings of **Goonewardene et al. (1997) who reported the kidding percentage 64 % in case of Alpine goats.**

#### **Gestation Length**

The results pertaining to gestation lengths in Beetal goats among all groups of annual and accelerated kidding systems are shown in table-1. The does under annual kidding system showed more or less similar gestation period for producing 1<sup>st</sup> and 2<sup>nd</sup> kid crop. This might be more or less same due to does of same breed. The average gestation length, among different groups of accelerated kidding system, was found the lowest in March, 2011 group as compared to September, 2009. The results of gestation length (March, 2011) are in line with the findings of Moaeen-ud-Din et al. (2008) who observed mean gestation period as  $150 \pm 7.4$  days in Matou goats. Similarly it was  $144.8 \pm 3.9$  days in four Dwarf female goats (Khanum et al. (2008)). Among different age groups of annual kidding system length of average gestation period was almost similar in two groups of September 2009 and 2010. The results of Bessette and Rurak (2010) also coincide with the results of present study i.e. annual kidding system as the gestation length varied between 141 to 151 days.

#### **Litter Size**

**Trends of litter size by different goats in accelerated and annual kidding systems are presented in figure-2.** As regards litter size among different crops of accelerated kidding system, the highest percentage was observed in kid crop of March, 2011 as compared to September 2009. This result is comparable with the findings of Ungerfeld et al. (2007) who observed the litter size ranging from  $1.6 \pm 0.1$ - $1.8 \pm 0.1$  for low, medium and high

ranked goats, respectively. Higher value of litter size among crops of annual kidding system was found in kid crop received during 2010 as compared to September 2009. When comparison was made between accelerated and annual kidding system, it was observed that March 2011 group of accelerated kidding system led litter size %, although values were little close to each other. The results of present study showed quite resemblance with the findings of Khanum et al. (2008) who observed litter size in Dwarf goats of Pakistan as  $1.3 \pm 0.5$ . These findings of 2<sup>nd</sup> crop in annual kidding system also match with the results of Borde et al. (2006) who reported litter size as 1.5. It has been reported that fertility, reproductive rate, number of parturitions/doe and kidding interval has been reduced in accelerated system as compared to annual system.

### Kidding Percentage

The kidding rate among different crops of accelerated kidding has been presented in table-1. While obtaining different kid crops through accelerated kidding, the highest kidding percentage was observed in September, 2009 i.e. 80% during August, 2010. Similarly, among crops of annual kidding system, percentage of kidding during September, 2009 was 56%. These findings are closely in line with the results of Zhao et al. (2010) who described kidding percentage as 53.8% in goats of subtropical monsoonal climate of Southwest China. **High kidding percentage could a phenomenon of better feeding and housing management.**

### Type of Births

#### Single Births %

The single births obtained from different crops of accelerated kidding has been presented in table-1. Single birth percentage among different kid crops of accelerated kidding was observed high in August, 2010 as compared to March, 2011. Among crops of annual kidding system higher percentage of single birth was found in August 2009 as compared to September, 2010. When comparison was made between accelerated and annual kidding system, it was observed that September, 2009 group of accelerated kidding and September, 2009 group of annual kidding system shared the same value i.e. 40 and 42.86%, respectively. The results of present study **for single % in case of 1<sup>st</sup> crop of accelerated kidding system are closely in line with the findings of Goonewardene et al. (1997) who reported that single births were 40%.**

#### Twin Births %

The goats of annual group exhibited overall more twinning% than accelerated group. This might be due to the adoptability with the environment since long. The highest twinning percentage was observed in annual during September, 2010 as compared to accelerated during August, 2010. The results of present study **for twin % in case of 1<sup>st</sup> crop of accelerated kidding system are not closely in line with the findings of Goonewardene et al. (1997). However, the results for twinning% in case of 2<sup>nd</sup> crop of accelerated kidding do not agree with the findings of these scientists.** When comparison was made between accelerated and annual kidding system, it was observed that September, 2010 group of accelerated kidding led in kidding percentage. Twinning percentage was found to be increasing significantly by following different managemental protocols as reported by different scientist. Twinning rate observed by Moaeen-ud-Din et al. (2008), Afzal et al. (2004) were found to be 45.5% in Matou goats and 47.9% Beetal in Pakistan, respectively. These results are not in line with those of the findings of present study that might be due to kids crops obtained during out of season through accelerated kidding system. However, managemental practices like provision of flushing ration could be a question mark in annual kidding system. **The results of does for twinning of annual crop-1, 2009 were less than the annual crop-2 while goats producing accelerated crops 1 were higher than crops 2 and 3. The results of does for accelerated crops 1 and 3 do not match with the findings of Moaeen-ud-Din et al. (2008)** who reported twinning 47.9% in Beetal goats of Pakistan.

#### Triple Births %

Triplets percentage was found only in 3<sup>rd</sup> crop of accelerated kidding system (20%) as contrary with the findings of Goonewardene et al. (1997) as 6%. However, triplets were not found in rest of all other crops of accelerated as well as annual kidding system. The overall triplet percentage in case of Matou goats was 16.3% (Moaeen-ud-Din et al., 2008).

### CONCLUSION

Accelerated kidding system was found more profitable in terms of reproductive performance. Similarly, estrous, conception and kidding percentage was high in accelerated kidding system. Therefore it can be concluded that accelerated kidding system in Beetal goats is economically viable and adaptable.

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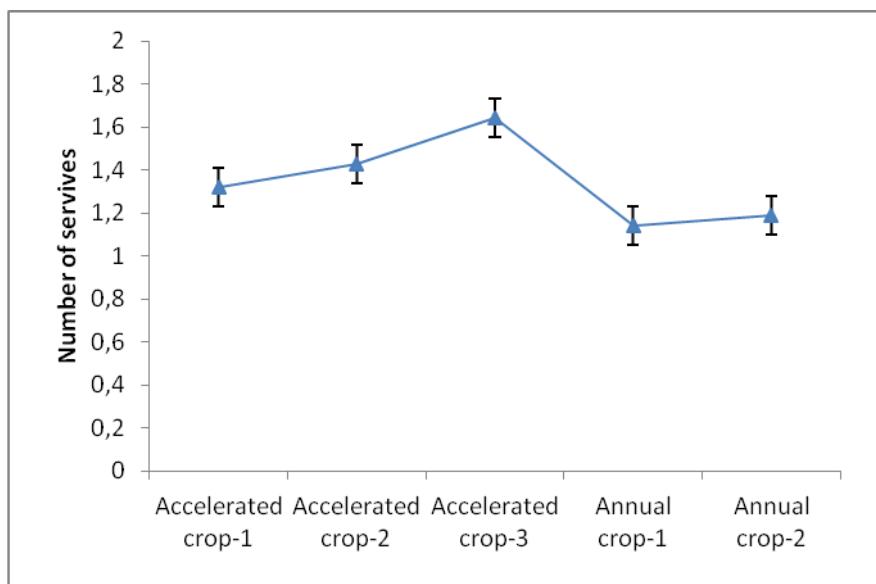
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**Table-1. Productive and reproductive performance in Beetal goats under accelerated and annual kidding systems.**

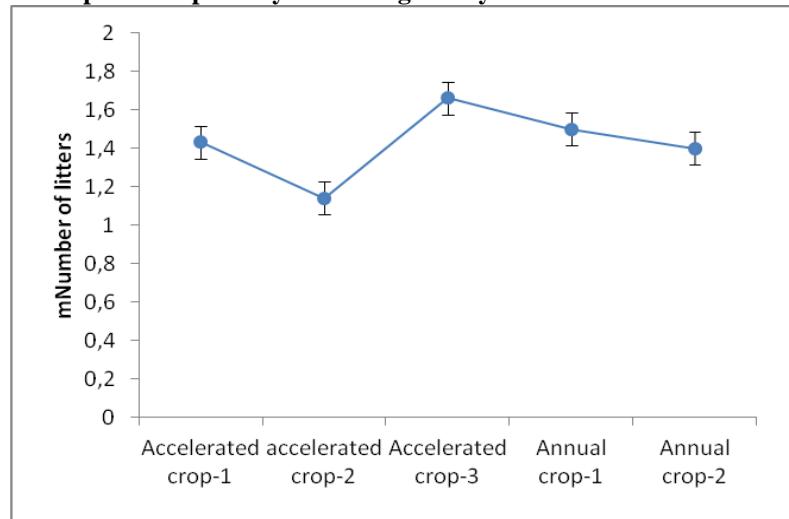
Parameters	Month of breeding season						
	Annual kidding system			Accelerated kidding system			
	September, 2009	August/September 2010	Mean Value	September,2009	August, 2010	March, 2011	Mean Value
Total no.of goats		25			25		
Goats in oestrus (No)	56% (14)	64% (16)	60%	84% (21)	72% (18)	48% (12)	68%
Goats conceived (No)	56% (14)	24% (06)	40%	60% (15)	28% (07)	36% (09)	41.33%
Goats kidded (No)	40% (10)	24% (06)	32%	56% (14)	28% (07)	36% (09)	40%
Kids produced (No)	56% (14)	36% (09)	46%	80% (20)	28% (07)	60% (15)	56%
Kids died (No)	0.0	0.0	-	4.76% (02)	0.0	0.0	4.76%
Single birth (No)	42.86% (06)	33.33% (03)	38.09%	(08) 40%	71.43% (05)	26.67% (04)	40.03%
Twin birth (No)	51.14% (08)	66.67% (06)	58.90%	(12) 60%	28.57% (02)	53.33% (08)	47.3%
Triplet birth (No)	0.0	0.0	-	0.0	0.0	20% (03)	-
Services/Conception	1.14 <sup>a</sup> ±0.36	1.19 <sup>a</sup> ±0.40	-	1.32 <sup>b</sup> ±0.58	1.43 <sup>b</sup> ±0.53	1.64 <sup>c</sup> ±0.81	-
Litter size	1.50 <sup>a</sup> ±0.55	1.40 <sup>b</sup> ±0.52	-	1.43 <sup>b</sup> ±0.51	1.42 <sup>b</sup> ±0.38	1.66 <sup>c</sup> ±0.71	-
Gestation length (days)	150.40 <sup>a</sup> ±0.40	150.33 <sup>a</sup> ±0.49	-	151.23 <sup>a</sup> ±0.43	149.57 <sup>a</sup> ±0.95	147.67 <sup>a</sup> ±1.33	-

Means having different superscripts in a row are statistically significant (P<0.05)

Values in paranthese are the number of animals



**Figure.1- Services per conception by different goats by accelerated and annual kidding systems**



**Figure.2- Litter size by different goats in accelerated and annual kidding systems**

## THE EFFECT OF TWO FEEDING REGIMENS (PROGRAMS) UPON BROILER GROWTH PERFORMANCE, CARCASS TRAITS AND ECONOMIC INDICATORS

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### ABSTRACT

An experiment was conducted to study the effect of using two feeding regimens (programs) upon the broiler growth performance and processing traits. The first regimen (first treatment) was included two types of the broiler diet. The chicks received the starter diet from day-old to 28 days of age and the finisher diet from 29 days of age to 42 days of age (market age), in the Second regimen (Second treatment) the birds received three types of diets (Starter diets from 1-day-old to 21 days of age, grower diet from 22 days of age to 35 days of age while the finisher diet fed to broilers from 36 days of age to market age (42 days of age). Formulation of the diets were based on NRC standards. Experimental diets were formulated to have 3 levels of crude protein (23, 20 and 18 %) for the starter, grower and finisher diets respectively with one metabolized energy (3200 kcal/kg diet) in each starter, grower and finisher diets. The 1-day-old Ross-308 broiler chicks were randomly divided to 14 experimental pens, 25 chicks in each pen and each feeding regimen was included 7 replicates (pens) randomly. The experimental birds access ad libitum to water and feed. The birds maintained in environmentally controlled broiler house under litter floor. At 42 day of age each pen birds was evaluated for performance data were included live body weight (LBW), conversion ratio of feed, protein and energy to (LBW) and to hot carcass weight (HCW). The performance efficiency factor (PEF) and feed cost for production one kilogram of body weight (FC/BWP) and feed cost per one kilogram carcass production (FC/CWP) were calculated. Then 10 broilers (5 males and 5 females) were randomly selected from each treatment for processing data. Processing variables included HCW. The results at market age showed that broiler growth performance and HCW for the birds of second treatment (Second feeding regimen) was better than the first treatment (first regimen) birds.

**Keywords:** Feeding Regimen, Broiler, Diet, Growth performance, Carcass Traits

### INTRODUCTION

Protein is generally considered one of the major cost components of the poultry rations (Kamran et. al, 2004) . Broilers have high dietary crude protein needs when using intact protein to supply essential amino acids. Dietary protein Level, therefore, has major effects on growth performance and overall const of finished product (Firman and Boling, 1998). Feed represents over 70% of the cost of producing chicken meat (Agah and Norollahi, 2008 and Gajana et al, 2011).The starter period represents a much higher proportion of the growing cycle, emphasizing the importance of a good starter diet.(Epol Broiler Feeding Brochure, 2009). Broiler are commonly fed starter, grower and finisher rations to meet relatively stable nutrient requirement levels for specific feeding programs (Skinner et al, 1992 and NRC, 1994). The time of providing diets has a significant effect on the economics, growth and uniformity of broilers (Gehle et al, 1974; Brown and No Cartney, 1982; Skinner et al, 1992; Saleh et al, 1996, 1997 a, b; Warren and Emmert, 2000; Pope and Emmert, 2001; Vandegrift, 2002; Vandegrift el al, 2003 and Roush et al, 2004). Traditional dogma in the feeding programs of meat type poultry holds that birds should be fed rations with decreasing protein percentages and increasing metabolizable energy levels as they approach market age and or target body weight of birds and broilers are commonly fed three rations with increasing metabolizable energy levels and decreasing percentage of crude protein content (skinner-Noble et al, 2002). Poultry industry has shown tremendous development in the recent years as it's one of the best systems of production of animal protein foods. Poultry production possesses excellent prospects such as quick growth rate, rapid turnover of capital, better feed conversion ratio and highly demanded products such as eggs and meats (Mehmood et al, 2014). Phase feeding is performed to take advantage from the changes in nutrient requirements of broilers at various stages of growth. Phase feeding or program feeding or regimen has been described by Emmert and Baker (1997) and by NRC (1994) as a system designed to meet the needs of diversified poultry production systems. phase feeding is a good means of reducing feed costs during the starter, grower and finisher phases (Pope and Emmert, 2001). With out in flouncing performance and having environmental benefits (Gutierrez et al, 2008). The finding studies (Sahota et at 2012 and Mahmood et al, 2012). indicated that phase-feeding (feeding program or regimen feeding) is directly correlated with feed intake, body weight and feed conversion ratio.

## MATERIAL AND METHODS

Three hundred and fifty (350) day-old Commercial (Ross-308) day-old (unsexed) broiler chicks were used in this experiment. They were provided two type of feeding Programs (phases). The chicks were randomly divided into 14 experimental replicates of 25 chicks each replicate. The experiment was a completely randomized design. Treatments consisted of a first feeding program; (T 1), the birds were given starter ration (23% crude protein and 3200 ME kcal/kg ration) from 0-28 days age and the finisher ration (20% crude protein and 3200 ME kcal/kg ration) from 29- 42 days of age, while the second feeding program; (T2) the birds were give starter ration (23% crude protein and 3200 ME kcal/kg ration) from 0-21 days age, the grower ration (20% crude protein and 3200 ME kcal/kg ration) from 22-35 days age and the finisher ration (18% crude protein and 3200 ME kcal/kg ration) from 36-42 days age. The rations were formulated to meet the nutritional requirement according to NRC (1994). Feed (Table 1) and water were provided ad libitum. Measurements were the feed, protein, energy, lysine and methionine intaked (FI, PI, EI, LI and MI) by the birds in each treatment was estimated weekly. Live body weight (LBW) and the body weight gain (BWG) were recorded weekly starting from 1 day age to 42 days age for each treatment. Feed, protein, energy, lysine and methionine conversion ratio (FCR, PCR, ECR, LCR and MCR) were calculated by dividing FI, PI, EI, LI and MI respectively by BWG. At 43 d, 10 birds from each treatment (5 male and 5 females) were selected at random for processing and the birds were manually eviscerated. Hot eviscerated carcass weight (HCW), performance efficiency factor (PEF), feed cost (\$) per 1 kg body weight production (FC/BWP) and feed cost (\$) per 1 kg carcass weight production (FC/CWP) were recorded. The PEF, FC/BWP and FC/CWP were calculated as follow:

$$PEF = \frac{\text{livability}(\%) \times \text{live weight in kg}}{\text{feed conversion ratio} \times \text{age in days}} \times 100$$

Feed cost (American dollars:\$)/one kg of LBW production= price of one kg of feed (\$) × feed conversion ratio

## STATISTICAL ANALYSIS

Data were statistically analyzed with the GLM Procedure of SAS (2002) using a complete randomized design. The comparison of means was made through Duncan's Multiple Range (DMR) test (Duncan, 1955).

**Table (1) Feed Ingredients And Chemical Composition Of Starter, Grower And Finisher Broiler Diets.**

Feed Ingredients %	Diets		
	Starter	Grower	Finisher
Wheat ground	37.49	68.44	70.96
Yellow Corn	21.90	—	—
Soybean meal (44% protein)	25.00	19.00	18.96
Animal protein concentration (50% protein)	10.00	5.00	—
Vegetable oil	5.00	5.00	5.00
Salt	0.20	0.20	0.20
Limestone	—	1.11	1.94
Dicalcium phosphate	—	0.70	1.94
DL-Methionine	0.20	0.15	0.10
L-Lysine	0.01	0.20	0.10
Mineral and Vitamin premix	0.10	0.10	0.10
Enzymes premix	0.10	0.10	0.10
Total	100	100	100

Chemical Composition			
Crude protein %	23	20	18
M.E (Kcal/Kg diet)	3200	3200	3200
Lysine %	1.10	1.00	0.85
Methionine %	0.50	0.38	0.32
Calcium %	1.00	0.90	0.80
Available Phosphorus %	0.45	0.35	0.30
C.P Ratio	139.0	160.0	177.7

## RESULTS AND DISCUSSION

Overall means (Table 2) showed significant ( $p \leq 0.05$ ) difference in live body weight (LBW) and body weight gain (BWG) between two-phase-feeding programs (regimens), where maximum (LBW) and (BWG) were attained by birds in three-phase feeding Program (Second treatment) and the average of the (LBW) and (BWG) for the birds of the second treatment were higher (9.86% and 9.96% respectively) than the birds of the two-phase-feeding program (first treatment), because the birds were fed according to crude protein percent requirement at specific of age which ultimately resulted into more pronounced growth as compared to the first treatment because the compensation in body weight gain is more evident for second treatment receiving diets with high crude protein or ideal protein levels in the consecutive phase (Eits et al, 2003; Narsil, 2003 and Mahmood et al, 2014) and on the other wise in the present study overall mean showed (Table 3) significantly ( $p \leq 0.05$ ) better (FCR), (PCR), (ECR), (LCR) and (MCR) in broilers fed a three-phases (Second treatment) than those under two -phase feeding program and the enhancement percentage for FCR, PCR, ECR, LCR and MCR were 6.12, 6.92, 6.10 and 10.77% respectively for the second treatment with first treatment, similar findings have also been documented in few other reports (Pope and Emmert, 2001, Sahota et al, 2012, Mahmood et al, 2012 and Mahmood et al, 2014). Significantly ( $P \leq 0.05$ ) better (FCRC), (PCRC), (ECRC), (LCRC) and (MCRC) were achieved by birds in three-phase feeding Program (Second treatment) by those maintained on two-Phase feeding program (first treatment) (Table 4), it appears the values of the percentage of the improvement were 6.82, 7.76, 6.53, 5.05 and 10.58% respectively for the conversion feed, protein, energy, lysine and methionine ratio to hot weight carcass respectively in the birds fed three-phase feeding program. The our results show that efficiency conversion ratio of feed, protein, energy, lysine and methionine to body weight and to hot carcass weight significantly affected by the amount of protein and energy consumed (Waldroup et al, 2005; Epol Broiler Feeding Brochure, 2009 and Gajana et al, 2011) and by reducing the time of feeding the finisher diet from 14-28 days to 7 days (Gajana et al, 2011). The economic indicators (PEF), the FC/BWP and FC/CWP were better for the second treatment birds (Table 5).

**Table (2) The Effect Of Feeding Programs (Feeding Regimes) Upon The Growth Rate (gms) And Feed Intake (gms).**

Growth Rate and Feed Intake	Treatments	
	First	Second
L.B.W (gms/bird) at 42 d age	b 2376.07±29.09	a 2610.32±46.47
B.W.G (gms/bird) 0-42 d age	b 2335.65±29.07	a 2568.32±45.75
Feed Intake (gms/bird) 0-42 d age	a 4206.21±80.77	a 4367.64±146.18

Means in a column with different superscripts are significantly different ( $p \leq 0.05$ ).

**Table (3) The Effect Of Feeding Programs (Feeding Regimes) Upon The Efficiency Conversion Ratio Of Nutrients.**

Efficiency Conversion Ratio of Nutrients	Treatments	
	First	Second
Feed (gms)/ B.W.G (gm)	a 1.803±0.044	a 1.699±0.027
Protein (gms)/ B.W.G (gm)	a 0.371±0.008	b 0.347±0.005
Energy (kcals)/ B.W.G (gm)	a 5.779±0.148	a 0.5447±0.0917
Lysine (gms)/ B.W.G (gm)	a 0.017±0.00	a 0.080±0.032
Methionine (gms)/ B.W.G (gm)	a 0.007±0.00	b 0.006±0.00

Means in a column with different superscripts are significantly different ( $p \leq 0.05$ ).

**Table (4) The Effect Of Feeding Programs (Feeding Regimes) Upon The Feed Conversion Ratio Of Nutrients To Hot Carcass.**

Conversion Ratio of Nutrients to Hot Carcass	Treatments	
	First	Second
Feed (gms)/ Carcass (gm)	a 2.394±0.144	a 2.241±0.077
Protein (gms)/ Carcass (gm)	a 0.4918±0.029	a 0.4564±0.015
Energy (kcals)/ Carcass (gm)	a 7.648±0.455	a 7.179±0.249
Lysine (gms)/ Carcass (gm)	a 0.0299±0.0132	a 0.02182±0.0007
Methionine (gms)/ Carcass (gm)	a 0.0094±0.00	a 0.0085±0.00
Hot Carcass wight (gms)	b 1787.7 ±89.12	a 1976.7±74.20

Means in a column with different superscripts are significantly different ( $p \leq 0.05$ ).

**Table (5) The Effect Of Feeding Programs (Feeding Regimes) Upon The PEF, FC/BWP And FC/CWP.**

Economic Indicators	Treatments		
	First	Second	
PEF	308.41	359.53	
*FC/BWP (\$)	1.081	1.002	
**FC/CWP (\$)	1.412	1.322	
Economic Indicators Improvement (%) T <sub>2</sub> vs. T <sub>1</sub>	PEF 16.57 (Higher)	FC/BWP 7.31 (Lower)	FC/CWP 6.37 (Lower)

\*, \*\*: The localprice of the broiler diets starter, grower and finisher were 590,580 and 570 \$ / Ton of diet respectively.

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## THE EFFECT OF USING LEVELS OF RED TIGER SHRIMP MEAL IN STARTER BROILER DIET UPON GROWTH PERFORMANCE

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### ABSTRACT

This objective of this study was to measure the effect of replacing different levels of animal protein concentrate with Red Tiger shrimp meal (RTSM) in the broiler starter diets. A total 300 broiler chicks (Ross\_308) were randomly assigned in treatments dietary contained three different levels of RTSM (0.00, 4.16 and 8.32%) with a completely randomized design (CRD). Each treatment included four replicates (floor pens). The results of this study indicated that body weight gain (B.W.G), conversion ratio of feed, protein and energy (F.C.R, P.C.R and E.C.R) were significantly ( $p \leq 0.05$ ) decreased by Complete substituting (RTSM) for animal protein concentration (third treatment). Mortality percentage significantly ( $p \leq 0.05$ ) increased for third dietary treatment. No significant differences were found for feed, protein and energy intake among treatments during the experimental period (three weeks). In conclusion, (RTSM) could be included to 4.16% in the broiler starter diet or substitute the protein of Red Tiger shrimp as alternative of protein animal protein concentrate as much as 50%.

**Keywords:** Red Tiger shrimp, Broiler, Starter diet, growth performance, animal protein concentrate

### INTRODUCTION

Shrimp meal (SM), a dried and powdered feedstuff as sea protein source contains high-level of crude protein approximately 40-62%, 3-8% ether extract, 4-13% crude fiber, 11-14% chitin and 12-23% minerals as ash (Islam et al, 1994; Rosenfeld et al, 1997; Gernat, 2001 and Oduguwa et al, 2004). Chemical composition (nutritional analysis) of SM Varies widely, depending upon the amount percent of shell or exoskeleton (Singletary et al, 1935; Damron et al, 1964, Raab et al, 1971; Ilian et al, 1985 and Islam et al, 1994). Species and Size of shrimp, and method of preparing the SM and Storage (Oduguwa et al. 2004). Shrimp meal is one of the feed Stuffs alternative for animal protein Sources for broiler and layer diets as partially or totally replacing (Rosenfeld et al, 1997; Gernat 2001; Mahata et al, 2008; Khempaka et al, 2011) Gernat (2001) mentioned using Shrimp waste meal (SWN) instead of Soybean meal in the layer diet at relatively high percentage without causing negative effects upon layer Performance, on other hand, Okoye et al (2005) concluded the SWM is a good source of animal protein and can be used up to 10% in the starter and finished broiler diets and there was no negative effect upon the performance (live weight, live weight gain, feed Consumption, feed conversion efficiency and carcass characteristics). Khempaka et al (2011). Were randomly fed 400 one day old male chicks with five levels (0.0, 5.0, 10.0, 15.0 and 20.0%) of shrimp head meal (32% Crude protein and 18.99% chitin) through 42 day of age and showed no significant changes in growth Performance, digestibility of dry matter, organic matter, ash and chitin and retention when shrimp head meal was at or below 15% of the finisher diet. Islam et al (1994) and Rosenfeld et al (1994) mentioned that SM was excellent source for animal protein when used at high percentage for broiler feeding (14.3% and 31.6% respectively), Some anthers have referred to the negative results by feeding broiler diets contained SM. Oduguwa et al (2004) reported that rations Containing 11.3% and 6.7% of SM in the starter and finisher diets respectively led to depression body weight gain and feed intake, while Fanimo et al (1996) showed increasing and decreasing fed intake and feed conversion efficiency for broilers fed diets contained 9.9% and 8.2% of SM in the starter and finisher rations respectively.

The purpose of this trial was to investigate the optimal level of Red Tiger Shrimp meal inclusion in broiler starter diet instead of animal protein concentrate and its effects on the broiler chick's growth performance.

### MATERIAL AND METHODS

This study was carried out at the poultry farm of the agriculture college-kirkuk University-Iraq. Three hundred day old broiler chicks (Ross-308) were randomly assigned to 12 replicates (floor pens) of three dietary treatments: three levels of Red Tiger shrimp meal imported from china (0.00, 4.16 and 8.32%). Chemical analysis of RTSM were (60% crude protein, 2400 kcal metabolizable energy (M.E)/kg of RTSM. Complete Randomized Design (CRD) and four replicates per each treatment and 25 chicks per Pen (replicate). Therefore, floor space for each broilers was 900cm<sup>2</sup>. The dietary protein, metabolizable energy and other nutrients formulated to meet the Nutritional requirements for broiler chicks at starter period (1-21days) according to NRC (1994). Feed and Water were provided ad libitum and chicks had initially exposed to a continues lighting of 23:30 hours and dark period of 30 minutes in each 24 hours. The experimental diets are shown in Table 1. From

1-21 days of age live body weight (L.B.W), live weight gain (L.W.G), feed, protein and energy intake (FI, PI and EI) and conversion ratio of feed, protein and energy (\*F.C.R, \*\*P.C.R and \*\*\*E.C.R) were calculated weekly, while mortality percentage was daily recorded.

feed consumed (gms)

during (1-21) days

\*F.C.R= \_\_\_\_\_

average body weight gain  
(gms) during (1-21) days

average protein consumed  
(gms) during (1-21) days

\*\*P.C.R= \_\_\_\_\_

average body weight gain  
(gms) during(1-21) days

average energy consumed  
(kcals) during (1-21) days

\*\*\*E.C.R= \_\_\_\_\_

average body weight gain  
(gms) during (1-21) days

**Table (1) Feedstuffs and Chemical Composition of the starter broiler diets.**

Feed stuffs %	Dietary Treatments		
	T1 (control)	T2	T3
Wheat ground	63.25	64.55	65.33
Soybean meal (44% protein)	20.90	20.54	20.50
Animal protein concentration (50% protein)	10	5	—
Red Tiger Shrimp meal (60% C.P)	—	4.16	8.32
Vegetable oil	5.30	5.20	5.10
L-Lysine	0.05	0.05	0.05
DL-Methionine	0.20	0.20	0.20
NaCl	0.20	0.20	0.20
Vitamin and Mineral premix	0.10	0.10	0.10
Total	100	100	100
Chemical Composition			
Crude protein %	22.36	22.43	22.53
M.E (Kcal/Kg diet)	3101	3133	3139
Calcium %	1.0	1.0	1.0
Available phosphorus %	0.45	0.45	0.45
Lysine %	1.10	1.10	1.10
Methionine %	0.50	0.50	0.50
Calorie: Protein Ratio	139	139	139

**Table (1) Feed ingredients and Chemical Composition of Finisher diets**

Feed Ingredients %	Age (days)		
	T1 (control)	T2	T3
Local White Barley	76.31	75.77	76.19
Soybean meal (44% protein)	13	13.5	13.5
Animal protein concentration (50% protein)	5	2.5	—
Shrimp	—	2.08	4.16
Vegetable oil	4.69	5.15	5.15
D I calcium	0.6	0.6	0.6
Vitamin and Mineral premix	0.1	0.1	0.1
DL-Me	0.1	0.1	0.1
Sodium Chloride	0.2	0.2	0.2
Total	100	100	100
Crude protein %	18.14	18.29	18.33
M.E (Kcal/Kg diet)	3211	3242	3244
C.P Ratio	177	177	177

## STATISTICAL ANALYSIS

All data were analyzed by analysis of variance procedures appropriate for a completely randomized design (CRD) using the GLM procedures of SAS (2002). Significant differences ( $p \leq 0.05$ ) among treatments means were determined using Duncans multiple rangetest (Duncan, 1955).

## RESULTS AND DISCUSSION

The results of this study were referred a significant depression for the means of body weight gain (B.W.G) and conversion efficiency ratio of the feed, Protein and energy (Tables 2 and 3) for third treatments (SM%). The limiting factor of the SM levels in the broiler diets were probably due to chitin levels, which are considered to have a low digestability when fed to animals (Austin et al, 1981; Fanimo et al, 1996; Oduguwa et al, 2004; and Khempak et al, 2006). Diets contains chitin at 3.23% in a starter diet led to depression body weight gain and digestibility (khempake et al, 2006). From our finding might be attributed to the high levels of chitin found in Red Tiger shrimp meal, The exoskeleton of the shrimp is composed mainly of chitin, N-acetylated glucosamine polysaccharide that forms part of the protein complex, and is considered to have low digestibility when fed to poultry (Austin et al, 1981; and Gernat, 2001). Due to this low digestability, Chitin physically blocks the access of digestive enzymes to lipids and protein, thus affecting the utilization of these nutrients (Castro et al, 1989; Mirzah, 1990; and Gernat, 2000). On other hand the poultry intestine is almost acidic than alkaline (Bronner, 1987). Kheiri and Rahami (2006) found that calcium might increase the intestine PH and consequently affect negatively on the digestion and absorption of nutrients. The third diet in the our study contained chitin and calcium, this is a possible cause of lower protein digestibility and nitrogen retention and this finding agree with Mahat et al (2008), Khempak et at (2011) and Okonkwo et al, (2012). The bird consumption of the feed, protein and energy (Table 4) were significantly ( $p \leq 0.05$ ) decreased for the third treatment by comparing that with control diet (first treatment).

**Table (2) Effect on the inclusion of Red Tiger shrimp meal (RTSM) in starter broiler diets on live body weight (L.B.W) and body weight gain (B.W.G).**

Dietary Treatment	L.B.W (gms/bird) (21 d age)	B.W.G (gms/bird) (1-21 d age)
First	ab	ab
(control)	563.61	523.16
Second	a	a
(4.16% RTSM)	655	615
Third	b	b
(8.32% RTSM)	409.77	369.77

\*Means in a column with different letters are significantly different ( $p \leq 0.05$ ).

**Table (3) Effect on the inclusion of Red Tiger shrimp meal (RTSM) in starter broiler diets on conversion ratio of feed, protein and energy (F.C.R, P.C.R and E.C.R).**

Dietary Treatment	F.C.R	P.C.R	E.C.R
First (control)	b 2.35	ab 0.531	a 7.38
Second	b	b	a
(4.16% RTSM)	1.88	0.426	5.92
Third	a	a	a
(8.32% RTSM)	2.91	0.660	9.16

\*Means in a column with different letters are significantly different ( $p \leq 0.05$ ).

F.C.R: gms of feed/gm of body weight gain

P.C.R: gms of protein/gm of body weight gain

E.C.R: kcal of energy/gm of body weight gain

**Table (4) Effect on the inclusion of Red Tiger shrimp meal (RTSM) in starter broiler diets on feed, protein and energy intake (F.I, P.I and E.I).**

Dietary Treatment	Feed Intake (gms/bird)	Protein Intake (gms/bird)	Energy Intake (kcal/bird)
First	a	a	a
(control)	1225.65	278.1	3862.6
Second	ab	ab	ab
(4.16% RTSM)	1155.79	262.2	3641.9
Third	b	b	b
(8.32% RTSM)	1075.21	243.9	3388

\*Means in a column with different letters are significantly different ( $p \leq 0.05$ ).

## CONCLUSION

RTSM could be included to 4.16% in broiler starter diet or substitute the protein of RTSM as alternative of animal protein concentrate as much as 50%.

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## EFFECT OF DAIRY CATTLE BREEDERS' ASSOCIATION (DCBA) MEMBERSHIP ON SUSTAINABILITY OF INNOVATIONS IN SAMSUN PROVINCE OF TURKEY

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### ABSTRACT

The aim of this research is to analyse the effects of Dairy Cattle Breeders' Association (DCBA) memberships on the sustainability of dairy related innovations in Samsun province of Turkey. Thus, the personal and farm characteristics and information systems of members and non-members of the DCBA were initially compared and the relations between these characteristics and the sustainability of innovations were analysed. Structured interviews were used to collect data from 43 members and 65 non-members of the DCBA by random sampling. The members had higher socio-economic status compared to the non-members in terms of farmers' personal characteristics and farm structure (i.e. gross agricultural and husbandry incomes, time allocated for agriculture and dairying, size of agricultural land and feed crops, number of European breeds, milk yield, agricultural information and innovation scores). Some of these factors affected the sustainability of innovations which were measured as the Innovation Sustainability Index (ISI) and calculated by multiplying the number of innovations with their years of adoption. Thus, partial correlation coefficient between ISI and some variables (controlled by the DCBA membership) was calculated. The result showed that the years of formal education, agricultural information score, agricultural income, milk yield, size of feed crops and number of European breeds were positively correlated with ISI. Positive association between ISI and higher socio-economic status emphasizes the importance of DCBA membership in adopting and sustaining innovations. It can be suggested that more functional cooperation between public and private institutions is needed to motivate conventional dairy farmers to adopt and sustain modern dairy farming innovations.

**Keywords:** Dairy cattle, Innovation Sustainability Index (ISI), sustainability of innovation, information, breeders' association.

### INTRODUCTION

Farmer organizations are civil communities that aim to protect the endeavors of the farmers and to utilize their products at their best in the market. It has become important for the producers in agriculture, a crucial sector for human diet, to gather under a cooperative (association) so that they could pursue their persistence competitively. Significant works have been done to activate these associations. Relationships are built between the farmers and extension worker through the associations, and new technologies to be adopted are introduced to the farmers in order that rural development could be enhanced. Furthermore, the farmers become more productive with new technologies, and this, in turn increases their production efficiency and domestic income. All these factors contribute to the persistence of the organizations. Social and economic characteristics (factors such as personalities, farm characteristics, agricultural information system, etc.) may differ for the farmers coming together with the same purpose and therefore, they can hardly adopt the new technologies at the same point of time. However, they can be aware of the innovations and try to practice by means of the organizations they enroll; and hence, decide to adopt. In other words, the change in their adoption behaviors can be facilitated. It is therefore obvious that farmer organizations have definite effects on the sustainability of the innovations.

Rogers (1995) defined innovation as: "an idea, practice or object, perceived as new by an individual or organization". Innovation is absolutely unknown in the beginning of the introduction to a society. The individuals or the organizations do not use it before it is adopted by the innovators (Berger, 2005). Moreover, the innovation may be developed alternative solutions to problems for meet the needs of individuals or organizations. In addition, it may be new ways in detection of problems or needs (Rogers, 1995). Taken from this perspective, innovation may be defined as new products, technology, point of view or a way out for individuals or organizations.

The concept of innovation has recently been mentioned in a system approach understanding and it is noted to be more effective when conveyed to the farmers by all institutions coming together rather than by one single institution. The approach of Agricultural Innovation Systems (AIS) unites different people and institutions (agricultural policy makers, private research institutions, local extension staff, farmer groups, etc.) from agricultural and rural areas, and emphasizes the significance of the relationship between these actors (Demiryürek, 2014). AIS is a constantly changing concept, and it brings flexibility to the use of innovations under different circumstances (Pound and Essegney, 2008). The approach of AIS includes a radical shift from a traditional, linear, and top-down technology transfer approach towards the innovation systems approach

(Spielman et al., 2011). Agricultural innovation, on the other hand, is not only the adoption of new agricultural technologies, but also the re-organization of marketing strategies by a group of farmers, the utilization of a new learning and education methods by the extension workers, or the use of a new crop processing technique by an agricultural institution (Demiryürek, 2014).

Many studies have been conducted worldwide on farmers who are member and non-member to farmers' organizations, largely centering upon the adoption behaviors. A large number of international studies have been fulfilled on rural women's adoption of production techniques in dairy cattle breeding and their socio-economic features, the factors affecting the adoption of agricultural technologies, the adoption behaviors of the members of breeder associations, socio-psychological factors influential in member and non-member farmers' adoption of artificial insemination, and the factors affecting the adoption decisions of the rural young (for instance, Haque and Ray, 1983; Kunzru and Tripathi, 1994; Motamed and Singh, 2003; Ghosh et al., 2004; Agwu, 2004; Ghosh et al., 2005; Mafimisebi et al., 2006; Rahman, 2007; Onemolease and Alakpa, 2009; and Uaiene et al., 2009). In Turkey, the related studies rather focus on the factors influencing the adoption of innovations and on determination of extension staff roles in adoption of agricultural innovations (Esengün and Sivaslıgil, 1993; Aktaş, 2005; Sezgin, 2010; Hasdemir and Taluğ, 2012; Kaya and Atsan, 2013). Among the studies that have been conducted, those that concentrate on the role of farmers' organizations in farmers' adoption of innovation so far have not been encountered. The purpose of this study is to determine the relationship between socio-economic variables and innovation index, in other words, the farmers' innovative characteristics analysed with the aim of comparing social and economic features of members and non-members of dairy cattle breeders' association (DCBA) in the districts of Bafra and Vezirköprü, determining the farmers' adoption of innovations in dairy cattle breeding, and confirming the effects of the associations on sustainability of innovation.

## MATERIALS AND METHODS

The initial material of the current study is the data gathered via face-to-face interviews conducted with farmers registered and not registered to DCBA in Bafra and Vezirköprü districts of Samsun province in the year of 2006.

Purposeful sampling method was used in the survey where 95 % confidence interval and 10 % margin of error were determined. The survey was administered to 43 registered, 65 unregistered, and totally 108 farmers and random numbers table was used in determining the participant.

## DATA ANALYSIS METHODS

Innovation Sustainability Index (ISI) was calculated by adapting the innovation adoption score developed by Dasgupta (1968). This index refers to "adopted and applicable practices" of the farmers. In its calculation, not only the number of adopted innovations but also the number of years throughout which each adopted innovation has been practiced is taken into consideration. It can be stated that as the index value increases, the sustainability of innovations that the farmers have been adopted increase accordingly. In other words, the farmers with higher index values can be considered to be more innovative. The index used in this study is calculated as:

$$\text{Innovation Sustainability Index (ISI)} = \frac{\text{number of years of adoption} \times \text{number of adopted innovations}}{\text{Total innovation number}}$$

The innovations that the breeders adopt are artificial insemination, milking machine, silage making, keeping records, animal health, forage crops, concentrate feed, animal insurance, automatic drinking bowl and open/closed barn systems.

The study also included the comparison of the breeders personal characteristics (age, period of formal education, agricultural experience and dairy cattle breeding experience, time spend for agriculture, and agricultural income), farm characteristics (land size, land used for forage crops, time spend for breeding, milk yield, etc.), and information scores of members and non-members of DCBA via the independent samples t test. The Information Score is formulated as:

$$\text{TIS} = \text{FC} \times \text{IU}$$

Where FC is the number of contact with information score for the i-th dairy farm and IU is the usefulness of information for the i-th dairy farm (Demiryürek et al., 2008). Then partial correlation coefficient (control variable: state of membership) was calculated, and Innovation Sustainability Index and the relationship between these variables were presented.

## RESULTS AND DISCUSSION

This study is grounded on the comparison of socio-economic characteristics of breeders who are members and non-members of the association, and on the analysis of the effects of these breeder features on the sustainability of the innovations. No significant difference was found between members and non-members of the Association in terms of their age and formal educational background (Table 1). According to t test results, significant

differences were found between the breeders inclined to the association and the non-members with regards to their general agricultural experiences, dairy cattle breeding experiences, agricultural income, time spend for agriculture, total information score, innovation index, land used for forage crops, time spend for breeding, income from breeding, and the number of European breeds. It is notable that dairy cattle breeding experience and general agriculture experience were found to be higher for non-members, and relatively younger breeders were found to be more a member of breeders' association.

Agwu (2004) aimed to determine socio-economic features influencing the adoption of cowpea manufacturing technologies among the farmers in Bauchi and Nigeria, and 69.3 % of participating farmers were between the ages of 30 – 49 and 70 % were literate. The study also found that farmland size (total enterprise land size) and formal education level had significant effects on the adoption of manufacturing technologies.

**Table 1. Socio-economic features of members and non-members of dairy cattle breeders' association**

Variables	Members	Non-members	t test  P
	Mean ± SE	Mean ± SE	
Age (years)	44.53 ± 1.28	47.75 ± 1.47	
Years of formal education	6.12 ± 0.33	5.46 ± 0.29	
General agricultural experience (years)	26.42 ± 1.40	33.18 ± 1.65	**
Dairy cattle breeding experience (years)	12.05 ± 1.48	21.23 ± 1.83	**
Share of agricultural income in total (%)	90.81 ± 3.23	79.23 ± 4.40	*
Share of time spend for agriculture in total (%)	90.00 ± 4.38	76.31 ± 4.96	*
Total farm land area (decar)	240.07 ± 128.41	49.68 ± 7.44	*
Milk yield (litre/animal)	13.79 ± 0.66	8.23 ± 0.54	**
Total Information Score (TIS)	1408.87 ± 93.04	1037.08 ± 76.6	**
Innovation Sustainability Index (ISI)	21.43 ± 3.15	12.12 ± 1.46	*
Land used for forage crops (decar)	121.05 ± 49.46	21.22 ± 2.69	*
Share of time spend for breeding in total (%)	52.33 ± 3.76	33.85 ± 3.12	**
Share of income from breeding in total (%)	56.51 ± 4.20	36.54 ± 3.16	**
Number of European breeds	17.14 ± 4.47	2.48 ± 0.46	**

\*p<0,05   \*\*p<0,001

According to the innovations practiced by the farmers are presented in Table 2, the members practiced more numbers of innovations than no-members. This indicated that the members of the breeders associations adopt more innovations and probably earlier since they learnt from members about them compared to the non-members. Artificial insemination was adopted most of the breeders, but animal insurance was adopted by few breeders. The non-members can hardly be familiar with equipments such as milking machine and automatic drinking bowl unless they were members of the association.

**Table 2. Innovation practices of members and non-members of Dairy Cattle Breeders' Association**

Innovations	Members				Non-members			
	Practiced	%	Not practiced	%	Practiced	%	Not practiced	%
Artificial insemination	41	95.3	2	4.7	57	87.7	8	12.3
Silage making	39	90.7	4	9.3	45	69.2	20	30.8
Keeping record	30	69.8	13	30.2	18	27.7	47	72.3
Animal health	28	65.1	15	34.9	37	56.9	28	43.1
Forage crops	27	62.8	16	37.2	22	33.8	43	66.2
Concentrate feed	27	62.8	16	37.2	39	60.0	26	40.0
Milking machine	22	51.2	21	48.8	8	12.3	57	87.7
Automatic drinking bowl	20	46.5	23	53.5	15	23.1	50	76.9
Barn system	10	23.3	33	76.7	7	10.8	58	89.2
Animal insurance	4	9.3	39	90.7	5	7.7	60	92.3

According to partial correlation analysis results (Table 3), where the membership to the association was taken as the covariant, Innovation Sustainability Index showed a statistically significant positive correlation with the period of formal education, income from agriculture, milk yield, total information score, number of cultivated breeds, and land used for forage crops. Farm land size and total information score were found to be the highest correlation with the innovation index (0.589 and 0.481, respectively) while the lowest correlation was found with share of agricultural income in total income (0.203).

**Table 3. Correlation between socio-economic variables and Innovation Index**

Variables	Innovation Sustainability Index
Farm land size (decar)	0.589**
Total Information Score	0.483**
Milk yield (litre per animal)	0.375**
Number of European breeds	0.365**
Years of formal education	0.269*
Land used for forage (decar)	0.209*
Share of agricultural income in total (%)	0.203*

\*p<0,05 \*\*p<0,001

Ghosh et al. (2004) found significant relationship between the adoption of improved breeding practices and “age and educational status” among other socio-economic characteristics of cooperative members in Gaighata and Bagdah block of North-24 Pgs district, West Bengal. In another study, conducted by Mafimisebi et al. (2006) in Nigeria, educational status and agricultural income were detected among significant factors influencing the adoption of breeding management technologies. Rahman (2007), Motamed and Singh (2003), Sezgin (2010) and Haque and Ray (1983) also obtained similar results in their studies.

## CONCLUSION

Farmers' associations have critical functions in organizing the farmers and activating them in the market. An efficient organization of the farmers can increase agricultural output, yield, products quality, and raise the standard of living for rural people. Introducing recent technology through association members is considered to diffuse the innovations in a rural society more rapidly. The study showed that members of breeders association produced more consciously, keep more aware of the innovations, and adopt and use them more often when compared to non-members. Therefore, significant differences observed between members of association and

non-members with respect to socio-economic status. Thus, early adopters of innovations (i.e. members of association) are primarily contacted in order to introduce new inputs and methods in a society. An increase in the interest of the producers into innovations may lead to important increase in their income. Consequently, it is noticed that association members were higher socio-economic status compared to non-members. In addition, the higher information scores indicated that the members contacted more information sources, more often and benefited more compared to non-members. Moreover, members of association functioned to adopt more innovations with earlier times and sustain longer these innovations. Thus, factors effecting the sustainability of innovations should be identified with a comprehensive research throughout Turkey focusing more on producers registered to farmer organizations. It can be also suggested that more functional cooperation between public and private institutions is needed to motivate conventional dairy farmers to adopt and sustain modern dairy farming innovations and support them to become members of farmers' associations.

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## **SURVEY ON IMPACT OF DAIRY HUB TRAININGS ON LIVELIHOOD OF FARMERS IN PUNJAB DISTRICT SAHIWAL.**

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### **ABSTRACT**

Livestock management is an important factor linked to milk and meat production worldwide specifically in Pakistan. Pakistan livestock sector contributes 56.3 % to the agriculture and about 11.8% to total GDP. It was a dire need to understand the limitations and key aspects related to low milk and meat production in the country. In the present survey 2 tehsils of Sahiwal, 42 villages of Mian Channu and Kasowal, associated with dairy milk collection centers of Nestle and Engro Dairy Hubs were selected.

Two separate questionnaires were used to examine the prerequisites for Dairy Hub Trainings Program. Significantly higher milk yield, meat production and income exhibited through capacity building of farmer. During April to June 2011 farmers were interviewed keeping in view the 500 questionnaire sample size. . Meanwhile 250 questionnaires from each survey area were analyzed. Result of survey show that daily milk yield was 4-5L per Sahiwal cattle traditionally in rural subsistence farming production system and 6-7 liters/ cattle in peri-urban commercial farming system with 1.5% increase in milk production. Report figured out that addition of cottonseed cake, free access of water and silage and hay with concentrates lead to remarkable increase in milk yield during dry and rainy season. Quality semen for Artificial Insemination services improved quality of animal production (13.2% farmers require AI services for 1 time ) It was concluded that dairy hub trainings module supports capacity building of farmers shifting from traditional to advanced modern dairy farming ultimately impacting farmer's livelihood via generating more income from milk sale.

**Keywords:** Livestock; Dairy hub trainings; Farmer's livelihood; Milk sale; Income generate

### **INTRODUCTION**

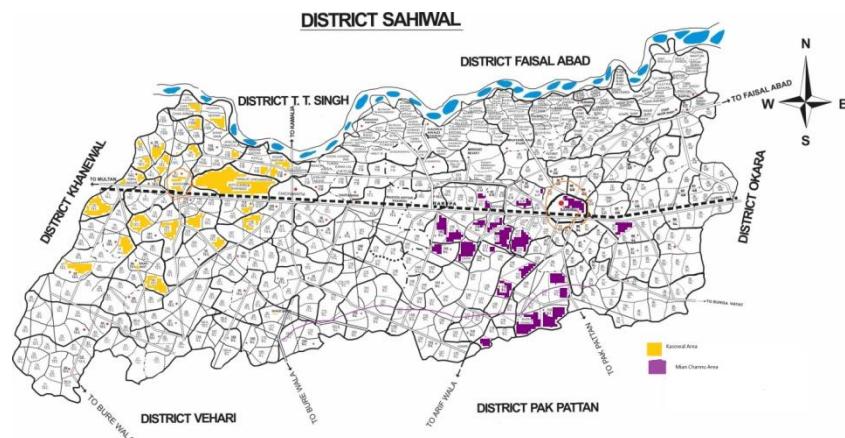
Sahiwal cattle are a breed of Zebu cattle which primarily is used in dairy production. Sahiwal cattle has home tract from the district Sahiwal, Punjab province of Pakistan. Well adopted to hot & humid ambient temperature tick resistant of all zebu breeds. Sahiwal cattle originated in the dry region of Punjab which lies along the Indian-Pakistani border, on the basis of its high milk production under stress conditions it has also been exported to other Asian countries as well Africa and the Caribbean (Australian-Friesian-Sahiwal). Sahiwal cattle average milk yield 7000-9000Lit/lactation internationally while 1500-2300Lit/lactation with fat contents of 4.5% in Pakistan (Economic survey of Pakistan, 2014). There is huge room for improvement of milk yield per lactation while suckling a calf much higher milk yields have been recorded (Anonymous, GOP,2015) The Sahiwal is the heaviest milking breed of all Zebu breeds and display a well-developed udder. District Sahiwal having highly fertile agricultural land, particularly the growing of cotton, grain, potato, wheat and rice exported all around the world.

Pakistan produces 52.62 million tons of milk annually and per capita milk availability is 259 Liters per annum, has one of the highest per capita milk consumption rates in Asia and is the 4<sup>th</sup> largest milk producing country in the World (Economic survey of Pakistan 2015). The human population of Sahiwal 208,778, 14<sup>th</sup> lage city of Pakistan (GOP, 2015), still meeting serious problems of scarcity food and malnutrition The farmers which are key players were still facing constraints, inherent because of their small size herds, malpractices, malnutrition, less milk production and cannot reach to market channels directly to consumers. In 2013, statistical data The Ministry of National Food Security of Pakistan estimated the population of dairy cattle 39.70 million in which Sahiwal cattle contributes 3.96 million ( Economic survey of Pakistan 2015). Livestock sector provides employment to a large number of rural households and about 40-45 million people are engaged in livestock related activities, earning about 65 percent of their income from it(Anonymous, Government of Pakistan, 2015). The purpose of this study was to investigate the pre requisites for the Impact of dairy hub trainings on the living standard of farmers and increase in milk production, milk handling at milk collection centers through a survey.

## MATERIALS AND METHODS

### Areas

The study was carried out during the period April to June 2011 around the two tehsils of Sahiwal district: the Kasowal area and Mian Channu area (Figure 1). The Kasowal area is located in the West of the country at coordinates 30°29' latitude North and 72°32' longitude east. The town situated in the densely populated region between two river named the Sutlej and Ravi having hot and humid climatic conditions which favor intensive agriculture and animal production. The Mian Channu area is located in the central region of the country at the coordinates 30°27' latitude North and 72°22' longitude east. The distance between the two tehsil is 32 km.



Source: <http://www.sahiwal.eu.pn/map.html>

Figure.1 Map of District Sahiwal with studt area : Kasowal area and Mian Channu area

### Social survey

The survey study targeted both dairy farmers and dairy milk collection centers at Mian Channu and Kasowal, respectively. The project includes 20 villages of Main Channu Dairy hub training programs collaborated with Nestle Pak Ltd and 20 villages of Kasowal Diary milk collection centers collaborated with Engro Food Pvt Ltd. The inclusion criteria for dairy farms were that they were linked to one of the dairy hub milk collection centers included in the study. They were located not more than 15-20km from the city and they were willing to participate in the study.

Two questionnaires were designed for the survey one for the Impact of dairy hub trainings program including aspects of increase in quality of animal production in previous 2 years, landholding capacity of farmers, farmer's aptitude towards modern dairy farming, handling of mastitis cases, use of mineral mixture, concentrates, silage and hay. And the second questionnaire figure out the income generated from milk sale at milk collection centers, including aspects of increase in milk production, response of farmers for artificial insemination, mastitis control and free access of water for dairy animals. The survey was conducted as interviews direct with the farmers, dairy farm owners, managers of each dairy hub milk collection center. The dairy farmers asked step by step about their activities. The questionnaire for impact of dairy hub trainings and increase in milk production includes 20-25 questions respectively. At farm level interviews conducted after milking time. The questions include identification of farmers, increase in number of household animal production, landholding farmers, artificial insemination practices, nutritional imbalances, use of silage, and management of mastitis finally the increase in milk production with manners of milk storage. The questionnaire also included questions about different activities in dry season for fodder storage like silage and hay making as study area having hot climate.

### Sampling measurement

In total 500 samples from individual farmers were analyzed, Statistical analyses was performed with SPSS for windows (version 14.0.1, © 2010). The variables in the two questionnaires were coded accordingly to the SPSS coding system. Descriptive statistics were performed for all variables; Frequencies were established for qualitative variables and mean, standard deviation, minimum and maximum values were obtained for increase in potential number of animals, landholding farmers, mastitis cases, feeding concentrates, milk production/lit/day/animal, mineral mixture, silage, hay, free access of water and income from milk sale/day. In the text, values are presented as mean + standard deviation. Furthermore, the Chi-square test was used to test relationships between variables. Data for the two areas were compared with t-test. Differences were considered to be significant at the level  $P < 0.05$ .

## RESULTS AND DISCUSSION:

### Social survey – farm level

Four categories of farmers observed during study(Table-1). About 30-35% were specialized in animal production on traditional dairy farming under **Rural Subsistence Production System** farmers holding 1 -5 number of animals, having no land /landless with low animal production due to mal practices and lack of knowledge. Animals mostly graze on wheat straw and green fodder. In this system 1/4<sup>th</sup> milk production sold and remaining utilized for domestic use. The second category **Rural Market Oriented Smallholder Production System** 20-25% farmers possessing 5-10 animal also land holding for silage preservation. They feed their animals on green fodder, silage, wheat straw with seed cake and hay in dry season. 70% milk sold direct to the milk collection centers of dairy hub. Their influence towards dairy hub trainings is positive mostly attend dairy hub trainings and practicing their knowledge to combat managemental diseases like mastitis. They also report to increase in their animal numbers by adopting artificial insemination and gain genetically more potential animals as compared to last 2 years. They focus at khal wanda banola and free acces of water to their animals. The third type of farmer under the system of **Rural Commercial Dairy Farming**, 18.08% farmers holding 10-20 number of animals, agriculture as their main occupation with dairy farming. They feed their animals on balanced ration called wanda,practicing modern technique . During survey it was observed that milking machines at Tolamba, Iqbal nagar and Mohsin wal. They showed more interest in the milk production field in new management routines but seemed to lack the knowledge and needed to trained in dairy farm management. About 90% milk sold directly to the milk collection centers. The fourth type of farmers about 8% under the system of **Peri-urban Commercial farming**, holding 20-50 numbers of animals. They invest in dairy farming for better return in cash amount. Availability of cash making no hindrance to switch them to corporate dairy farming. Animal feed chopped green fodder i-e silage, wheat straw and cottonseed cake or cereal bran as concentrate mixture in dry season with target to sell almost total milk produced.

**Table 1. Increase in Animals Production after Training Programs.**

No. of animals	Percentage (%)
1-4	10.4
5-10	41.6
10-20	31.6
20-50	16.0
50-60	0.4
Total	100

According to (Table.1) 10.4 percent of dairy farmers owned 1–4 animals, 41.6 percent of dairy households maintained herd sizes of 5–10 animals; another 31.6 percent had herds of 10-20 animals, 16.0 percent of the dairy farmers could be considered 20-50 animals and 0.4 percent of dairy farmers owned 50-60 animals.

The aptitude of farmers towards dairy hub training programs and their understanding on modern dairy farming about 14.8 percent farmers said that they had never received training or further education as having negative attitude towards training programs, not willing to change traditional practices (Table-2). They mostly watered their dairy animals in the river Sutlej and Ravi. Listing the lack of grass during dry season; the small fragmented number of animals and poor financial status are the factors that limit them to motivate and strengthen. While 86.2 percent farmers are those having moderate to significant aptitude towards dairy hub training programs (Table-3). They report daily milk yield 6-7 L per cattle and sometimes 10-20 L with seasonal variations. The produced milk was sold to dairy hub milk collection centers and this was the most important source of income they generated. Furthermore, they engaged in cropping cotton around their houses and used crop residues, silage and hay preservation for dry season.

**Table 2: Farmer's knowledge about Dairy Hub Training Programs.**

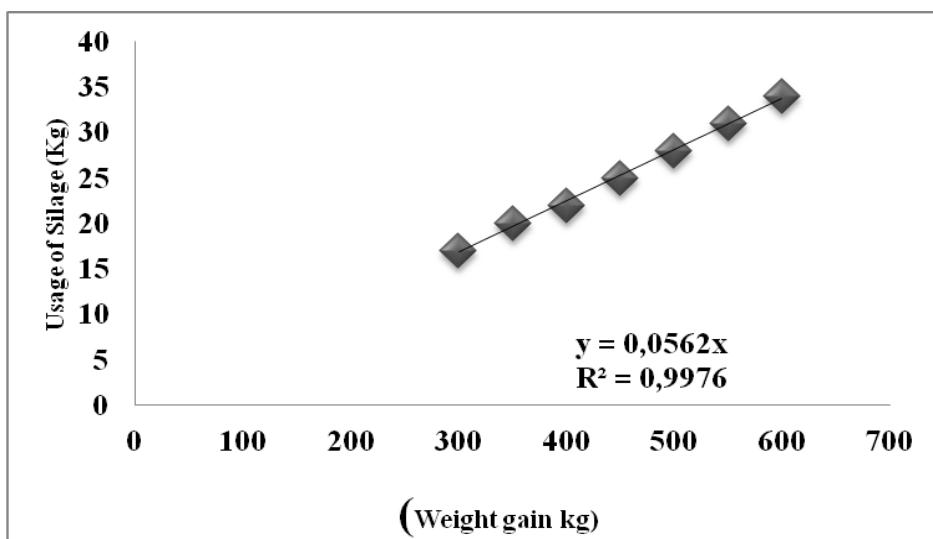
QUESTIONS	ANSWERS	PERCENTAGE OF FARMERS
What is the Impact of trainings or training response from farmers?	Significant Impact	43.6% farmers are those whom have significant impact on the health of animals
	Moderate Impact	43.2% are those whom have moderate training impact on the health of animals,
	No Impact	10.4% are those whom have no training impact
Increase in milk production last 2 years lit/day	Yes	85.6%
	Never	15.4%
Utilization of Artificial Insemination.	Yes (only once)	13.2%
	Never	86.8%
Use of Silage , Hay, wheat straw	Yes	75.4%
	Never	24.6%

The main activity of the farmer was strongly related to the aptitude of farmers towards the training programs ( $\chi^2 = 5.63$ ;  $P = 0.001$ ). The survey found that farmers with a low education level were specialized only in animal production and kept local breeds for milk production; while the other farmers had secondary school education level kept cross breeds and had farming on modern dairy farming techniques. Most of the animals were non-producing and the proportions of the different types of animals varied between farms. According to the survey, 14.8% farmers said that they had applied artificial insemination only one time and conception rate is high getting genetically more potential animals. The current situation in Sahiwal is similar to the situation in Nigeria and Zimbabwe (Ngongoni et al., 2006; Osotimehin et al., 2006) where the educational level of traditional farmers was less than primary school and who only used local breeds. The large herds described by the traditional farmers require a lot of feed, more workers and more treatments against diseases than smaller herds with a higher proportion of lactating cattle.

**Table-3: Training Aptitude (Chi-Square Test)**

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	242.278 <sup>a</sup>	1	.000		
Continuity Correction <sup>b</sup>	234.618	1	.000		
Likelihood Ratio	200.363	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	241.309	1	.000		
N of Valid Cases	250				

Table-3: It shows that the comparison of farmer's aptitude towards dairy hub training programs. The minimum expected count is less than 0.05 so it concluded that results are significant.



#### Social survey – dairy hub milk collection centers

**Figure-2: Animal weight gain while using Silage.** In this figure graph shows that 300 kg Sahiwal breed can consume 17 kg of silage on the basis of 3% body weight at dry matter. And 350kg body weight can consume 22 kg of silage .

Fourteen dairy hub milk collection centers were located in Kasowal district Sahiwal. All dairy hub milk collection centers were privately owned by Nestle Pak Ltd. The total quantity of milk collected per day varied between dry and rainy season and from 400 to 700 L per day. Eight of the dairy hub milk collection centers had three employees, while one Sub Center Agent, who is working along with other employees collecting milk and handover to the collection centers for milking tests. Sub center agent also testing the milk quality and issue receipt to the farmers. The survey found that these 14 dairy hub milk collection centers only collecting the milk from farmers and paying reasonable cash amount on the spot. The survey showed that training sessions to the farmers having great impact on average milk yield of sahiwal cattle after adopting technologies of modern dairy farming production system .In Pakistan, 3-4 percent of total milk is produced and marketed through formal channels while remaining 97% of milk reaches to end consumers for immediate consumption through extensive multilayered distribution system of middleman (Hamzo Khan Kunbhar, 2015 and Ahmed N, 1995.). There are clear differences in the management of dairy farms owned by traditional farmers and those owned by people who have moved into modern dairy production system during the last two years. Similar conditions have been reported from Kenya, (Abeyagunawardena H, Abayawansa WD, 1995 and Khan M, 2013).

Forage quality has a direct effect on animal production and animal performance, ultimately good quality of milk and meat is obtained for human consumption (Wisconsin, 1984-98). Sahiwal district having highly cultivated fertile land, farmer preserve silage for dry season during shortage of green fodder. When animal eat fodder, volatile fatty acids are formed by the process of fermentation. Fermentation is a process which occurs in the absence of oxygen with the help of aerobic bacteria resulting end product as a ethyl alcohol and volatile fatty acids. In the process of silage making same environment is provided that is naturally present in rumen. Animal needs energy for the process of fermentation. By using silage animal can save that energy hence animal can utilize that surplus energy in milk and meat production (Figure-2).

The capacity of Sahiwal cattle is higher in peak milk yield could be as high as 20L of saleable milk per day in the Sahiwal cattle, including the milk consumed by the calf (Z. Rehman, 2013). The current study suggests that milk production could increase if the Rural Subsistance farming system farmers move towards the Rural and Peri-urban Commercial farming system. There is a need to develop knowledge and learning systems within livestock services that can strengthen the capacies of livestock farmers to demand or seek information, training and advices. Capacity building of livestock farmers should be strengthened and sustained to be much more functional (M.Afzal, 2011).

Dairy smallholding farmers however continue to face serious challenges especially in milk and meat production. This is mainly due to lack of knowledge on important practices and technologies that can sustain agriculture and livestock. Lack of commercial dairy farming is another limiting factor in Pakistan dairy industry (M.Afzal, 2011). The main changes to implement should be smaller dairy herds holding genetically potential animals with a higher proportion of lactating cattle and a higher number of crossbred through AI services. Furthermore, farmers should feed roughage of quality silage and also include cottonseed cake in the diets for the lactating cattle.

## CONCLUSION:

In conclusion the study showed that the main challenge is to educate the farmer and to motivate them for modern dairy farming practices on international standards to overcome the milk shortage. Second biggest challenge is in increase milk yield per sahiwal cattle. The survey suggests that this can be achieved by active mobilization of community through awareness campaigns and field farmer training programs in collaboration with public-private partnership. The smallholder farming sector is in most producing position but the animals are of low genetic potential however because of high number of people and animals, it represents a huge potential for increase of total milk production and generation of employment. Despite this, the training implementation has been neglected. It is recommended that more investment is directed towards the smallholder production system through educational and training programs.

There is lack of consumer information on their consumption habits and preferences for dairy products. This aspect has been aggravated milk marketing bottlenecks, when producers are not aware for the demand for milk, neither in quantity nor in quality. It is concluded and recommended that dairy development should be promotional, focus on promotion of milk marketing and consumption through consumer education.

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## UTILIZATION OF CRYOPRESERVED RUMINAL FLUID IN IN VITRO GAS PRODUCTION TECHNIQUE FOR EVALUATING ENERGY AND DIGESTIBILITY VALUES OF FEEDSTUFFS

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### ABSTRACT

In vitro gas production technique (IVGPT) is routinely used worldwide to attain energy content, and organic matter digestibility of various feedstuffs, based on gas production and nutrient content, within 24-72 hrs. Rumen fluids collected from two ruminally cannulated Holstein heifers (350 kg) were used in fresh and cryopreserved form with two stage protocol in the inoculum for IVGPT to evaluate starch- (barley, wheat, and corn) and protein-rich (sunflower meal, cotton seed meal, and soybean meal) feedstuffs in 5 replicates in order to determine feasibility and validity of thawed rumen fluid usage. Gas production and organic matter digestibility parameters were measured. Data were analyzed by 2-way ANOVA. Using thawed rumen fluid was associated with lower cumulative gas production, and ME estimate for all feedstuffs. To compare in vitro data using ANOVA and regression approaches, 6 Merino rams were used for nutrient digestibility and energy content. Overall, in vivo ME values of the feedstuffs were greater than in vitro ME values. Energy and digestibility data determined from IVGPT employing fresh and thawed rumen fluids experiment poorly predicted those obtained from in vivo experiment. In conclusion, despite considerable agreement between in vitro data obtained from fresh and thawed rumen fluids to predict in vivo ME, and digestibility values of the feedstuffs, further experiments dealing with improvement of cryopreservation protocol for rumen fluids are necessary to increase microbial activity for maintaining fermentation pattern.

**Keywords:** in vitro gas test, cryopreserved rumen fluid, energy prediction, digestibility

### INTRODUCTION

Because of being less costly and laborious and more reliable while producing a large number of data with low variability in a short time in a controllable environment and compatible with in vivo experimentation, in vitro gas production technique (IVGPT, also known as Hohenheimer Futter Test) is common (Getachew et al., 1998). Many researchers have employed IVGPT to determine OM digestibility (OMD) (Dijkstra et al., 2005; Umucalilar and Şeker, 2000), energy (Menke and Steingass, 1988). Nevertheless, there disagreements between in vitro and in vivo outcomes as well as inconsistencies among in vitro outcomes from different laboratories exist. It appears that availability of uniform and continuous rumen fluid supply is one of the major factors in yielding variable results (Getachew et al., 2002).

Cryopreservation of rumen fluid from defined donors may offer some advantages for IVGPT. Thus, utilization of cryopreserved rumen fluid from a batch may reduce variability, which allows sampling from a constant donor reared under defined conditions. However, studies coping with cryopreserved rumen fluid usage as a source of inoculum in IVGPT are limited. This study was therefore conducted to evaluate fermentation characteristics and nutritive value of commonly used concentrate feedstuffs in ruminant nutrition by IVGPT employing fresh and cryopreserved rumen fluids in comparison with in vivo experimentation.

### MATERIALS AND METHODS

#### Animals and Management

The experimental protocol (#2008/028) was approved by the Selçuk University Ethic Committee on Animal Experimentation (Konya, Turkey). Two ruminally cannulated Holstein heifers were served as rumen fluid donors. Heifers fed a ration consisting of 60% forage and 40% concentrate, delivering 5 kg alfalfa hay plus 3.5 kg

concentrate per day (NRC, 2001). The ration contained 95.2% DM, 15% CP, 41.2% NDF, 26.7% ADF, 50.1% nitrogen-free extract (**NFE**), 3.1% ether extract (**EE**), and 9.8% crude ash (**CA**). Fresh water was available ad libitum.

### Experimental Feedstuffs

Commercially available barley grain (**BG**), wheat grain (**WG**), corn grain (**CG**), sunflower seed meal (**SFM**), cottonseed meal (**CSM**), and soybean meal (**SBM**) samples (n=5) were ground to pass a 1-mm screen (Retsch, SM100 Comfort, Germany) and conserved for experimentations in plastic containers.

### Rumen Fluid Collection and Cryopreservation Protocol

Before am feeding, rumen fluids collected from both heifers were mixed, and filtered through a double-layer cheese cloth under CO<sub>2</sub> pump. A part fluid was separated for the cryopreservation protocol and centrifuged at 4,640 g for 30 min (Allegra 64R, Beckman Coulter, USA). After removing supernatant, pellet was added with dimethyl sulfoxide (DMSO, 5%, vol/vol), a cryoprotectant and let stand at 25°C for 5 min (equilibration time). For the two-step cryopreservation protocol (Nsabimina et al, 2003), treated aliquots (1 ml) were transferred into 1 ml cryotubes for freezing in a computer-controlled freezer (Ice Cube 14S, Sy-Lab, Austria). Thus, cryotubes were frozen from 25 to -2°C (extracellular ice nucleation temperature) at a rate of 7°C/min (the first step). Then, the suspension was continued to freeze from -2 to -30°C, at a rate of 1.4°C/min and kept at -30°C for 45 min (holding temperature, the second step) before placing them into N tank (-196°C). On the day of IVGPT, frozen rumen fluids were thawed at 39°C for 5 min in water bath.

### In Vitro Gas Production Technique

For the in vitro gas production, the media were prepared using the Hohenheim Gas Test as outlined by Menke and Steingass (1988). Each of 0.2 g feedstuff samples, in triplicates, was incubated with the mixture (20 ml medium solution and 10 ml fresh rumen fluids; 29 ml medium solution + 1 ml cryopreserved rumen fluid after centrifugation) in a pyrex bottle (100 ml). A digital manometer (error sensitivity, 0.2%; Keller Leo 1, Winterthur, Switzerland) was used for determination of gas production (Lopez ve ark. 2007). In each assay, blank bottle without a feed sample were run in triplicates. The mean gas production of a standard concentrate and roughage mixture was used as a correction factor.

Gas production was measured at 6, 12, 24, and 48 hrs post-incubation. Using the cumulative gas production (**CGP**) as well as nutrients such as CP, EE, and CA, in vitro ME (**IVME**) values were calculated using following formula as defined by Menke and Steingass (1988): IVME, Mcal/kg DM = [(1.06 + 0.157 x CGP + 0.084 x CP + 0.022 x EE - 0.0081 x CA) x 1000] / 4.186. In vitro NEL (**IVNE**) value of feedstuffs was determined using the same variables as defined by Steingass (1983) as follows: IVNEL, kcal/kg DM = [(1.64 + 0.0269 x CGP + 0.00078 x CGP<sup>2</sup> + 0.0051 x CP + 0.01325 x EE) x 1000] / 4.186. In vitro digestible OM (**IVDOM**) was calculated as follows: IVDOM, % DM = 0.7602 x CGP + 0.6365 x CP + 22.53 (Öğretmen, 1991).

### In Vivo Digestibility

Digestibility of feedstuffs was also tested using classical in vivo experimentation to compare in vitro results estimated from inonolums prepared from fresh and thawed rumen fluids. Six Merinos rams weighing 90.2±16.9 (mean±SD) and aged 1-1.5 year were placed in individual metabolism cages and had free access to water and mineral blocks. Digestibility of alfalfa (pelleted) used in difference method for determining test feeds in rations consisting 60:40 forage:concentrate. Rams were fed once daily and orts were collected daily in a 21-d digestibility trial, 14 days of adaptation and 7 days of sample collection periods. About 10% of total feces was uniformly collected and frozen at -20°C until laboratory analyzes. (Şeker, 2002).

In vivo ME and NEL values of feedstuffs were estimated using the prediction equations defined by Kirchgessner and Kellner (1981), which were as follows: In Vivo ME (kcal/kg DM) = [(0.0152 x DCP + 0.0342 x DCF + 0.0128 x DCF + 0.0159 x DNFE x 1000) / 4.186, where ME = Metabolizable energy, DCP = digestible crude protein, DCF = digestible crude fat, DCF = digestible crude fiber, DNFE = digestible nitrogen-free extract. For estimation of NEL, gross energy (GE) and q coefficient following formula was used: GE (kcal/kg DM) = [(0.0242 x CP + 0.0366 x EE + 0.0209 x CF + 0.0170 x NFE)\*1000] / 4.186 and in vivo NEL (kcal/kg DM = 0.6 x [1+0.004 (q - 57)] x ME, where q = ME x 100 / GE

### Measurements and Laboratory Analyses

Feedstuffs were subjected to wet chemistry for DM, CP, CF, EE, and CA (AOAC, 1990) as well as for NDF and ADF (Goering and Van Soest, 1970) using The Ankom200 Fiber Analyzer.

### Statistical Analysis

Two-way ANOVA with repeated measures option was employed to determine the effect of the rumen fluid form

and feedstuff on gas production (SAS 2002). The linear model was  $y_{ijk} = \mu + RF_i + FS_j + (RF \times FS)_{ij} + Tk + (RF \times T)_{ik} + (FS \times T)_{jk} + (RF \times FS \times T)_{ijk} + e$ , where  $RF = i$ th rumen fluid (fresh vs. thawed),  $FS = j$ th feedstuff,  $T = k$ th incubation time, and  $e =$  residual error. For other variables measured at a single time point (i.e., IVME, IVNEL, IVDOM), “time” parameter and its interaction terms were omitted from the linear model. In vitro and in vivo ME, NEL, and IVDOM values of feedstuffs were compared by one-way ANOVA and subjected to the PROC CORR and REG procedures to attain correlations and mathematical equations. Finally, IVDOM value estimated from in vitro and in vivo experimentations and ME values estimated from CGP and nutrient contents were analyzed by multivariate regression to develop prediction models. In data analyses, statistical significance was considered at  $P < 0.05$ .

## RESULTS AND DISCUSSION

In general, nutrient contents of tested feedstuffs (Table 1) are in agreement with those reported in the literature (Getachew et al., 2004).

**Table 1. Nutrient contents (%) of the experimental feedstuffs.\***

Nutrient <sup>2</sup>	Feedstuff <sup>1</sup>						P > F
	BG	WG	CG	SFM	CSM	SBM	
DM	91.2±0.3ab (0.7)	91.4±0.3ab (0.6)	89.2±0.4c (1.1)	91.2±0.4ab (0.9)	92.2±0.7a (1.60)	90.8±0.4b (0.9)	0.001
	13.7±0.5c (8.3)	12.5±0.9c (15.9)	7.8±0.5d (13.6)	30.6±2.5b (18.1)	29.0±2.3b (18.0)	46.8±0.6a (3.0)	
CP	2.44±1.09b (11.1)	2.40±1.07b (25.6)	4.16±1.86a (12.1)	1.38±0.62b (25.5)	4.30±1.92a (67.7)	2.02±0.90b (30.18)	0.0001
	2.19±0.18b (18.6)	1.46±0.33b (50.8)	1.37±0.41b (66.5)	6.61±0.27a (9.1)	6.46±0.38a (13.3)	6.78±0.14a (4.5)	
EE	6.97±0.43bc (13.7)	4.73±0.41c (19.4)	4.89±0.15c (7.0)	24.03±1.23a (11.5)	22.78±1.31a (12.8)	8.77±0.40b (10.1)	0.0001
	74.7±0.9b (2.8)	78.9±1.6ab (4.5)	80.3±2.4a (6.8)	37.4±1.7c (10.3)	37.4±1.5c (9.0)	35.7±0.3c (1.97)	
CA	21.5±0.4b (4.3)	17.3±1.0bc (13.4)	13.6±0.4cd (6.6)	46.9±4.2a (20.1)	51.1±1.9a (8.2)	10.8±0.4d (8.7)	0.0001
	6.71±0.32b (10.6)	4.08±0.25b (13.9)	3.61±0.14b (8.5)	32.3±2.7a (18.8)	35.0±2.7a (17.1)	6.77±0.47b (15.7)	
CF							
NFE							
NDF							
ADF							

\*Data are LSM±SE (% CV), n = 5. Different superscripts within the same rows differ ( $P < 0.05$ ).

1BG = barley grain; WG = wheat grain; CG = maize grain; SFM = sunflower seed meal; CSM = cottonseed meal; SBM = soybean meal.

2 DM= dry matter; CP=crude protein; EE = ether extract; CA = crude ash; CF = crude fiber; NFE = nitrogen-free extract.

### In Vitro Experimentation

The amount (40.32 vs. 39.10 ml,  $P < 0.0001$ ; Table 3) of gas production during the in vitro incubation with fresh rumen fluid were greater than thawed rumen fluid. Fermentation of starch-rich feedstuffs resulted in 1.73-fold greater gas production than protein rich-feed stuffs, being greatest in WG (53.6 ml) and lowest in CSM (23.4 ml) ( $P < 0.0001$ ).

Gas production from fermentation of the feedstuff is related to its OM content, which reflects its energy level (Menke and Steingass, 1988). Indeed, the positive correlation between CGP and NFE content ( $r=0.86$ ,  $P < 0.0001$ ) in the present study and elsewhere (Getachew et al., 2005;  $r=0.89$ ). Incubating starch-rich grains with thawed rumen fluid resulted in gas production was similar to those incubated with fresh rumen fluid, suggesting importance of starch content for bacterial activation. Lacking carbohydrate source in in vitro environment was associated with 38% decrease in total bacteria count and 25% in viable bacteria count (Leedle and Hespell, 1983). These suggest that provision of soluble carbohydrates could increase efficiency of frozen rumen fluid.

Moreover, even in fresh rumen fluid, gas production was shown to be negatively correlated with NDF ( $r=-0.83$ ) and ADF ( $r=-0.91$ ) contents (Getatchew et al., 2004). Similar relationship was determined in frozen rumen fluid ( $r=-0.84$  for NDF and  $r=-0.91$  for ADF), suggesting that freezing adversely affect cellulolytic bacteria as reflected by 11-30% reduction in gas production (Menke and Steingass, 1988).

### **Organic Matter Digestibility and Energy Estimate**

The mean ME and IVOMD values for feeds incubated with thawed rumen fluid were lower than those for feeds incubated with fresh rumen fluid (2562 vs. 2590 kcal/kg;  $P < 0.0001$  and 74.0 vs. 74.5%,  $P < 0.003$ ; Table 3). The rumen fluid form did not differ the mean NEL value for feeds. The mean NEL estimates in media containing fresh and thawed rumen fluids were 47.0 and 48.1% ME values estimated by IVGT employing fresh and thawed rumen fluids, respectively. The ME, NEL, and IVOMD values for starch-rich feedstuffs increased by 3.0, 4.9, and 2.4%, respectively, whereas those for protein-rich feedstuffs decreased by 8.8, 10.0, and 5.7%, respectively in media containing thawed rumen fluid as compared to media containing fresh rumen fluid ( $P < 0.0001$  for all; Table 3).

This experiment, rumen fluid was subjected to condensation (centrifugation), 2-step controlled freezing, and keeping in liquid N. Freezing rumen fluid was associated with about 1% underestimation of ME and NEL values. Such a small percentage of underestimation could be due to low variability in CGP, a regression model component (Mauricio et al., 1999). Rumen fluid by feedstuff interaction revealed increases in estimate ME values for starch-rich grains and decreases in estimate ME values of protein-rich feedstuffs in thawed rumen fluid as compared to fresh rumen fluid.

In vitro OM digestibility data from fresh rumen fluids (71.8-75.9%) were lower than those reported by Umucalilar et al. (2002; 78.5-87.3%) and similar to those reported by Şeker (2002; 78.2-81.3%). In vitro OM digestibility values had low variability in both rumen fluid forms. Limitations occurred for gas production in thawed rumen fluid appears to be valid for IVOMD data, as well.

### **In Vivo Experimentation**

#### **Nutrient Digestibility and Energy Estimate**

In general, protein-rich feedstuffs had lower OM, CP, EE, NDF, and NFE digestibilities and higher CF digestibility in vivo, except for SBM (Table 2). Moreover, NEL and ME values of starch-rich feedstuffs were greater than protein-rich feedstuffs (Table 3).

Dry matter and OM as well as nutrient digestibility of alfalfa hay in vivo (Table 2) are in agreement with the literature (Barnes, 1968; Wilson et al., 1978). In vivo corn data are similar to those reported by Kromann et al. (1975), whereas its DM and CP digestibilities were lower than data by White et al. (1973). Digestibility of CSM is higher than those reported in the literature (Milis et al., 2007; Woods et al., 1962). SBM digestibility data (DM, OM, CP) are compatible (Milis et al., 2007). In SFM, digestibilities of DM, OM, and CP in SFM are greater, whereas digestibility of NDF is similar to those reported by Woods et al. (1999).

In vivo ME (kcal/kg) and NEL (kcal/kg) values were correlated ( $r = 0.99$ ,  $P < 0.0001$ ) and fit to following model:  $\text{NEL} (\text{kcal/kg}) = -360 + 0.66 \times \text{ME} (\text{kcal/kg})$  ( $R^2 = 0.98$ ,  $P < 0.0001$ ). In vivo OMD was positively correlated with ME (kcal/kg) ( $r = 0.92$ ,  $P < 0.0001$ ) and NEL (kcal/kg) ( $r = 0.89$ ,  $P < 0.0001$ ) estimated in vivo.

**Table 2. In vivo nutrient digestibility.\***

Nutrients <sup>2</sup>	Feedstuff <sup>1</sup>							P > F
	ALF	BG	WG	CG	SFM	CSM	SBM	
DM	57.5e (3.4)	89.5a (4.2)	86.4ab (3.7)	83.9b (3.8)	84.5ab (7.5)	73.6c (7.8)	63.6d (6.6)	0.001
OM	57.4c (7.0)	87.9a (11.1)	87.9a (6.6)	85.7a (6.1)	87.4a (6.0)	70.2b (8.0)	65.0bc (11.5)	0.001
CP	63.7b (4.9)	84.8a (12.1)	72.5b (18.2)	65.3b (15.0)	85.0a (8.6)	67.8b (4.0)	85.1a (5.4)	0.0001
EE	57.3b (6.7)	82.7a (28.6)	92.7a (12.3)	82.1a (7.3)	49.6bc (34.8)	87.1a (6.7)	37.0c (41.2)	0.001
CF	44.3ab (10.9)	71.9a (91.9)	82.4a (47.6)	19.6b (219)	27.0b (17.2)	81.2a (9.1)	52.0ab (26.0)	0.01
NFE	65.0c (6.6)	89.0b (7.2)	91.0b (4.7)	94.1b (4.0)	102.5a (6.4)	66.7c (8.2)	59.9c (21.2)	0.0001
NDF	63.8ab (4.9)	76.6a (29.1)	61.7ab (42.2)	67.0a (38.6)	67.2a (12.2)	53.9ab (10.7)	42.1b (27.0)	0.04

\*Data are LSM±SE (% CV), n = 5. Different superscripts within the same rows differ (P < 0.05).

1ALF = alfalfa; BG = barley grain; WG = wheat grain; CG = corn grain; SFM = sunflower seed meal; CSM = cottonseed meal; SBM = soybean meal.

2 DM= dry matter; CP=crude protein; EE = ether extract; CA = crude ash; CF = crude fiber; NFE = nitrogen-free extract.

Menke and Steingass (1988) evaluated 700 feed samples using IVGPT and reported strong relationship between nutrient content and gas production. It was also shown that in vivo energy content and OMD (Aiple et al., 1996) were correlated with in vitro gas production measured using fresh rumen fluid (Getachew et al., 2002). Many researchers (Getachew et al., 2005; Şeker, 2002) suggested that in vitro ME values were lower than their in vivo ME values, even in highly digestible feeds.

#### Comparison of In Vivo and In Vitro Energy and Organic Matter Digestibility Values of Feedstuffs

Metabolizable energy and NEL as well as OMD values determined in vitro were lower than those determined in vivo (P < 0.0001 for all; Table 3). Despite no difference in NEL and OMD values obtained from media containing fresh and thawed rumen fluids, usage of thawed rumen fluid underestimated ME value as compared to usage of fresh rumen fluid. Energy content and OMD of protein-rich feedstuffs decreased and those of starch-rich feedstuffs increased in frozen rumen as compared to fresh rumen fluid (P < 0.0001).

**Table 3. Comparison of metabolizable (ME) and net (NEL) energy values and organic matter digestibility (OMD) values of concentrate feedstuffs estimated by in vivo and in vitro gas technique employing fresh and frozen rumen fluids.\***

Group		Response variable		
Method	Feedstuff1	ME (kcal/kg)	NEL (kcal/kg)	OMD (%)
In vivo	BG	3275±45	1807±28	87.9±1.3
	WG	3369±45	1867±28	87.9±1.3
	CG	3091±45	1727±28	85.7±1.3
	SFM	2190±45	1098±28	65.0±1.3
	CSM	2660±45	1346±28	70.2±1.3
	SBM	3013±45	1538±28	87.4±1.3
	Overall	2933±18a	1564±12a	80.7±0.5a
In vitro (Fresh rumen fluid)	BG	2806±32	1433±20	75.9±0.9
	WG	2928±32	1487±20	77.4±0.9
	CG	2743±32	1386±20	71.8±0.9
	SFM	1934±28	818±18	64.5±0.8
	CSM	2283±28	899±18	71.0±0.8
	SBM	2846±32	1131±20	86.7±0.9
	Overall	2590±12b	1192±8b	74.5±0.4b
In vitro (Frozen rumen fluid)	BG	2836±32	1455±20	76.5±0.9
	WG	3096±33	1621±21	80.8±0.9
	CG	2766±33	1404±21	72.3±0.9
	SFM	1840±28	774±18	62.6±0.8
	CSM	1979±28	753±18	64.9±0.8
	SBM	2853±32	1135±20	86.8±0.9
	Overall	2562±13c	1190±8b	74.0±0.4b
ANOVA		P > F		
Method	0.0001	0.0001	0.0001	0.0001
Feedstuff	0.0001	0.0001	0.0001	0.0001
Method x Feedstuff	0.0001	0.0001	0.0001	0.0001

\*Data are LSM±SE. Different superscripts within the same columns differ (P < 0.05).

1BG = barley grain; WG = wheat grain; CG = corn grain; SFM = sunflower seed meal; CSM = cottonseed meal; SBM = soybean meal.

In comparison with in vivo measurements ME, NEL, and OMD estimates of starch- and protein-rich feedstuffs differed by the rumen fluid form. The ME, NEL, and OMD values were underestimated by 12.9, 20.3, and 13.9% for starch-rich feedstuffs and 10.2, 28.5, and 0.2% for protein-rich feedstuffs when inoculum prepared from fresh rumen fluid, whereas they were underestimated by 10.7, 17.1, and 12.2% for starch-rich feedstuffs and 15.1, 33.1, and 3.7% for protein-rich feedstuffs when inoculum prepared from thawed rumen fluid (P < 0.0001 for all; Table 3).

In vivo data were correlated with in vitro data generated using fresh and thawed rumen fluid as inoculum. They all were also correlated with nutrient contents of feed samples. However, models developed from small sample size (replication of feed samples) and animals may require precaution for reliability. Şeker (2002) conducted in vivo digestibility trial and IVGPT to evaluate energy content of barley, wheat, corn, oat, wheat bran, SFM, CSM, SBM, and two commercial concentrate mixtures and developed prediction models with R<sup>2</sup> of 0.64, concluded that comparison was not feasible with limited number of replication.

Menke and Steingass (1988) reported that in vivo ME and in vitro ME differences were +9±281 for mixed feeds

and +28±485 for individuals (mean±SD). Moreover, they reported that in vivo ME and in vitro ME difference for barley ranged from -75 to -708, which ranged from -3.9 to -89.9 in the present study, +4±204 for all tested feed samples. The variability thus appears to be less in IVGPT, which make it reliable (Menke and Steingass, 1988), except for feed such as CSM whose nutrient content is different, and may not be suitable to determine CSM energy and OM digestibility.

## CONCLUSION

This experiment question feasibility of frozen rumen fluid usage in IVGPT through evaluating fermentation of commonly used concentrate feeds in ruminant nutrition in comparison with in vivo technique. Usage of thawed rumen fluid decreased ME and OMD values of feedstuffs were estimated to be lower in media containing thawed rumen fluid than in media containing fresh rumen fluid. However, CGP obtained using thawed rumen fluid was a good predictor of energy estimates obtained using fresh rumen fluid and digestibility. Also, response variables to fresh rumen fluid were highly correlated with response variables to thawed rumen fluid. It can be concluded that usage of frozen rumen fluid in IVGPT can be feasible if cryopreservation techniques are advanced to assure no change in microbial survival and activity.

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## DAIRY CATTLE BEHAVIOUR IN DIFFERENT HOUSING SYSTEMS

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### ABSTRACT

Dairy cattle housing are designed in different ways. Generally, the tie-stall housing systems, free-stall housing systems and loose housing systems are used in dairy cattle. Loose barn and free-stall barn systems have spread in recent years. Nowadays, housing types and building designs are come into prominence as the main trend in shelters planning for improving the animal welfare. Animal behaviours and environmental factors affect the herd management and shelter design in dairy cows company widely. When the animals are free in the housing area, cows stress reduces and productivity and animal welfare rise. Dairy cattle spent more time standing in freestall housing system according to the loose barn. As the lying bout is extended in the total time budget of dairy cattle, milk production is increased. Along with each hour increase of resting time is predicted to increase by 1.7 kg in milk production (Allen et al., 2013). In this review, studies conducted on the behaviour of dairy cattle in different housing systems were summarized owing to coming into the forefront appropriate shelter design to animal behaviour in dairy cattle breeding.

**Keywords:** Behaviour, dairy cattle, design, housing systems

### INTRODUCTION

The dairy sector has an important place in a protection of country economy and public health. Nowadays, the level of consumption of animal products in the country is an indicator of the development of the country. In dairy cattle, the most important parameter indicating the productivity is annual milk production per animal. Mean milk production was 2.942 tons animals-1 in Turkey, 9.9 tons animals-1 in The USA and 6.6 tons animals-1 in European Countries (Anonymous 2012).

Though dairy cattle presence of Turkey was 24 % of the European Countries average, milk production was 10% of that. This situation shows that is low in the milk yield per cattle in Turkey. Among results major of this can show inappropriate environmental conditions, deficiency in nutrition and genetic structure (Uzal and Uğurlu, 2008). A purpose of making a shelter for animals, in the first place, protect them from adverse environmental conditions and provide a suitable habitat for obtaining high yields (Demir, 1990). The behaviour dairy cattle depend on the interaction between the cows and their physical environment (Krawczel and Grant, 2009).

To understand behaviour features of livestock ensures to increase the economic benefits in animal husbandry and to more easily guidable of animals. The importance of issues related to animal behaviour in the design of animal shelters closely correlates with the intensity of the production and length of stay in the shelter for animals. Today, intensive farming practices limits the optimal environmental demands of animals and therefore it is known that they show abnormal behaviour as a result of failure to adapt to the environment of the animals. High temperature and relative humidity, the lack of ventilation and lighting facilities, failure in feeding, the behaviour of animal of breeders, needs and preferences unknown them, incorrect selection of tools and machinery, the housed more animals per unit area makes difficult to adapt to the environment of the animals. When all this negative conditions added limiting the freedom of movement of animals, in the animals housed individually or in groups consists of psychological pressure and stress is increasing (Olgun and Çelik 1997).

Behaviour is considered as a good indicator of animal welfare (Overton et al., 2002). Behaviour is reaction coming out thanks to in an animal body muscles and changing position a portion of or the entire body. A move showing as stable without changing the position of the animals can also be behaviour (Ünal and Akçapınar, 1994). Animal behaviour, organism's is the reaction the whole body against a particular alert or way a reaction against them environment (İnal, 2006). Animal behaviour is an expression of an effort to comply with various internal and external environments, and It is a response to a stimulus (Cengiz, 2006). The total duration of lying per day can be used as a measure of cattle welfare (Haley et al., 2001). Modern dairy cattle lie for 12 h per day and become stressed if deprived of lying (Fisher et al. 2002; Jensen et al. 2004).

Although a conflict may emerge in high yielding cows between eating and lying, they are lying primarily. Decreased lying can reduce food intake and yield, as well (Munksgaard and Thomsen 2012). Daily time budget for lactating dairy cows is given in Table 1.

**Table 1. Daily Time Budget for Lactating Dairy Cow (Grant, 2007)**

Activity	Time devoted to activity per day
Eating	3 to 5 h
Lying/resting	12 to 14 h
Social interactions	2 to 3 h
Ruminating	7 to 10 h
Drinking	30 min
Management activities	2.5 to 3.5 h

### BEHAVIOUR OF DAIRY COWS KEPT IN TIE-STALL BARNs

Keeping dairy cows in tie stalls are more traditional systems. This system is substantially limited to movement, grooming and social interaction is disrupted (Anderson, 2008), cows are unable to escape from dominant individuals (EFSA, 2009b). And there is a raised risk of lameness and hock inflammation (Krohn and Munksgaard 1993).

Dairy cattle spend approximately 50 to 60% of their time lying down and are considerably motivated to maintain lying times of 12 to 13 h per day (Munksgaard et al., 2005). Cows housed in tie-stall barns spend more time increasingly depth of both sawdust and straw bedding increase (Tucker et al., 2009). Resting time per day of cows change in different barn systems (Figure 1).

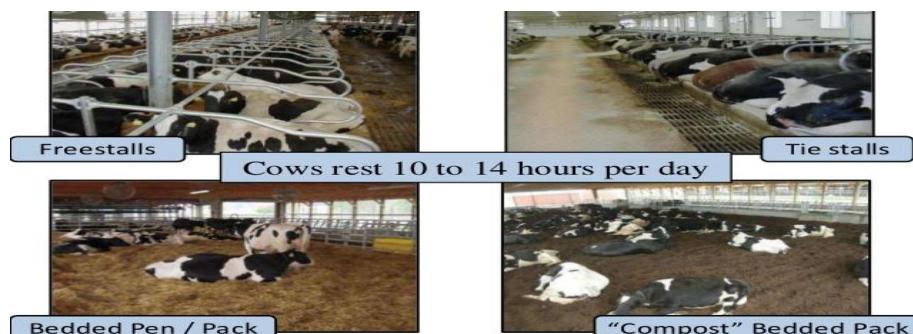


Figure 1. Daily Resting Behaviour of Cows (McFarland, 2015)

Cows kept in tie-stall barn experience more difficulty in lying down. And they have a bigger incidence of collision with equipment and lower score of health status which reflects negatively on animal welfare. Moreover, it can also cause the decrease in productivity (Ostojic et al., 2011).

In tie-stall barns, cows are restricted to stalls where they are fed individually, and cows are either directly milked in the stall or walked to milking parlour (Reich, 2010).

Dairy cattle housed in tie-stall barns are more time spent idle standing and lying down. However, feed intake and time spent eating are unaffected by housing conditions (Haley et al., 2000).

In tie-stall barns, cows may forced to maintain movements necessary to lying down due to spatial restriction related to a very short tether (Haley et al., 2000). A very tether may limit the cows' ability to lunge forward (Haley et al., 2000).

As cows labour significantly on their front knees during changes in body position, the hardness of the concrete flooring may make standing and lying painfully for cows (Metzner, 1978).

Owing to tie-stall barns were light especially of workload, it was a system preferred in the beginning. However, nowadays this system is not preferencing to animals' movements limits (Figure 2).

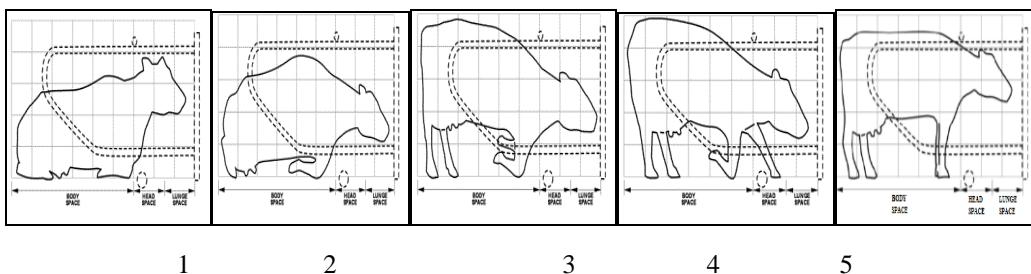


Figure 2. The Stages of a Cow's Stand Up Behaviour (Graves et al., 2009)

### BEHAVIOUR OF DAIRY COWS KEPT IN FREE-STALL BARNs

One of the most important design criteria for dairy cattle shelters is to access to a comfortable sleeping area (Ito et al., 2009). Stall design (Tucker et al., 2004; Tucker et al., 2006) and especially stall flooring (Tucker et al., 2003; Tucker and Weary, 2004) are most important factors affecting of time cows spend lying down.

Placement of neck rail affects stall usage (Reich, 2010). Neck rail arranged in very restrictive status decrease amount of time cows spend standing in the stalls (Tucker et al., 2005; Bernardi et al., 2009; Fregonesi et al., 2009) (Figure 3).

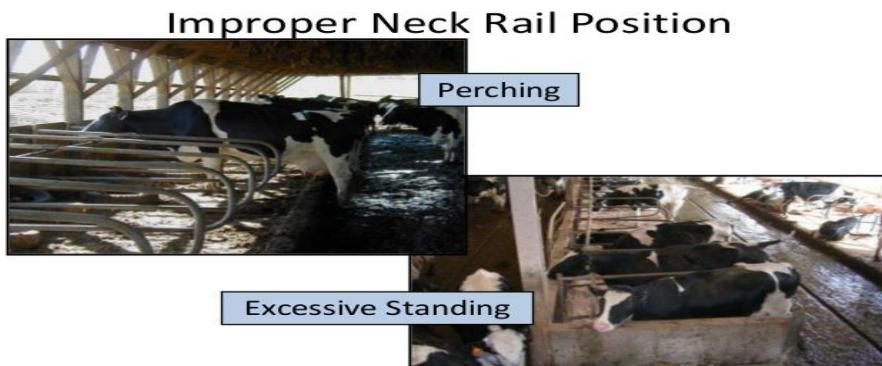


Figure 3. Improper Neck Rail Position (McFarland, 2015)

Cows spend more time lying down in wider stalls (132 vs. 112 cm; Tucker et al., 2004) and in stalls with no brisket boards (Tucker et al., 2006). Cows spend more time lying down on surfaces that are more comfortable and softer (Tucker and Weary, 2001). Dairy cattle prefer to lie down on soft bedding depending on the quality and quantity of bedding used (Herlin, 1997; Tucker et al., 2003; Benz, 2009). When cows are ensured an undesirable stall surface, raised standing outside of stalls occurs (Tucker et al., 2006; Fregonesi et al., 2007b). Cows occur a reduction five hours per day in time spent lying down on wet bedding (26.5% dry matter) by comparison with dry bedding (86.4% dry matter) (Fregonesi et al., 2007b). Daily time spent lying down increased from 8.8 h to 13.8 h when dry bedding was turned into wet bedding (Fregonesi et al., 2007b). While 54% of cattle on dry bedding were observed to lie down, this incidence decreased by 17-20% as bedding were dirty (Varlyakov, 1989). Cows spend lower time 1.1 h per day on wettest treatment compared to driest treatment (Reich, 2010) (Table 2).

**Table 2. The Hours per Day (mean  $\pm$  SE) Cows Spent Performing Each Behaviour on Each Bedding Dry Matter Level, Averaged Across Seasons (Reich, 2010).**

Behaviours (Mean $\pm$ SE)					
Bedding Dry Matter (%)	Lying in Stall (h/d)	Standing in Alley (h/d)	Perching in Stall (h/d)	Standing in Stall (h/d)	Feeding (h/d)
34.7	10.4 $\pm$ 0.4	6.2 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.6 $\pm$ 0.1
43.9	10.9 $\pm$ 0.4	6.0 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.3 $\pm$ 0.1
62.2	11.2 $\pm$ 0.4	5.3 $\pm$ 0.3	1.4 $\pm$ 0.1	0.3 $\pm$ 0.1	5.6 $\pm$ 0.1
74.2	11.0 $\pm$ 0.4	5.6 $\pm$ 0.3	1.6 $\pm$ 0.1	0.2 $\pm$ 0.1	5.4 $\pm$ 0.1
89.8	11.5 $\pm$ 0.4	5.4 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.4 $\pm$ 0.1

When there are more cows than free-stalls, the behaviour may be affected because all of the cows can't synchronously lie down (Fregonesi et al., 2007b). Overstocking free-stall barns reduce time spent lying down (Friend et al., 1977; Wierenga and Hopster, 1990). When the stocking rate increased from 100 to 150%, time spent lying reduced by 1.7 h (Fregonesi et al., 2007a). When cows are overcrowding, aggressive interactions are more common as they contend to restricted resources (Fregonesi and Leaver, 2002). They spent more time standing outside of free-stalls when cattle were overstocked, and they spent less time lying down (Fregonesi et al., 2007a) (Table 3).

**Table 3. Time Budget to Stocking Level in Freestall Barns**

<b>Variable</b>	<b>Stocking level for freestalls</b>				
	<b>%100</b>	<b>%109</b>	<b>%120</b>	<b>%133</b>	<b>%150</b>
Lying in stall (h/d)	12.9	12.1	12.0	11.5	11.2
Front legs in stall (h/d)	1.4	1.4	1.4	1.4	1.5
Outside stall (h/d)	8.4	8.9	9.1	9.6	9.9
Latency to lie (min)	29	34	38	28	26
Displacements (n/5h) (n=4 groups)	0.7	0.9	1.6	2.1	1.9

Free-stall barns are considered important for allowing the adequate opportunity to dairy cattle in lying and resting area, for maximizing production as well as cow comfort and well-being (Haley et al., 2000). Some free-stalls barns are overcrowded with cattle in excess of the number of the stall. In addition, uncomfortable stalls can decrease the time that dairy cattle spend lying down either because of providing insufficient area to the cattle for resting or because floor of the free-stall is too hard (Leonard et al., 1994).

### **BEHAVIOUR OF DAIRY COWS KEPT IN LOOSE HOUSING SYSTEMS**

Loose dairy cattle shelters are barn system given the ability to move freely to cows. In dairy cattle are selected lighter, low-cost, open barns instead of completely closed, heavy and expensive barns. These shelters are also appropriate to natural behaviours of cows (Anonymous, 2015).

Loose housing systems provide the chance to move to dairy cattle and allow them to display their natural behaviour of the animals. In addition, a well-established social environment can have a positive effect on the adaptability to environment of individuals through social facilitation and learning, and stable social relations within the herd may be useful in reducing the impact of the overall stressful conditions. (Bouissou et al., 2001). However, when the dairy cattle are housed in groups, there is a risk of aggression and social unrest. Aggressive interactions occur against establishing and maintaining social order within the group. Competition for resources as well as the source of improper shelter design is vitally important factors that can be reduced or increased the social stress and aggressive behaviour (Bouissou et al., 2001).

In loose housing system, the automation of business processes can decrease the manpower up to 40 hours annually per animal. Also, advantages of the loose housing system are easier supplying of enough micro-climate and zoo-hygiene circumstances (Ostojic, 2011).

In loose housing system was observed behaviour of twelve Holstein dairy cattle during three day and as a result of research, it was determined to spent by resting 45% and by feeding 25.9% of cattle daily times' (Antov and ark, 1991).

Resting behaviour is an important factor increased productivity in dairy cattle. Matzke (2003), examined the behaviour of cattle groups getting average and high milk yield. According to the survey results, the group of cattle with high milk yield of resting more 2-3 hours than the group of cattle average milk yield.

The flooring of shelters where dairy cattle lie down should be adequately comfortable to provide an adequate resting and welfare to animals. Recreation is defined as the situation lying down or standing doing nothing but ruminating. Before lying down, cows generally stand for a few minutes in the choice of places to rest. Preferences to lying side of cattle are not random. When cattle lying for the second time, more than 80% of them change lying side (Mitev et al., 2012).

Agonistic interaction can be more in indoor freestall systems than on pasture (Miller and Wood –Gush, 1991). Behaviour of cattle in freestall housing systems having to inadequate space for lying and getting up is worse than on pasture (Schreer and Pelzer, 2006).

When tie stall barns compared with free systems, on the lying behaviour of both heifer and cows have certain effects (Krohn and Munksgaard, 1993; Jensen, 1999). Area discovery and attempts to lying before lying down of cattle housed in tie stall barns are restricted much more than loose housing barns of that. Because of the reasons mentioned above, nowadays loose housing systems instead of freestall barns and tie stall barns are recommended in terms of both compliance with behaviour of animal and construction cost.

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## ANIMAL DEATH AND ENVIRONMENTAL POLLUTION

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### ABSTRACT

Today, an animal, especially a bovine animal, which is died in the barn, in enterprises or pasture; What is it being done? In the livestock companies, the animals which are killed in stalls, can they be eliminated to without polluting the barn, in business even environment? Does these corpses being moved to necropsy-autopsy rooms and/or the pet cemetery or to the center of medical waste in appropriate conditions?

At the present time, in summit of technological development in all areas, bovine animals died in the barn, have been usually dragged out of the barn to remove! Later, they are sometimes buried in a pit at a location away from the enterprises, but most of the time; they are thrown at random for eating by dogs and wild animals!

More than 200 of the infectious diseases seen in animals are zoonotic diseases (transmitted from animal to human) such as rabies, anthrax, tuberculosis, brucellosis etc. Thus, it is understood that this statement how is a serious problem for public health and also animal health!

With the development of today's technology, does not it possible to destroy the dead animals without polluting the environment, after performing necropsy of dead animals and identifying the cause of death of the animal without contaminating the around with infectious agents? -Of course possible, if the relevant agencies and organizations understand the importance of this issue.

In this presentation, it will be drawn attention to this problem that extremely important in terms of public health and animal health, and concrete solutions will be presented.

**Keywords:** Animal death, pollution, necropsy, environment, zoonosis

### HAYVAN ÖLÜMLERİ VE ÇEVRE KIRLILIĞI

Bilindiği gibi hayvan ölümlerinin en önemli nedeni viral, bakteriyel ve paraziter enfeksiyonlardır. Hayvanlarda görülen kuduz hastalığından, antraksa, tüberkülozdan, bruselloza kadar yaklaşık 200 den fazla hastalık zoonoz hastalıklardır. Bunun yanı sıra kimyasallarla zehirlenmeler ve hatta radyoaktif maddelere ilgili hayvan ölümleri de söz konusudur. Bütün bu sonuçlar dikkate alındığında ölen hayvanların çevreyi kirletmeden yok edilmesinin hem insan sağlığı ve hem de hayvan sağlığı açısından son derece önemli olduğu anlaşılmaktadır.

Bu nedenlerden ölen hayvanlar mutlaka hastalık etkenlerini çevreye yapmadan, çevreyi kirletmeden uygun usullerle imha edilmelidir. Eğer hayvanın neden olduğu belirlenmek isteniyorsa veteriner hekimler tarafından nekropsileri yapılp, daha sonra imha edilmelidir. Yalnız burada önemli bir noktayı hatırlatmak gereklidir; hem insan ve hayvan sağlığı açısından ve hem de hastalıklara karşı mücadelede alınacak tedbirler açısından ölen hayvanların mutlaka nekropsileri yapılarak ölüm sebebi belirlenmelidir.

Günümüzde hayvancılık işletmelerinde, ahırlarda ölen hayvanlar, özellikle de büyükbaş hayvanlar ahırları, işletmeyihatta çevreyi kirletmeden yok edilebiliyor mu? Nekropsi-otopsi salonlarına, hayvan mezarlıklarına veya tıbbi atık merkezlerine uygun şartlarda taşıınıyor mu? Mevcut şartlarda büyükbaş havanlar ahırdada ölmüş ise genelde sürüklenerken ahır dışına çıkartılabilir. Ahır dışına çıkarıldıktan sonra ise ya kepçe ile veya traktöre bağlanıp sürüklenerken işletmeden uzak bir yere götürülmekte. Bazen burada bir çukur kazılıp gömülmemekte ise de, çoğu zaman köpekler, yabani hayvanlar yesin diye rast gelmektedir.

Eğer hayvan sahibi hayvanının nekropsisini yaptıır, ölüm nedenini öğrenmek isterse ne yapılabilimekte? Bazen hayvanın olduğu yerlerde, yani dış ortamlarda Veteriner hekimlerce nekropsileri yapılmaktadır. Nekropsiler dış ortamlarda yapılacağsa seçilecek yer ahır ve yerleşim yerleri ile yeraltı ve yer üstü akarsulardan uzakta olmalı ve de nekropsiden sonra burada derin bir çukur kazılarak buraya gömülümelidir. Her ne kadar yönetmelikler bu tür uygulamalara izin veriyorsa da artık hem ulaşımın son derece hızlı ve seri bir hale geldiği ve hem de nekropsi yapılan laboratuarların yaygın olduğu günümüzde artık laboratuarlar dışında nekropsilerin yapılmasına müsaade edilmemelidir. Çünkü laboratuarlar dışında yapılan nekropsilerin hem insan ve hayvan sağlığı açısından ve hem de çevre kirliliği açısından ciddi riskleri vardır. Fakat mevcut şartlarda özellikle büyükbaş hayvanların laboratuarlara nakilleri de ciddi düzeyde çevre kirliliğine, çevrenin enfekte

olmasına neden olmaktadır. Çünkü ölen hayvanların nakilleri açık kasa kamyonlarla, kamyonetlerle yapılmaktadır. Bu durumda da ölüme neden olan enfeksiyonun çıkış yerinden laboratuara kadar veya imha yerine kadar çevreyi kirletmesi demektir. Bu durum özellikle antraks, yanıkara gibi septisemik seyirli, ölümden sonra da doğal deliklerden pihtlaşmayan kanın veya diğer akıntıların gelmeye devam ettiği hastalıklarda, etkenlerin kilometrelere alana saçılmış olmasına neden olmaktadır. Ayrıca yine antraks, yanıkara da olduğu gibi etkenler dış ortamlarda sporlanarak çok aşırı direnç kazanan hastalıklarda ise çevrenin yıllarla ifade edilen süre boyunca enfekte olması demektir. Bu tür uygulamalara maalesef zaman zaman şahit olunmuştur.

Mevcut şartlarda ahırdı, çiftlikte ölen büyükbaş bir hayvanın saha şartlarında nekropsisinin yapılarak, çevreyi kirletmeden imha edilmesinin ne kadar zor olduğu, bu nedenle de özellikle büyükbaş hayvan ölümlerinin ciddi düzeyde çevre kirligine, enfeksiyöz nedenlerden ölenlerin ise çevreyi enfekte ettiği bilinen bir gerçektir. Bu konuda hayvan yetiştircilerine yardımcı olacak mevcut bir uygulama da yoktur. Yani çiftliğinde, ahırında bir atı, bir ineği, bir boğası olmuş bir yetiştirci müracaat ettiğinde ölen hayvanı çevreyi kirletmeden, çevreyi enfekte etmeden çiftlikten, ahırdan alıp, nekropsi yapılacak laboratuara veya belirlenen bir imha yerine götürecek bir uygulama yoktur, böyle bir ihtiyaca cevap verebilecek bir kurum ve buna yönelik bir organizasyon da yoktur. Hatta bu konuda müracaat edebilecek bir birim de yoktur.

Teknolojinin gelişmesine uyumlu olarak çevreyi kirletmeden, enfeksiyöz etkenlerle etrafi kontamine etmeden, ölen hayvanların nekropsileri yapılarak hayvanın ölüm nedenini belirleyip, daha sonra yok etmek mümkün değil mi? İlgili kurumlar bu konunun önemini kavrularsa tabii ki mümkün.

Bu konuda ne yapılabilir?

Öncelikle ölen hayvanlar, özellikle de büyük baş hayvanlar nekropsi salonlarına, hayvan mezarlıklarına, yakma firınlarına özel olarak dizayn edilmiş araçlarla nakledilmeli. Bu araçlar vinç sistemi kurulu olmalı ve ölen hayvandan gelen akıntıları dışarıya sızdırmayacak, kapalı konteyner şeklinde olmalı. Bu amaçla dizayn edilen bu araçlardan özellikle büyükşehir belediyeleri bünyelerinde bulundurmali. Bu amaçla alınan özel bir telefon hattı ile yetiştircilerin bu araca kolaylıkla ulaşması sağlanmalıdır. Bu araçlarla alınan ve nakledilen hayvanların çevreyi kirletmeden yok edilebilmeleri için yine büyükşehir veya il belediyelerinin öncülüğünde bir hayvan mezarlığı ve yakma ünetesi kurulmalı. Mevcut şartlarda çeşitli kuruluşların bu maksada yönelik yakma firınları varsa da hem büyükbaş bir hayvanı yakamayacak kadar küçük ve hem de artık şehir merkezlerinde kalmış durumda. Yakma firınları çevreyi kirletecek bir duman ve kötü koku çıkarmayacak şekilde dizayn edilmeli. Bunun için bütün bir şehrin ve çevresinin ihtiyacını karşılayacak kapasitede merkezi bir yakma fırını olmalı. Hatta bu yakma firınları ile hayvan mezarlıkları aynı yerde olursa daha uygun olur. Ayrıca buraya bir de nekropsi salonu ilave edilecek olursa hayvanı ölen bir yetiştirci ilgili birime telefon ettiğinde bu özel araçla hayvan öldüğü yerden alınıp direk olarak ölen hayvan imha merkezine getirilir, nekropsisi yapılması isteniyorsa, ki uygun olanı bütün ölen hayvanların nekropsileri yapılmalı, nekropsileri yapılır, bu arada ölüm nedenini belirlemeye kullanılacak marazi maddeler alındıktan sonra aynı birim içinde fırınır, gömülecek bir durum söz konusu ise yine orada gömülü olur. Böylece ölen bir hayvan çevreyi kirletmeden, ölümüne neden olan enfeksiyonu çevreye yaymadan, ölüm nedeni belirlenerek yok edilmiş olur.

## SONUÇ

Bu sistemin kurulması, uygulanması zor mudur? Büyük yatırımlar gerektirir mi? Öncelikle belediyelerce, çevre il müdürlüklerince tarım il müdürlüklerince ve yetiştirci birliklerince konunun önemi iyi anlaşılması gereklidir. Artık günümüzde çevreyi korumaya yönelik projelere destek veren çok sayıda kuruluşlar var. Bu kuruluşlarla işbirliği halinde yapılacak bir projeye bu düşünceler uygulamaya geçebilir. Böylece Ülkemiz için örnek bir uygulama da başlatılmış olur.

## EFFECT OF PROBIOTIC AND UREA ON NUTRITIVE VALUE OF MALVA AND BARLEY SILAGE

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### ABSTRACT

This study was conducted to determine the effect of ensiling Malva grass (, *Malva sylvestris* ) (75%) , green barley (15%), urea (5%) and molasses(5.5 - 6%) with 0, 0.2 and 0.5 % probiotic on silage quality and chemical composition, the silage were determined at 40 days of ensiling.

Results showed that physical characteristics indicate acceptable physical attributes and rang from good quality to Very good silage. Silage scores however revealed that the best physical attributes were attained at 0.2 and 0.5 % probiotic. Additives improved fermentation quality by reducing final pH from 4.80 to 4.50, indicating that the silages mixtures were adequately fermented .

Silage without probiotic showed lower ( $P < 0.05$ ) dry matter losses as compared to 0.2 and 0.5% probiotic,while, organic matter and crude protein content had more ( $P<0.05$ ) for silage without probiotic than probiotic additives. Addition of probiotic produced silages with significantly higher ( $P < 0.01$ ) in vitro dry matter and organic matter digestibility and metabolizable energy value than without probiotic .

Neutral detergent fiber, hemicellulose and lignin decreased ( $P<0.05$ ) for silages 0.02 and 0.5% probiotic than without probiotic ,no significant defenses for acid detergent fiber and water soluble carbohydrate contents in silage .

In conclusion, probiotic used in this study enhanced nutritive value of silage. Ensiling may be applied as a practical approach for long-term preservation of fresh grass.

**Keywords:** silage quality, probiotic, *Malva sylvestris*

### INTRODUCTION

In the tropics and sub tropics the grasses unavailable as feed in the off season ,the shortage of good quality forage during the dry season needed search for alternative ways to provide good quality feed (Babayemi and Igbekoyi ,2008) , hence the need for conservation as a silage .silage is one of methods to produce feedstuff by fermentation of crops or agricultural byproduct.

Malva grass biennial–perennial herbaceous plant as a weed in most parts of the world, perennial root annual stem two to three feet high, Leaves are large (Lust, 1974). *Malva sylvestris* L. (Malvaceae), usually known as common mallow, is widely used in Mediterranean and European traditional medicine for treatment of external and internal inflammation and injuries and is also locally regarded as a wild food herb. Malva grass may also be a feed resource because of high quality, fast growth rate and easy adaptation to the environment, However, ensiling is a suitable method for forage conservation and is aimed at minimizing nutrient wastage by enhancing the growth of lactic acid producing bacteria (Baytok et al., 2005). Urea can be used to increase nitrogen content and improve the fermentation quality of the silage (Filya et al., 2000). Molasses, a source of water soluble carbohydrate (WSC), is often used with urea to help preventing silage instability (Jaurena and Pichard, 2001). Also, molasses prevents increase silage temperature and poor aerobic stability of silage (Soderholm et al., 1998), molasses added to the silages to increase dry matter concentration, fermentation rate and production of lactic acid (McDonald et al., 1991).

Previous studies have shown that inclusion of molasses as a source of readily fermentable WSC has improved the fermentation of tropical pasture silages (Catchpoole and Henzell, 1971).

The present study was designed to ensile Malva and green barley grass with probiotic as feed for ruminants .

### MATERIALS AND METHODS

#### Silage making

Malva grass and green barley was harvested manually , chopped into 5-8 cm length and wilted for 24 hours in order to reduce the moisture content to 60-70%, silage was prepared as follows:

1- Malva 75% ,green barley 15%,urea 5% and molasses 6% .

2- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.8% and probiotic 0.2%.

3- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.5% and probiotic 0.5%.

Filling and compaction was done simultaneously to eliminate inherent air. The silage was prepared in polythene bags in duplicate, the polythene bags were sealed and compressed. Fermentation was done for 40 days.

### Determination of silage quality

The bags were opened after 40 days, fermentation quality can be assessed by making visual observations and some physical quality such as moldiness, odor (aroma), color, temperature ,pH and texture change were determined according to Babayemi and Igbekeyi (2008).

Fleig score was calculated by using the equation of  $220 + (2 \times DM\%) - 15) - (40 \times pH)$  (Kılıç, 1984)

### Chemical composition

Crude protein, crude fiber, ether extract and ash content of the silages were carried out as described by AOAC (1995), The fiber components including neutral detergent fiber, acid detergent fiber and acid detergent lignin were determined according to Van Soest et al. (1991). Water Soluble Carbohydrates (WSC) determined according to (Pollock and Jones, 1979).

### statistical analysis

Data were analyzed by using the procedure of SAS (SAS, 2002). The significant means separated using Duncan (1955) multiple range.

### Results and discussion

#### Physical quality

The results of the physical quality of the silage on different additive of probiotic are shown in Table 1, The colour of silage in all treated were greenish brown, It was normal colour range for grass which was an indication of good quality silage (Oduguwa et al., 2007),The odor of silage varied from Musty (silage A) to pleasant (silage B and C) , The silages with probiotic exhibit pleasant odor which is an indication of well-made silage, Kung and Shaver (2002) reported that pleasant smell is accepted for good or well-made silage. The texture of silage A were presence of mould , which means that air has enter the silage, DM has been lost and silage quality (ME content) will have declined during storage (as show in table 3), While silage B and C were Moderately firm ,Likely to have high ME. Probably the probiotic consumed the air has enter the silage B and C , moderately firm was expected to the good texture of good silage (Kung and Shaver, 2002), Presence of mould texture or fungi growth indicates spoilage in the silage.

Addition of probiotic to silage changed the temperature from 25 (silage A) to 22 C° ( silage B and C ), this was due to the active of mould in silage A, ,the temperature range appears to be the fitting temperature for normal silage fermentation, The temperature of silages with probiotic lower than the range (25-27°C) obtained by Babayemi (2009) in silage of Guinea grass, good quality silage should be cooled at opening and at feed to a normal room temperature (McDonald et al., 1995). Bolsen et al. (1996) reported that any excessive heat production can result in mallard or browning reaction which can reduce the fiber and protein digestibility,If the temperature of silages was above 30°C the grass silage would have become dark or brown due to caramelization of sugars in the forage (McDonald et al., 1995), temperature is one of the essential factors affecting silage colour. Moreover, there were slightly mould in silage A which affected the temperature and odor.

Fermentation characteristics of the different silages presented in Table 2.the pH value of the silage was decreased from 4.80 to 4.5 in the silage, These were within the acceptable range for good silage in the tropics (Bilal, 2009 and Nhan et al 2009), and was within the range of 3.5-5.5 classified to be pH for good silage . The pH of the ensiled mixtures decreased with inclusion of probiotic, This suggests that the probiotic responsible for anaerobic fermentation of the silage , according to Obua (2005) the excellent silages had pH range of 3.5 – 4.9,pH is one of the simplest and quickest ways of evaluating silage quality. However, pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH (be more acidic) than the original forage. low content of water soluble carbohydrate which are essential to successful ensilage (Woolford ,1984).As shown in table 2 Water Extraction were 62.330 , 66.132 and 66.428 % for silages A,B and C respectively. table 3 show that Water-soluble carbohydrate in crops is concentrated by water evaporation during wilt time between forage cutting and chopping which the final pH drop in the ensiled crop depend largely on the type and moisture of forage being ensiled.

Wile Fleig points were 74.64, 87.27 and 87.01 for silage A, B and C respectively, Quality classify were good for silage A to Very good quality for silage B and C respectively .

**Table 1: Physical quality of the different silages**

Parameters	Silages		
	A	B	C
Color	Greenish brown	Greenish brown	Greenish brown
odor	Musty	Pleasant	Pleasant
Texture	Presence of mould	Moderately firm	Moderately firm
Temperature (°C)	25	22	22
Moldiness	Slightly mould	Without mould	Without mould

A-Malva 75% ,green barley 15%,urea 5% and molasses 6% .

B- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.8% and probiotic 0.2%.

C- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.5% and probiotic 0.5%.

**Table 2. Fermentation characteristics and Fleig points of the different silages**

Parameters	Silages		
	A	B	C
PH	4.80	4.50	4.50
Water Extraction%	62.330	66.132	66.428
*F.P.	74.64	87.27	87.01
Quality classify	Good	Very good	Very good

A-Malva 75% ,green barley 15%,urea 5% and molasses 6% .

B- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.8% and probiotic 0.2%.

C- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.5% and probiotic 0.5%.

\*Fleig points = 220 + (2 x % dry matter - 15) - 40 x PH ( kilic,1986)

Where Fleig Points: 81 -100 Very good , 61 – 80 Good ,40- 60 Satisfactory, 21 – 40 Middle,0 -20 Bad.

### Chemical composition

Chemical composition of different silages is shown in Table 3.it was observed that in vitro dry matter , organic matter digestibility and metabolizable energy value in silage B and C significantly higher ( $P < 0.01$ ) (58.50%, 51.88% and 8.775 MJ/kg DM,59.38%,51.46% and 8.907 MJ/kg DM respectively) compared with silage A( 48.36, 47.59 % and 7.25 respectively ), There were significantly differences ( $P<0.05$ ) in the Dry matter contents of the silage , The highest Dry matter content was for silage B (97.220%) and silage C (97.433 %),while the lowest Dry matter content was for silage A (93.150 ). The reduction in the silage dry matte might be due to the fermentation process. Organic matter content significant highest ( $P<0.05$ ) for silage A (91.093%) compared with silage B and C (87.821 and 87.280%) ,while Crude protein content of the silage was significantly lower ( $P<0.01$ ) in silage B and C ( 15.272 and 15.461 % ) compared with silage A (17.391%).There were no significant different in ash, Water Soluble Carbohydrates and ether extract contents of all silages.

The chemical composition of the cell wall are presented in Table 4 ,There were significant differences ( $P<0.05$ ) in the Neutral detergent Fiber and Lignin contents of the silages,Silage A ( 34.242 and 14.406 %) had the highest followed by silage B and C (30.486 and 12.265,30.863 and 12.084 %),this could be attributed to the anaerobic fermentation case by probiotic. the contents of Hemicellulose were significant higher ( $P<0.05$ ) in the silage A (8.770%) and low in silage B and C (5.850 and 5.290%),the Cellulose contents had significant higher ( $P<0.05$ ) in the silage C (13.487%) follow silage B (12.370%) then silage A (11.07%),While there is no effect on silage Acid Detergent Fiber .

**Table 3. Chemical Composition (g/100g) and estimated energy (MJ/Kg DM) of the different silages**

Parameters	Silages			
	A	B	C	
Dry matter	93.150 <sub>b</sub>	97.220 <sub>a</sub>	97.433 <sub>a</sub>	*
Dry matter recovery	30.820	31.138	31.005	NS
Organic matter	91.093 <sub>a</sub>	87.821 <sub>b</sub>	87.280 <sub>b</sub>	*
Crude protein	17.391 <sub>a</sub>	15.272 <sub>b</sub>	15.461 <sub>b</sub>	*
Ash	16.057	16.003	16.155	NS
Ether extract	2.799	2.806	2.743	NS
WSC	17.327	17.431	17.357	NS
IDMD%	48.36 <sub>b</sub>	58.50 <sub>a</sub>	59.38 <sub>a</sub>	**
IOMD%	47.59 <sub>b</sub>	51.88 <sub>a</sub>	51.46 <sub>a</sub>	**
ME (MJ/kg DM)●	7.250 <sub>b</sub>	8.775	8.907 <sub>a</sub>	**

Means on the same row with different superscripts differ significantly (P<0.05).

A-Malva 75% ,green barley 15%,urea 5% and molasses 6% .

B- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.8% and probiotic 0.2%.

C- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.5% and probiotic 0.5%.

WSC:Water soluble carbohydrate ,

● ME (MJ/kg DM)= 0.15 × IDMD ( MAF,1975)

**Table 4. Chemical Composition (g/100g) of plant cell wall of the different silages**

Parameters	Silages			
	A	B	C	
Neutral detergent fiber	34.242 <sub>a</sub>	30.486 <sub>b</sub>	30.863 <sub>b</sub>	*
Hemicellulose	8.770 <sub>a</sub>	5.850 <sub>b</sub>	5.290 <sub>b</sub>	*
Acid Detergent Fiber	25.472	24.633	25.571	NS
Lignin	14.406 <sub>a</sub>	12.265 <sub>b</sub>	12.084 <sub>b</sub>	*
Cellulose	11.07 <sub>b</sub>	12.370 <sub>a b</sub>	13.487 <sub>a</sub>	*

Means on the same row with different superscripts differ significantly (P<0.05).

A-Malva 75% ,green barley 15%,urea 5% and molasses 6% .

B- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.8% and probiotic 0.2%.

C- Malva 75% ,green barley 15%,urea 5 % ,molasses 5.5% and probiotic 0.5%.

## CONCLUSION

Data of the present study indicate that the use of probiotic in silage cause to improved the nutritive value of silage ,Applying this kind of additives in silage had a benefit ,this effect might be due to the probiotic microbial that consumed oxygen in silage container to good fermentation and cell wall degradation, reduced initial populations of yeasts and mold that caused to delayed the fermentation ,and inhibition of rising temperature .

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## LIVESTOCK WASTE-BASED BIOGAS ENERGY POTENTIAL OF TOKAT PROVINCE AND POSSIBLE IMPLEMENTATIONS\*

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### ABSTRACT

Tokat Province has intensive livestock facilities. The present study was conducted to determine biogas production potential from livestock wastes and to assess energy production opportunities and possible resultant contributions to be made to country economy. The target is to create high-yield, easily constructed and feasible biogas facilities with low investment, operation and maintenance costs. Initially the number of livestock facilities and their waste potentials were determined and energy production potential from these wastes was assessed. Current calculations and assessments revealed that Tokat Province has biogas production potential of 301 434 m<sup>3</sup>/day with an electrical energy equivalent of 502 390 kWh/day.

**Keywords:** Biogas, livestock waste, geographical information systems, Tokat

### 1. INTRODUCTION

Ever increasing energy demands have brought about the needs to find new energy sources. With currently available potential, socioeconomic benefits and differences from the other energy sources, biogas may be considered as an alternative energy source. Biogas technology allows to make organic wastes creating various problems on environment and human health harmless and to use such wastes in energy production. It is also a significant factor with regard to renewable energy production.

Energy is an indispensable part of human life and is a significant indicator of economic and social development. It is highly effective in improvement of life standards and plays a vital role in technological production and development. Fossil fuels have commonly been used to meet world energy demands for ages. But it is evident that such resources will not be able to meet the demands of mankind in near future and consequently an energy bottleneck is envisaged for the upcoming years. So, renewable energy sources should be investigated and put into practice to overcome this prospective bottleneck in energy supply.

Agricultural, livestock and domestic wastes are considered as an alternative source of energy in Turkey as it was in various other parts of the world to meet a portion of energy demand and to overcome the problems related to energy resources. Therefore, there is a need for research to assess the energy production potential of such wastes, about the anaerobic digestion conditions and proper digesters. The studies on biogas production technologies should be supported and anaerobic treatment technologies should be developed.

There are 36 biogas facilities actively operating in Turkey and 34 of them are operating as the facilities of municipalities or industries (waste gas or wastewater treatment facility). These facilities are commonly located in western sections of the country. The number of facilities using livestock waste or additives is 18. Together with the facilities under construction, the number will reach to 85 (Turkmenler et al., 2014; Anonymous, 2014).

Despite the available organic waste potential (38 million tons), these wastes are not properly valued in Turkey. A significant economic input can be supplied by using these wastes (Turkmenler et al., 2014). About 85% of total biogas potential comes from waste gas and the rest comes from solid waste repository gas. Of waste gas potential, 50% comes from ovine, 43% comes from bovine and 7% comes from poultry (Topal et al. 2008). Considering the animal waste theoretical biogas potential, the annual potential was estimated to be 2 608,3 million m<sup>3</sup>, 401,5 million m<sup>3</sup> of which coming from poultry, 852,6 million m<sup>3</sup> from ovine and 1 354,2 million m<sup>3</sup> from bovine. Therefore, biogas potential of Turkey is estimated to be 1 400-2 000 Btep/year. Biogas sector of Turkey is composed of waste gas production facilities of some municipalities, waste water treatment facilities of municipalities, and industries, gasification demonstration facilities of the Ministry of Forest and Water Works and specialized biogas facilities of private sector. Biogas production is also performed from livestock wastes with investments made in this area (Anonympus, 2012).

For proper implementation of biogas technologies in Turkey, regional or local potentials should initially be

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\* This study presents partial results of a Graduate Thesis

determined. Tokat Province of Turkey has significant potential with regard to agricultural and livestock activities. Total livestock inventory of the province is 384 795 bovines, 258 944 ovine (sheep and goats) and 248 156 poultry (Anonymous, 2014). The province has also significant infrastructure and land resources for energy forestry and biofuels. However, biomass energy production from plant materials, livestock and forest wastes, grass lands, domestic and industrial wastes is not still at desired levels (Karaman and Ozguven, 2014). Livestock wastes are piled up over the fields and burnt as cowpat and such uses result in various environmental problems (Karaman, 2005). Despite the rapid growth of livestock industry of the province, possible use of livestock wastes and their conversion into energy sources are not assessed sufficiently. Thus, researches are needed to assess biogas production potential of these livestock wastes of the province.

The present thesis was conducted to determine the biogas production potential of livestock wastes of Tokat Province with intensive livestock facilities, to identify possible use of these wastes in energy production and to determine the contributions provided to economy. Since livestock facilities are common in the region and it is easy to collect livestock waste, livestock wastes among the animal wastes were taken into consideration and pilot central biogas facilities were designed for 250, 500 and 1 000 animal capacities. Floor plans, cross-sections and side wives were all drawn in AutoCAD and dimensioning, energy analyses and costing were performed for those facilities.

## 2. MATERIAL AND METHOD

### 2.1. Material

The present study was conducted to determine livestock inventory of Tokat Province and to assess biogas production potential from livestock wastes. Therefore, initially, characteristics of current livestock facilities, their livestock inventories, distribution throughout the province, land resources and distribution, population distribution and geographical characteristics were investigated. Relevant data was gathered from Tokat Provincial Directorate of Food Agriculture and Livestock, TUIK (Turkish Institute of Statistics), DMI (State Meteorological Works).

### 2.2. Method

The equations provided in Ergunes and Tarhan, (2009) were used to calculate daily manure production, daily slurry amount, amount of water to be added to manure, daily total slurry volume, reactor (digester) volume (RH), total specific gas production, daily gas production, volume of gas tank.

In calculation made to determine biogas potential, optimum biogas conditions were assumed and the recommendations provided in Ergunes and Tarhan, (2009) were considered to calculate daily manure production of an animal, biogas reactor volumes for different size facilities and hydraulic retention times.

Since livestock facilities are common in the region and it is easy to collect livestock waste, livestock wastes among the animal wastes were taken into consideration and pilot central biogas facilities were designed for 250, 500 and 1 000 animal capacities. Floor plans, cross-sections and side wives were all drawn in AutoCAD and dimensioning was performed for those facilities.

The principles provided in Kaya and Ozturk (2012) were taken into consideration while calculating daily organic matter to be fermented or loaded into reactor (reactor loading) and reactor height. Reactor loading was taken as 5 kg/m<sup>3</sup>/day as recommended and 33 m<sup>3</sup>/day gas production was assumed per ton of manure (Kaya and Ozturk, 2012).

Reactor sizing was performed by considering the recommendation provided in Kaya and Ozturk (2012) for vertical cylindrical floating balloon type biogas facilities. Reactor diameters were taken as equal to reactor heights and the ratio of RH/GD=3/1 was taken while calculating gas tank volumes (Kaya and Ozturk, 2012). While calculating livestock waste-based biogas production potential of the province, 30% of gas was assumed to be electricity, 60% heat and 10% loss through cogeneration method of the gas and thermic equivalent of biogas was taken as 20 MJ/m<sup>3</sup> (Kaya and Ozturk, 2012; Gulen and Arslan, 2005).

## 3. RESULTS AND DISCUSSION

### 3.1. Biogass Potential of Tokat Province and Enerji Equavelents

There are 384 795 bovines, 258 944 ovine and 248 156 poultry of which 239 805 are hens and 8 351 are the other poultry (Table 1). Of this livestock inventory, 55% are local races, 35% are hybrid and 10% are culture races. The ratio of culture races was significantly at low levels. Of total ovine inventory, 84% are sheep and 16% are goats. Of total poultry inventory, 91% are hens, 3% are goose, 2% are turkey and 2% are duck. Of livestock facilities, 63% have an animal inventory of 1-10, 2% have 11-20, % have 21-30, 3% have 31-40, 1.5% have 41-50, 1.4% have 51-100 and only 0.2% have an animal inventory of over 101. Of this bovine inventory, 70.5% are dairy cows and 29.5% are beef cattle (Anonymous, 2014).

**Table 1. Animal inventory of towns of Tokat Province (Anonymous, 2014)**

Towns	Bovine	Ovine	Hen	Other Poultry
ALMUS	20 702	18 687	10 355	852
ARTOVA	17 510	6 759	6 430	376
BAŞÇİFTLİK	5 434	3 581	2 890	395
ERBAA	32 112	54 492	48 797	1 363
MERKEZ	76 090	51 523	48 321	1 564
NİKSAR	52 455	30 811	28 328	679
PAZAR	12 646	5 531	5 865	118
REŞADİYE	23 322	23 040	20 743	467
SULUSARAY	14 189	4 072	3 567	301
TURHAL	58 539	33 941	31 021	985
YEŞİLYURT	14 945	6 002	5 032	234
ZİLE	56 851	20 505	28 456	1 017
TOPLAM	384 795	258 944	239 805	8 351

The amount of waste to be obtained from bovine (7 696 ton/day) was higher than the waste to be obtained from ovine and poultry. Thus, central biogas facilities using livestock (ovine) manure was decided to be designed since livestock facilities are common in the region and it is easy to collect livestock waste. Since 85% of livestock facilities have less than 20 animals, central facilities serving more than one facility were found to be proper. Large portion of livestock facilities (83%) also deal with plant production activities, these facilities can be organized as biogas cooperatives and use both livestock and plant production wastes together in biogas production.

Livestock-based biogas potential of Tokat Province and energy equivalents are provided in Table 2.

**Table 2. Total biogas potential of Tokat Province and energy equivalents**

TOWNS	DMP (ton/day)	Reactor volume (m <sup>3</sup> )	DGP (m <sup>3</sup> /day)	Total energy equivalent (kWh/day)	Cogenerated energy equivalents (kWh/day)		
					Electricity	Heat	Loss
ALMUS	453	29 452	16 895	93 861	28 158	56 317	9 386
ARTOVA	364	22 673	12 942	71 900	21 570	43 140	7 190
BAŞÇİFTLİK	117	7 401	4 244	23 578	7 073	14 147	2 358
ERBAA	755	51 964	30 227	167 928	50 378	100 757	16 793
MERKEZ	1 629	104 000	59 660	331 444	99 433	198 867	33 144
NİKSAR	1 113	70 545	40 392	224 400	67 320	134 640	22 440
PAZAR	264	16 538	9 451	52 506	15 752	31 503	5 251
REŞADİYE	514	33 665	19 399	107 772	32 332	64 663	10 777
SULUSARAY	292	18 030	10 267	57 039	17 112	34 223	5 704
TURHAL	1 241	78 609	45 009	250 050	75 015	150 030	25 005
YEŞİLYURT	311	19 411	11 075	61 528	18 458	36 917	6 153
ZİLE	1 180	73 275	41 873	232 628	69 788	139 577	23 263
TOTAL	8 234	525 563	301 434	1 674 633	502 390	1 004 780	167 463

DMP: Daily Manure Production, DGP: Daily Gas Production

### **3.2. Design of Central Biogas Facilities for Tokat Province**

Since livestock facilities are common in the region and it is easy to collect livestock waste, livestock manure among the animal wastes were taken into consideration for biogas production. Since biogas facilities have high initial investment costs and return on investment takes longer, livestock manure is not well utilized in the region and excessive manure haphazardly piled up over the fields and result in various environmental problems, pilot biogas facilities were designed for 250, 500 and 1 000 bovine manure capacities. Collection and storage of manures of rural settlements at a certain place will reduce the facility cost, time and labor losses. Environmental problems will also be eliminated through the use of such wastes in biogas production.

Besides livestock wastes, other agricultural wastes, food and fishery industry wastes, organic domestic wastes and sewage wastes can be used in central waste collection systems and biogas facilities and all these works can be carried out by a cooperative established by the farmers.

In several parts of the world with intensive livestock facilities, livestock wastes are transported to central biogas facilities with transportation vehicles. Biogas is produced from these wastes and converted into energy for heat and power generation. The fermented manure is then transported to storage tanks close to facilities to use in agricultural lands (Yokus, 2011). In central biogas facilities, livestock and other wastes are sent from pre-storage tanks or canals and special storage trucks to reactors. In-place storage, transfer and transport of resultant fertilizer are all the responsibility of farmers in these facilities. Manure storage sites can be used more than one farmer. Based on mesophilic and thermophilic processes, hydraulic retention time in these facilities is between 12-25 days and biomass mixture is taken inside with pumps. Pumps are also used to take out from the reactor at equal amounts (Gul, 2006).

Gas productions and energy equivalents of recommended biogas facilities are provided in Table 3.

**Table 3. Gas productions and energy equivalents**

Number of livestock	Reactor load (kg/m <sup>3</sup> /day)	DMP (ton/day)	DGP (m <sup>3</sup> /day)	Total energy equivalents (kWh/day)	Cogenerated energy equivalents (kWh/day)		
					Electricity	Heat	Loss
250	1.66	5	170	944	283	567	94
500	1.66	10	340	1 889	567	1 133	189
1 000	1.66	20	679	3 772	1 132	2 263	377

DGP: Daily Gas Production, DTP: Daily Total Slurry Volume

Reactor and gas tank dimensions for recommended facilities are provided in Table 4.

**Table 4. Reactor and gas tank dimensions**

Number of livestock	Reactor			Gas tank		
	Volume (m <sup>3</sup> )	Height (m)	Diameter (m)	Volume (m <sup>3</sup> )	Height (m)	Diameter (m)
250	300	7.25	7.25	100	3.63	7.25
500	600	9.15	9.15	200	4.58	9.15
1 000	1 200	11.50	11.50	400	5.75	11.50

Volume of pretreatment tank was calculated based on daily slurry volumes to be digested and bio fertilizer storage volume was calculated as to store six month fermented fertilizer based on 180 days total slurry volume (Table 5). Floor areas and elevations of proposed biogas facilities are provided in Table 6.

**Table 5. Pretreatment tank and bio fertilizer storage volumes**

Number of livestock	DTSV (m <sup>3</sup> )	Pretreatment tank (m <sup>3</sup> )	Bio fertilizer tank (m <sup>3</sup> )
250	10	10	1 800
500	20	20	3 600
1 000	40	40	7 200

DTSV: Daily Total Slurry Volume

Area and elevations for pilot facilities are provided in Table 6. Floor area of facilities planned for 250, 500 and 1 000 bovine manure capacities were respectively calculated as 41 m<sup>2</sup>, 66 m<sup>2</sup> and 104 m<sup>2</sup>; elevation from the floor including gas tank were respectively calculated as 11,00 m, 13,90 m and 17,45 m.

**Table 6. Floor areas and elevations of proposed facilities**

Number of livestock	Floor area (m <sup>2</sup> )	Surface area (m <sup>2</sup> )	Elevation (m)
250	41.39	165.35	11.00
500	65.89	263.30	13.90
1 000	103.86	415.47	17.45

Type of biogas facility was determined by considering strong and week points of various alternatives. Floating balloon type biogas facilities were preferred in this study because of resistance, design cost, easy design, reliability, gas tightness, security, easy transport, operation and maintenance. Steel profiles are used as construction material of the facilities because of easy transport, construction and easy integration into mixing system.

The floor plans, cross-section and side views of a pilot biogas facility designed for 250 ovine manure capacity are presented in Figure 1.

#### 4. CONCLUSION

Livestock manure is stored open fields and creates various problems on environment in Tokat Province. Besides being used over the agricultural lands as fertilizer, manure is also used for heating and cooking in rural parts of the province. When the manure is used for heating purposes, sufficient heat is not produced and post-burning residues are not able to be used as fertilizer. Energy obtained from direct burning is relatively lower than the energy obtained through conversion of manure into biogas. Using manure over agricultural fields is also more economical than converting it to energy through direct burning. On the other hand, fermented fertilizer from the biogas facilities to be designed is more beneficial for soil and has a potential to reduce chemical fertilizer use over agricultural lands.

Biogas use in heating and cooking purposes is found to be beneficial in Tokat Province. The greatest obstacle in front of widespread of biogas facilities in rural sections is not to provide end users with technical, economic and socially sustainable facilities. Livestock and plant waste potentials and geographical locations should be taken into consideration in biogas facility design for rural parts of the country. Considering the climate and production conditions, low-cost, high-yield, easily constructed, operated and maintained systems should be designed and constructed.

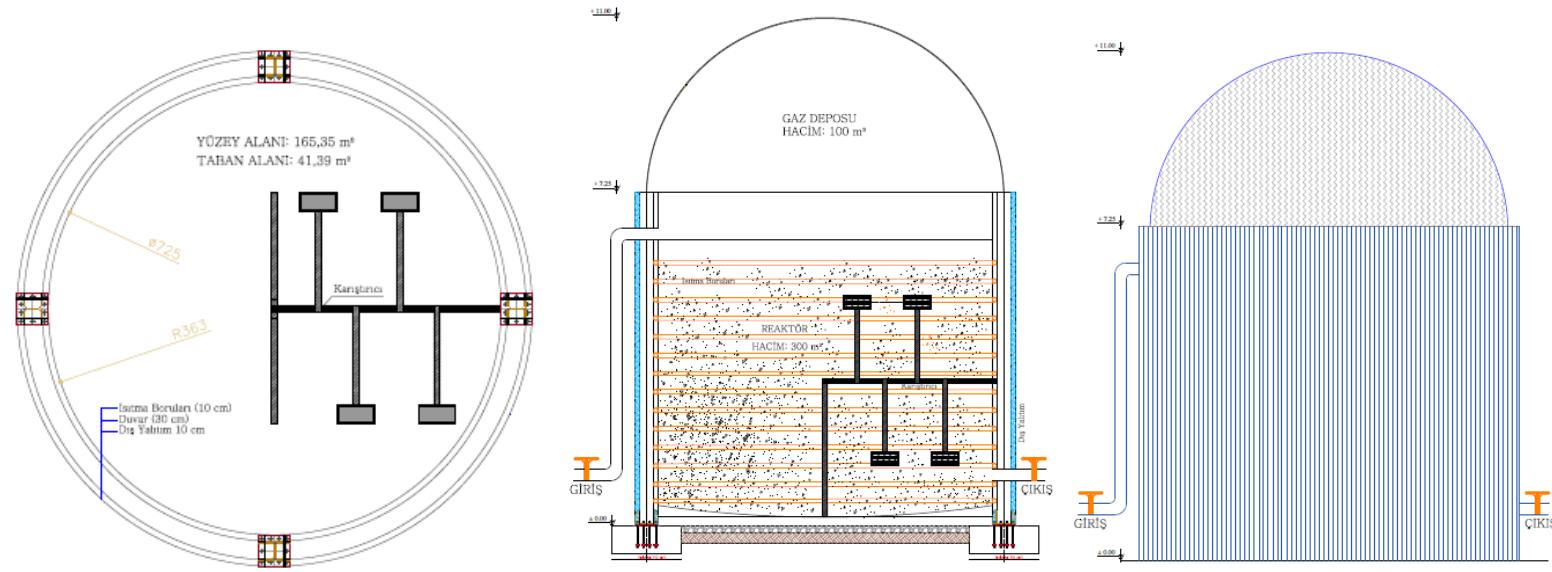


Figure 1. Floor plan, cross-section and side view of pilot facility designed for 250 bovine manure capacity (Scale: 1/200)

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**LOW-COST ENVIRONMENT-FRIENDLY WASTE WATER TREATMENT SYSTEMS  
(CONSTRUCTED WETLANDS)**

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**ABSTRACT**

Natural systems for the treatment and management of municipal and industrial wastewaters and residuals feature processes that use minimal energy, minimal or nochemicals and they produce relatively lower amounts of residual solids. In most cases, this approach will result in a system that costs less to build and operate and requires less energy than mechanical treatment alternatives. Among those natural treatment systems, the constructed wetlands are the systems emulating the natural wetland systems. They are commonly used for treatment of domestic and industrial wastewater in specially designed basins with aquatic plants and easily be used for small-to-medium sized communities. Serious interest in natural methods for waste treatments has reemerged throughout the world. Constructed wetlands with their cheaper and easy construction, low energy and labor costs, easy operation, maintenance and monitoring were specified as the primary issue in rural development strategy document of State Planning Organization of Turkey. Almost all the systems in Turkey are designed as sub-surface horizontal flow type constructed wetlands and most of them are not able to perform as expected because of errors and mistakes made during the design, construction, operation and maintenance of these systems. In this study, general issues to be considered in design, construction, operation and maintenance of sub-surface horizontal flow constructed wetlands commonly used in rural parts of Turkey for domestic wastewater treatment purposes were assessed and current implementations in Kayseri Province were investigated. Potential mistakes made in their design, construction, operation and maintenance of them were pointed out and possible solutions were proposed.

**Keywords:** Wastewater, natural treatment, constructed wetlands, Kayseri.

**1. INTRODUCTION**

Food and water demand are ever increasing together with rapid increase in world population. Besides, agricultural, domestic and industrial sectors are in continuous competition for limited water resources (Çakmak et al., 2003). Continuously polluted waters, decreasing water resources due to global warming and climate change, increasing labor and energy costs all brought the water and treatment technologies into the first place of the world's agenda. To overcome the water-related problems, water losses in agricultural, domestic and industrial uses should be prevented, effective and efficient water use should be provided and possible use of wastewater and treated water should be investigated (Aküzüm et al., 2010).

As it was throughout the world, wastewaters are mostly discharged into seas, rivers and other water bodies without any treatments due to high treatment costs in Turkey. About 2421 of 3225 municipalities have a sewage system and of 3.26 billion m<sup>3</sup> wastewater 44.7% is discharged into sea, 43.1% into rivers, 3.5% into dams, 2.1% into lakes, 1.5% into lands and 5.1% into other receiving bodies. About 69% of discharged wastewater is treated with 236 treatment facilities serving to 442 municipalities. Of these treatment facilities, 29 are physical, 158 are biological, 32 are advanced and 17 are natural treatment facilities (Anonymous, 2010).

Natural and constructed wetlands are treatment systems employed as an alternative to conventional treatment systems because of their low construction, operation and maintenance costs, low energy demands, simple operation and low sludge generation (Knight et al., 1987; Kadlec and Knight, 1996). Constructed wetlands with their cheaper and easy construction, low energy and labor costs, easy operation, maintenance and monitoring were also specified as the primary issue in rural development strategy document of State Planning Organization of Turkey (Anonymous, 2006). These systems are specially designed systems imitating the natural wetlands and include soil, plant and microorganisms to remove the pollutants from wastewaters. An excavated constructed wetland basin is lined with compacted clay or synthetic membrane and filled with graded sand-gravel substrate (Anonymous, 2011). Today, constructed wetlands are widely used to treat

domestic wastewaters (Cooper et al., 1997), agricultural wastewaters (Rivera et al., 1997), industrial wastewater and runoff waters (Dombush, 1989).

In this study, general issues to be considered in design, construction, operation and maintenance of sub-surface horizontal flow constructed wetlands commonly used in rural parts of Turkey for domestic wastewater treatment purposes were assessed and current implementations in Kayseri Province were investigated. Potential mistakes made in their design, construction, operation and maintenance of them were pointed out and possible solutions were proposed.

## 2. NATURAL WETLANDS

Natural wetlands are defined as the transition zones between lands and water bodies and include the sites with specific flora and fauna adapted to these regions and characterized with their high water tables and high organic matter contents (Çiftçi et al., 2007). They usually have water depths less than 6 meters and include the sites of flood plains, shallow shores, lagoons, estuaries, sluggish sections of rivers, lakes with fresh, bitter or salt water (Cirik, 1993). Nutrient inflow to wetlands supports the growth of vegetation and such vegetation constitute the primary component of wetland food-chain and converts inorganic materials into organic materials (Hammer and Bastain, 1989). Wetlands are the natural heritages of the world with their biologic diversity and provide the following functions (Ayvaz, 2005);

- Wetlands purify waters through retaining residues and poisonous materials or using nutrients (nitrogen, phosphorus).
- Wetlands raise the humidity of the region where they are located and have positive impacts primarily on local climate parameters such as precipitation and temperature.
- Wetlands stabilize the water regimes of the regions where they are located through charging or discharging groundwater tables, storing floodwater, controlling floods, preventing sea water intrusion.
- Wetlands provide a habitat for a rich flora and fauna.
- Wetlands are the ecosystems with the highest biological production like tropical rainforests.
- Wetlands have a high economic value with their supports provided in fishery, agriculture, livestock, reed production and tourism.

Water treatment functions of natural wetlands bring the preservation of such sites into consideration. Although researches indicated high waste water treatment performance of natural wetlands (Knight et al., 1987; Kadlec and Knight, 1996), such implementations may have some adverse effects with regard to preservation of these sites. Toxic elements in wastewaters, negative impacts of pathogens and additional hydraulic loading and nutrients can cause long-term degradations in these natural systems. Therefore, constructed wetland technologies have been developed instead of natural ones for wastewater treatment purposes

## 3. CONSTRUCTED WETLANDS (NATURAL TREATMENT SYSTEMS)

Natural treatments systems, also called constructed wetlands, emulate the natural systems and contain soil, plant and microorganisms, commonly encountered in natural ones, within specially-designed and constructed basins to remove pollutants from wastewaters (EPA, 1993). These systems are commonly composed of a compacted clay or synthetic liner overlaid with graded sand and gravel substrate material, reeds like aquatic plants and the other engineering structures adjusting hydraulic loading rates, retention times and water levels within the basin (Figure 1). Constructed wetlands, also called natural treatments systems, today are used for treatment of various wastewater resources.

Compared to conventional treatments systems, constructed wetlands have some advantages. They are cheaper and easier to construct, require low energy and operational costs, do not require expert personnel, environment-compatible systems and provide habitat for various wetland organisms. Beside these advantages, they have also some disadvantages. They require larger areas and system performance is less stable and easily be altered by changing climate conditions (EPA, 1995).

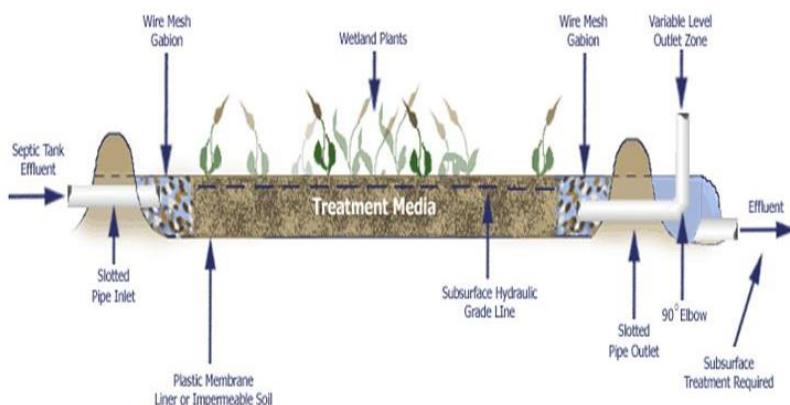


Figure 1. Constructed wetland components (Anonymous, 2011)

A successful constructed wetland design should take the following general criteria into consideration (EPA, 1995):

- The design should be kept as simple as possible and complex technological approaches should be avoided to prevent possible failures.
- The design should be so performed as to require the least maintenance.
- The wastewater flow should be supplied through gravitational flow.
- Extreme weather and climate conditions should be considered in design.
- The design should comply with the natural landscape and topography.
- The systems should be allowed time to reach the desired performance values.

Constructed wetlands can either be designed as the primary treatment unit or integrated into multi-stage treatment systems. They are commonly designed as surface flow and sub-surface flow constructed wetlands. Based on flow regime, sub-surface flow wetlands are also classified as vertical and horizontal flow constructed wetlands.

### 3.1. Surface flow constructed wetlands

Surface flow constructed wetland systems are typically composed of a bed or canal, a compacted impervious layer, soil or another media for plant rooting and relatively low water level flowing through the system (Figure 2). Water surface is above the filtrate or fill material. These systems resemble the natural wetlands and provide various benefits for wild life beside water treatment (Shutes et al., 2002). While the sections closer to surface are aerobic, deeper sections and substrate material are anaerobic. The primary advantage of these systems are their low investment, operation and maintenance costs, easy construction and operation and the basic disadvantage is the land requirement to construct such systems since they require significantly larger areas than the other constructed wetland or conventional treatment systems.

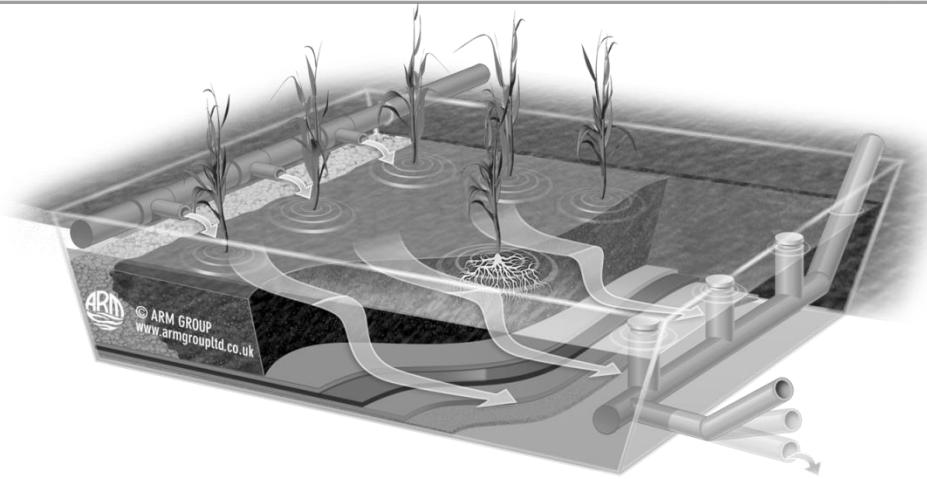


Figure 2. Surface flow constructed wetlands

In system design, biological oxygen demand (BOD), total suspended solids (TSS), nitrogen (total Kjeldahl nitrogen, denitrification and ammonium nitrogen), phosphorus, coliform bacteria, metal and other particulate pollutant performances are taken into consideration. Some recommended design criteria for optimum performance from surface flow constructed wetlands are provided in Table 1 (EPA, 1999).

**Table 1. Design parameters for surface flow constructed wetlands**

Parameter	Design Criteria
Influent quality	BOD $\leq$ 20 – 30 mg L <sup>-1</sup> TSS $\leq$ 20 – 30 mg L <sup>-1</sup>
Pre-treatment	Oxidation basins
Design flows	Q <sub>max</sub> (maximum monthly flow) Q <sub>ave</sub> (average flow)
Maximum BOD loding	20 mg L <sup>-1</sup> : 45 kg ha <sup>-1</sup> day <sup>-1</sup> 30 mg L <sup>-1</sup> : 50 kg/ha <sup>-1</sup> day <sup>-1</sup>
Maximum TSS loading	20 mg L <sup>-1</sup> : 45 kg ha <sup>-1</sup> day <sup>-1</sup> 30 mg L <sup>-1</sup> : 50 kg ha <sup>-1</sup> day <sup>-1</sup>
Water depth	0.6 – 0.9 m (full plant cover sections) 1.2 – 1.5 m (Open water surfaces) 1.0 m (Inlet settling section)
Maximum HRT	2 days (full plant cover sections) 2 – 3 days (Open water surfaces)
Basin geometry	Optimum 3:1 – 5:1
Inlet settling section	In case of failed pretreatment in settling
Inlet	Uniform influent distribution in inlet
Outlet	Uniform effluent collection in outlet

### **3.2. Sub-surface flow constructed wetlands**

Subsurface flow constructed wetlands are composed of a compacted clay or synthetic impermeable liner overlaid by graded gravel and sand substrate material planted with aquatic plants and water level control structures (Figure 3). They are designed in either horizontal flow or vertical flow and can be used with and without emergent plants (Young, 2000). Contrary to surface flow systems, water does not come out to surface in these systems and flows through a substrate material and reaches to outlet. Same parameters are considered in design and recommended design criteria are provided in Table 2 (EPA, 1999).

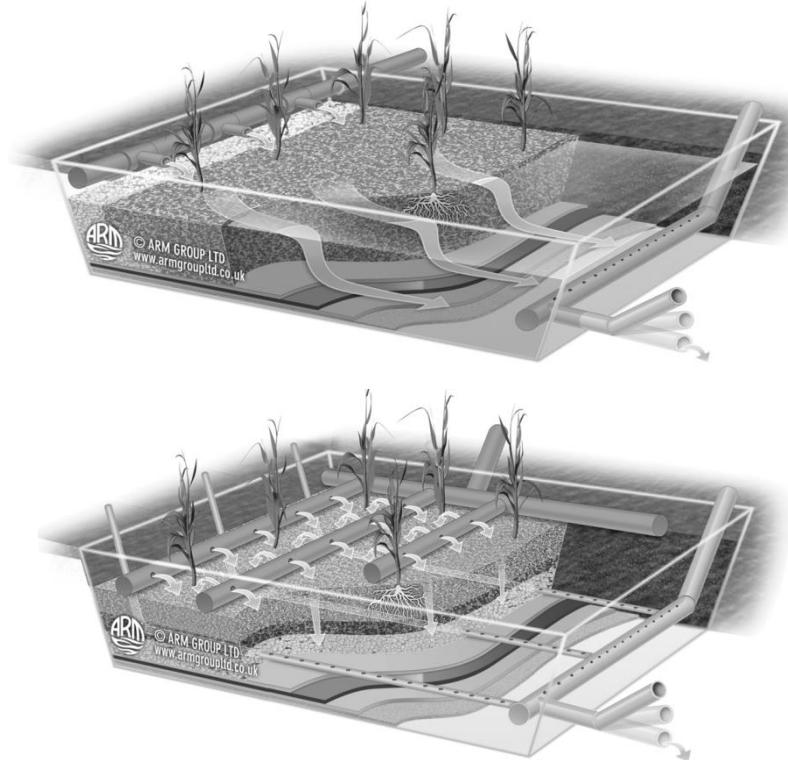


Figure 3. Horizontal and vertical flow sub-surface constructed wetlands

**Table 2. Design parameters for sub-surface flow constructed wetlands**

Parameter	Design Criteria
BOD	6 g m <sup>-2</sup> day <sup>-1</sup> – 30 mg L <sup>-1</sup> for inlet
TSS	20 g m <sup>-2</sup> day <sup>-1</sup> – 30 mg L <sup>-1</sup> for inlet
Depth	Substrate: 0.5-0.6 m Water 0.4-0.5 m
Length	Minimum 15 m
Width	Maximum 61 m
Bed bottom slope	0.5 – 1%
Bed surface slope	Flat or almost flat
Hydraulic conductivity	1000 m day <sup>-1</sup> for the first 30% of length 10000 m day <sup>-1</sup> for the last 70% of length
Substrate	Inlet section: 40-80 mm Process section: 20-30 mm Outlet section: 40-80 mm Planting section: 5-20 mm

The most significant component of these systems is the substrate material filtering wastewater. The material both provides a medium for rooting of aquatic plants and distributes influent, directs and collects effluent, provides surface area for microbial activity and filters suspended solids. Although various size and composition of substrate materials have been tried, there are not any concrete evidences about which size or

type of material is the best. The basic criterion is not to allow small particles settle into the pores of coarser ones. Substrate upper surface should be leveled and about 1% slope should be provided at bottom surface. Inlet pipes should be so arranged to prevent short-circuit and substrate clogging and provide an equal flow. Outlet pipes should also prevent short-circuits, provide equal water collection and allow the operators to arrange the water level and effluent drainage.

In Turkey, sub-surface horizontal flow constructed wetlands are commonly used for domestic wastewater treatment in rural parts, especially in villages. Usually the type-projects designed by Special Provincial Administrations just by taking the total population to be served into consideration are implemented (Figure 4). Most of the time, local conditions, influent quality parameters, hydraulic loading rates, retention times and site-specific characteristics are not taken into consideration. Therefore, various failures occur because of such design errors and most of the already constructed systems are not either well-operating or not-operating at all (Gokalp and Cakmak, 2013). The common failures are classified as: failures in site selection, inlet clogging, substrate clogging and consequent water pondings over the surface, outlet clogging, leakage through slopes, plantation failures, failures in operation and maintenance (Gokalp et al., 2014). Effluents of properly operating systems can also be used for irrigation purposes. However, irrigation water quality parameters should definitely be taken into consideration before using treated effluents.

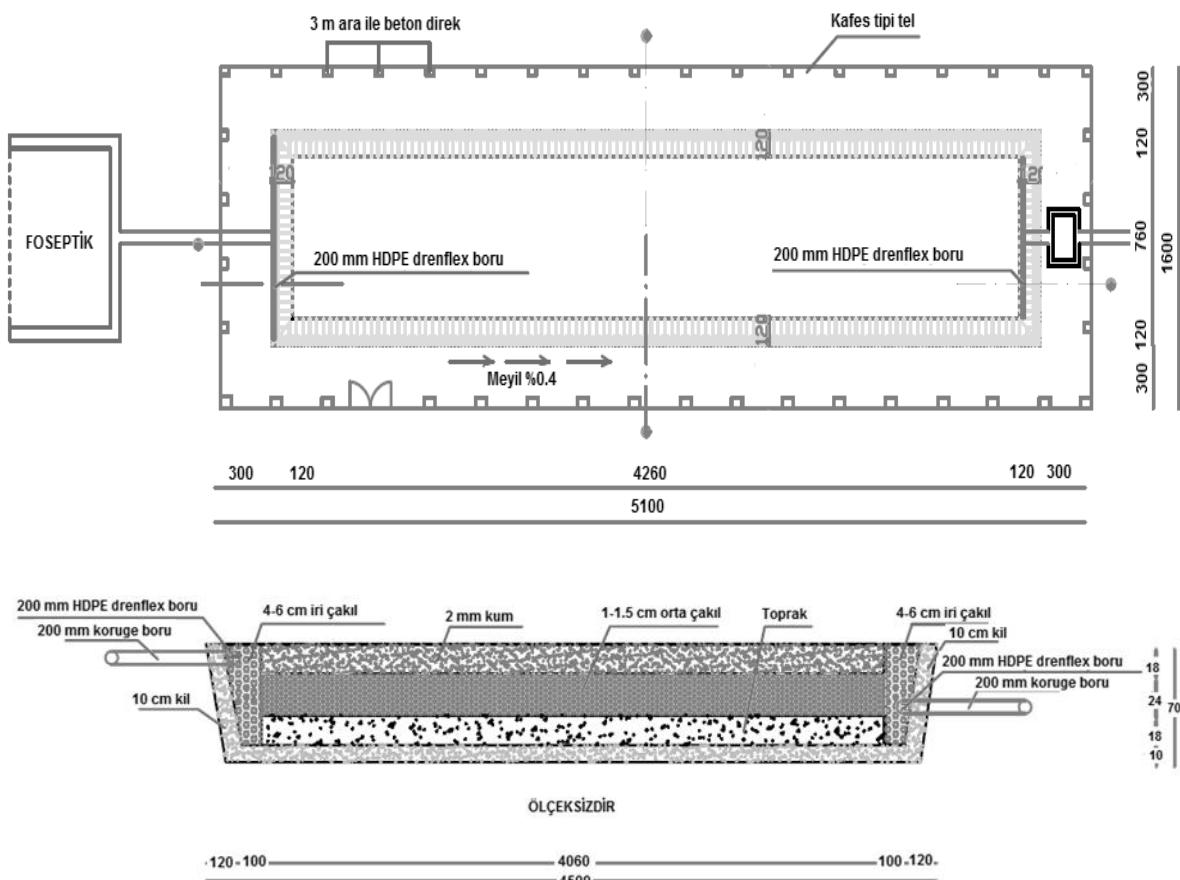


Figure 4. A pilot project designed for a population of 500 people

#### 4. CONCLUSION

Constructed wetlands, also called natural treatment systems, can reliably be implemented in sites with low land costs and limited labor force. They are getting common in rural parts of Turkey, especially in villages to treat domestic wastewater. Such implementations were also specified as the primary issue in rural development strategy document of State Planning Organization. Sub-surface horizontal flow constructed wetlands are common in practice. However, most of the already constructed systems are not either well-operating or not operating at all just because of errors and mistakes made in their design, operation and manenance processes. Such errors must urgently be corrected to prevent the waste of investment made on

these systems. Re-use of treated effluent for irrigation purposes is also a critical issue to be considered. Almost 70% of renewable water resources are allocated to irrigations and re-use of constructed wetland effluents may provide significant water savings in irrigated agriculture. But, irrigation water quality parameters must be taken into consideration before the re-use of treated effluents. As to conclude, constructed wetlands are the significant systems to prevent water resources pollution since the wastewater previously was being discharged into receiving bodies without any treatments. Now, treated effluents are discharged into water bodies with these systems and consequently both water quality and aquatic life are preserved against the toxic and hazardous impacts of untreated sewage.

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## EVALUATION OF POLY(ETHYLENE TEREPHTHALATE) WASTE CHAR IN EPOXY BASED COMPOSITES

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### ABSTRACT

In this study, poly(ethylene terephthalate) (PET) waste was recycled as raw material for the preparation of bisphenol A-type epoxy composite materials. The plastic waste char (PWC) was obtained by pyrolysis of unwashed PET waste at various temperatures (300°C, 400°C, 500°C, 600°C and 700°C). Effect of char wt.% (10%, 30% and 50%) and pyrolysis temperature on mechanical properties of epoxy composites were investigated. The obtained chars were characterized by means of Fourier Transform Infrared Spectroscopy (FTIR). Tensile strength and Young's modulus of the composites with PWC were generally higher with a high amount (over 10 wt%) of chars and at the pyrolysis temperatures over the 400°C.

**Keywords:** epoxy resin, poly(ethylene terephthalate) waste, char, composite

### INTRODUCTION

Five types of plastic account for around 75% of all plastic demand in Europe: polyethylene (PE), polypropylene (PP), polyvinylchloride (PVC), polystyrene (PS) and polyethylene terephthalate (PET). PET is one of the most frequently used raw materials for the manufacture of soft-drink bottles [1]. The problem of recycling polymeric materials has yet to be solved at a satisfactory level. Usually only 30% of polymeric waste is recycled. Recently, environmental, legislative, and consumer pressures have led to an increased interest in using polymeric wastes [2,3]. Upon heating, all the natural and synthetic polymers tend to decompose and pyrolyse through a self-sustaining combustion cycle. Char formation is likely the most important condensed phase mechanism to modify the combustion process of polymers [4]. Research on the pyrolysis of polymers was usually carried out to produce carbonaceous material. Suebsaeng et al. [5] reported that in the pyrolysis of PET, newly formed functional groups can react with the surface of the polymer to produce a more thermally stable, less volatile char. Gil et al studied [1] the pyrolysis of PET at 750°C. The final products included 58% gaseous compounds (CO, CO<sub>2</sub> and hydrocarbons), 20% terephthalic acid and 22% char. The resulting char was partially gasified at 925°C in order to obtain samples with 98-99% carbon. Pyrolysis is considered to be an effective technology, by which also biomass can be converted to valuable bio-oils, char, and gaseous products. Biomass char represents another potential renewable carbon source, which has attracted significant attention recently. Biomass char can be used as a material for combustion [6], activated carbon preparation [7], and gasification, such as H<sub>2</sub>-rich gas production by steam gasification of biomass char [8]. Some studies in the literature have focused on using char as an adsorbent for the removal of heavy metals and organic pollutants from water [9-12]. But there are limited studies on the use of char in composite preparation, and epoxy resin was not used as a matrix by other researchers in these composites. For example, coconut shell char was used in aluminium alloy matrix composites [13]. Ozaytekin and Kar [14] prepared the oligo(azomethine) composites using the carbon material (char) derived from the 450°C pyrolysis of waste PET. Carbonized coconut char powder-based friction materials were produced using styrene butadiene rubber as the polymer matrix [15]. In our previous study we used PET char obtained by pyrolysis at 450°C in epoxy composite in maximum 30 wt% [16]. The present study aims to examine the influence of reinforcement strategies of epoxy/char composites of different wt% (up to a maximum 50%) of chars produced by the pyrolysis of plastic (PET) waste at different temperatures in the epoxy matrix.

### MATERIALS AND METHOD

#### 2.1. Materials

The commercially available undiluted epoxy resin NPEK 114 (EEW 190-210 g/eq, Konuray Chemical Co.) was a bisphenol A-type epoxy resin (ER), diluted with C<sub>12</sub> ~C<sub>14</sub> aliphatic glycidyl ether. The curing agent was a cycloaliphatic polyamine Epamine PC17 (Konuray Chemical Co.). The epoxy embedding medium accelerator was a 2,4,6-tris(dimethylaminomethyl)phenol (Sigma-Aldrich). The raw carbon material PWC was obtained by the pyrolysis of polyethylene terephthalate (PET) waste at 300°C, 400°C, 500°C, 600°C and 700°C.

## 2.2. Composite preparation

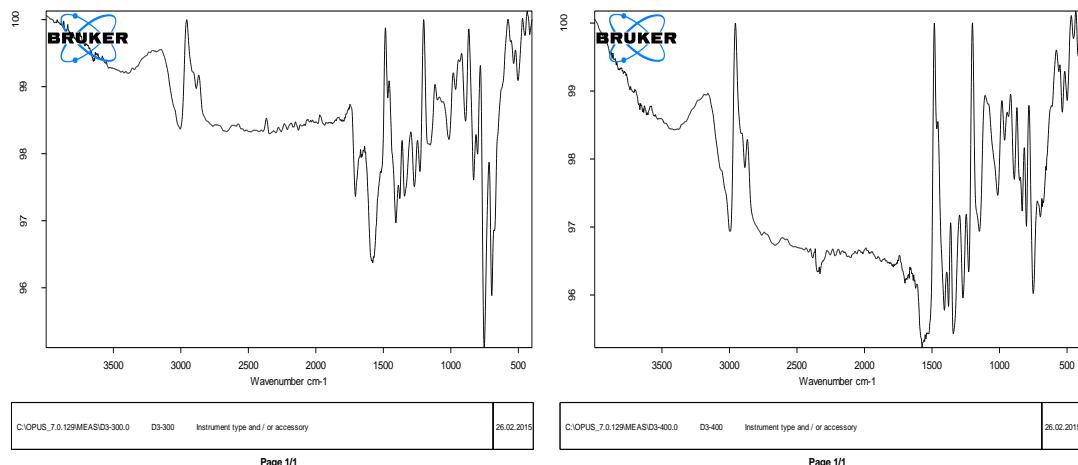
Chars were ground to obtain char powder before being mixed with epoxy. Char (particle size < 250 mesh in 10 wt.%, 30 wt% and 50 wt.%) and the epoxy matrix were mixed by mechanical stirring at 1000 rpm for 3h using a Heidolph RZR1-type stirrer in order to obtain a good dispersion. Later, 30 wt% epoxy hardener and 1 wt% epoxy accelerator were added and the mixture was degassed for 60 min at room temperature, then transferred into the mold. Composite specimens were prepared in stainless-steel molds according to ASTM D 638 standards. The curing procedure occurred in an oven at 40°C for 24h and then post-cured at 120°C within 48h.

## 2.3. Characterization of chars and composites

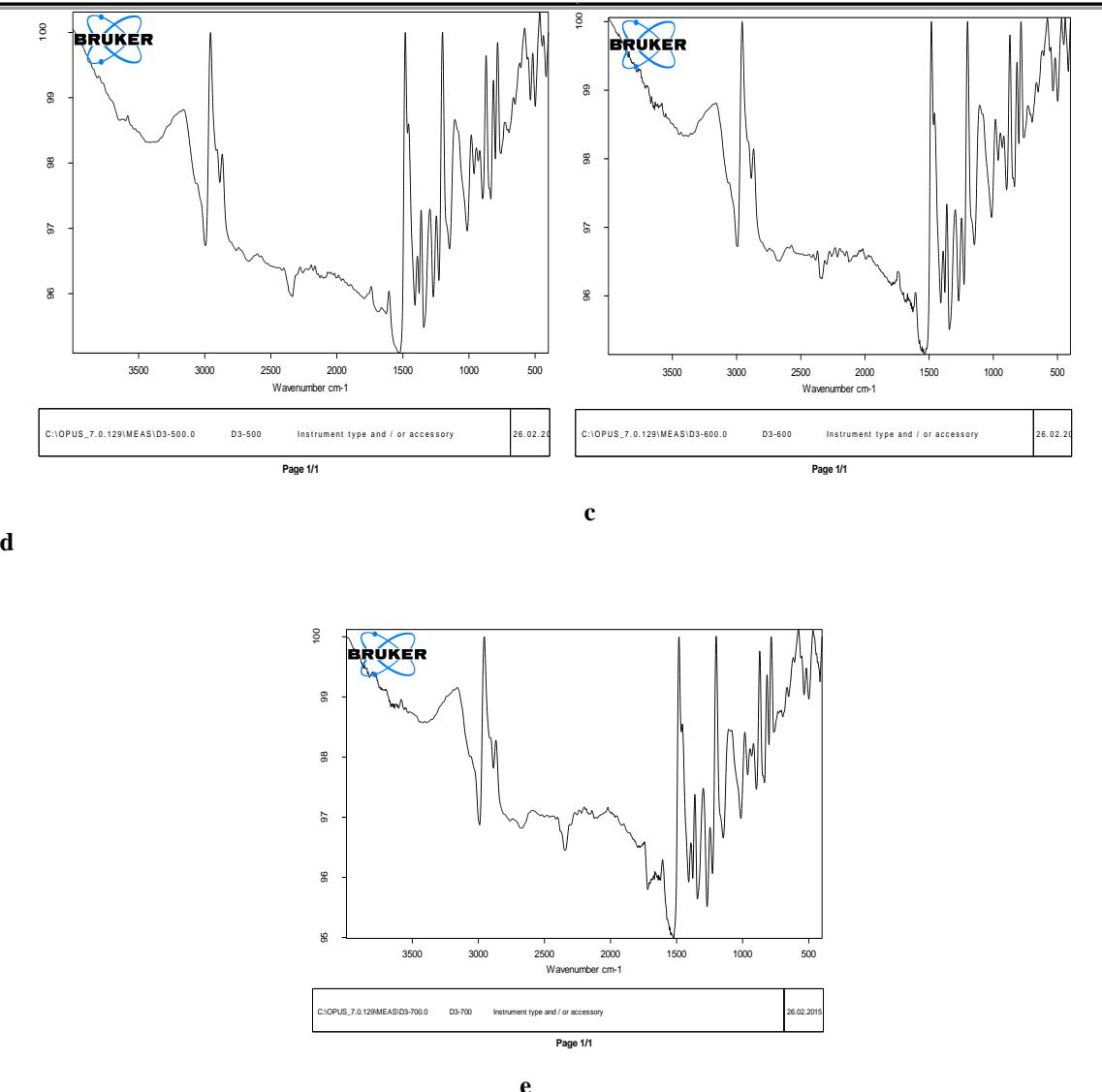
Scanning electron microscopy (SEM) was performed to investigate the surface morphology of chars and the prepared epoxy composites with a Zeiss Evo LS 10 instrument. FTIR spectra of the chars was recorded with Bruker-Platinum ATR- vertex 70. The stretch resistance properties were determined by the Stretch and Pressing Equipment TST-Mares/TS-mxe.

## Results and Discussion

Several authors have studied the thermal degradation products of the PET [17-19], highlighting that there is a high dependence on the temperature and time, a high contribution of aldehydes at low temperature treatments, and a high contribution of aromatics at high temperature treatments. The thermal degradation of the PET is initiated by random scission of the chain at the ester linkage, yielding carboxyl and vinyl ester groups [18]. Suebsaeng et al. [5] reported that the solid pyrolysis product of PET is a polyaromatic char formed by the addition of vinyl ester groups to nearby aromatic rings. Pyrolysis at lower temperatures resulted in a significant increase in carbon.



**b**



**Figure 1.** FTIR spectra of chars obtained: a) at 300 °C; b) at 400 °C; c) at 500 °C;  
 d) at 600 °C and e) at 700 °C

The infrared spectroscopic data in Figure 1 provides information on the chemical structure of char samples. The samples show absorption bands due to aliphatic C-H at 2920–3000 cm<sup>-1</sup> and two bands at 2875–2900 cm<sup>-1</sup> for the aldehyde group. The char obtained by the pyrolysis of PET at 0°C has a weak acidic character. The presence of terephthalic acid in PWC was detected by observing the wakpeaks at 1700 and 3200 cm<sup>-1</sup> for the -COOH group and 1600 cm<sup>-1</sup> for aromatic C-C. The other chars also possessed the aromatic character as seen in their FTIR spectrums. In particular, the aromatic skeletal vibration (1662–1587, 1429–1417 cm<sup>-1</sup>) and aromatic C-H deformation (816, 781 cm<sup>-1</sup>) showed maximum intensities at this temperature. In the FTIR spectra the small peak near 1740 cm<sup>-1</sup> is assigned to C=O stretching vibrations of ketones or aldehydes. The aliphatic CH<sub>3</sub> deformation and phenolic O-H stretching were identified at the band 1375–1380 cm<sup>-1</sup> and 1250 cm<sup>-1</sup>. Overall, the FTIR spectra for chars followed the trend previously observed for other chars: the growth of the aromatic structure.

The mechanical properties of composites are critically based on the microstructure and performance of the interface between the reinforcing filler and matrix. In order to investigate the mechanical properties, such as tensile strength, elongation at break, and hardness of the epoxy composites with 10-50 wt% of the chars, mechanical testing was performed. The results are summarized in Table 1.

**Table 1. Effect of char amount and pyrolysis temperature on mechanical properties of ER/char composites**

Pyrolysis temperature and filler (wt.%)	rigid	Elongation at break (%)	Tensile strength (MPa)	E-modulus (GPa)
<b>For neat ER</b>				
		0.721	86	6.2
<b>For ER/PWC composites</b>				
300 °C (%10)		0.703	93	3.3
300 °C (%30)		0.698	97	9.4
300 °C (%50)		0.482	78	10.8
400 °C (%10)		0.730	80	5.5
400 °C (%30)		0.725	116	4.5
400 °C (%50)		0.725	105	6.0
500 °C (%10)		0.752	110	8.4
500 °C (%30)		0.730	136	8.1
500 °C (%50)		0.613	129	12.3
600 °C (%10)		0.509	87	8.3
600 °C (%30)		0.509	113	13.9
600 °C (%50)		0.500	91	12.9
700 °C (%10)		0.477	80	8.1
700 °C (%30)		0.463	97	8.4
700 °C (%50)		0.365	84	13.4

It was shown in some studies that increased rigid filler content above a critical level lowers tensile strength [20, 21]. Thus, there should be an optimum filler level, the magnitude of which depends on the type of polymer, filler, and the effectiveness of the dispersion methods used. According to the mechanical test results, the appropriate mass level for chars in composites was found to be 30 wt%. Above these critical loadings, the tensile strength and e-modulus ER/char composites start to decrease. The optimal pyrolysis temperature was determined as 500°C.

#### Acknowledgement

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**EQUILIBRIUM AND KINETIC STUDIES ON LEVULINIC ACID ADSORPTION ONTO  
SUGAR PROCESSING FLY ASH**

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**ABSTRACT**

There is a growing demand on levulinic acid due its critical functions on the productions of several value-added chemicals. Its selective and efficient recovery is required from aqueous solutions. Adsorption is a promising technique with its low cost and simplicity for the recovery of carboxylic acids. Using a low cost adsorbent (i.e. fly ash) for the process makes the operation even cheaper. Fly ash is a solid waste generated from sugar factory and is generally used as a filling material in the industry. Moreover, it causes environmental pollution; however, its beneficial use will be very advantageous. This study shows that fly ash, an industrial waste can be used as an adsorbent for the recovery of a valuable carboxylic acid, levulinic acid. The effects of various parameters, i.e. adsorbent doses, aqueous phase concentrations and contact time on the adsorption parameters were experimentally studied. At a constant temperature, the level of adsorption was observed to increase with FA dose while decrease with an increase in LA concentration. A 97.1% recovery of LA was obtained using fly ash when solute concentration and adsorbent dosage was 0.1 M and 0.4 g, respectively.

**Keywords:** Adsorption, Levulinic acid, Fly ash, Equilibrium, Kinetics

**INTRODUCTION**

Levulinic acid (LA, 4-oxopentanoic acid) is a short-chain nonvolatile carboxylic acid and has a ketone and a carboxyl group. Its significant roles in the productions of several value-added biochemicals increase its attractiveness [1-3]. Recently, it has started to be produced by biological production methods from biomass. In addition, levulinic acid appears in the aqueous solutions following the pretreatment of biomass. However, selective recovery of levulinic acid from these process media is required. If this can be efficiently achieved with a low cost, LA can become one of the most important platform chemicals in the industry [3].

Various types of techniques were tested for the recovery of LA from dilute aqueous solutions. Adsorption, especially with its low-cost and simplicity, is proposed to be a promising method for the purpose. It is an affinity based separation technique and comprises attachment of adsorbate (levulinic acid) onto the adsorbent (fly ash). It occurs due to the intermolecular forces (Van der Waals) and electrostatic forces between the adsorbate molecules and the atoms which compose adsorbent surface. The efficiency of the process is mainly based on the type of the components, their amounts and temperature [4]. Using low-cost adsorbents or industrial based wastes for the process will even reduce the total cost and facilitates the commercialization of levulinic acid.

**MATERIALS AND METHODS**

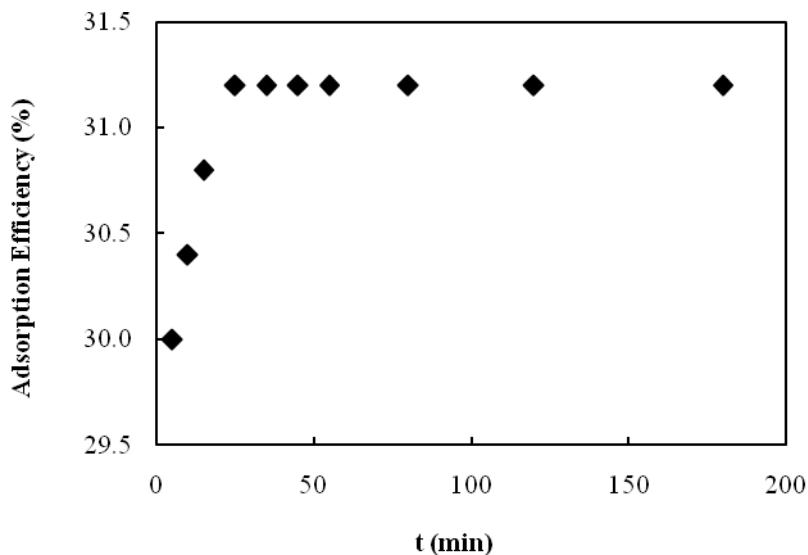
Levulinic acid (purity 98%) was supplied by Alfa Aesar while fly ash was obtained from a local sugar factory. Aqueous solutions of levulinic acid with different concentrations (0.1-0.5 M) were prepared using ultra high pure water, obtained from Millipore UHP Water System. 10 mL of each of these solutions were equilibrated with known amounts of FA (0.1-0.4 g) in a 100 mL conical flask at 150 rpm for 2 hours. A constant temperature shaker bath was used during the experiments and the temperature was kept constant as 298 K. Following equilibrium, the mixture was then centrifuged at 5000 rpm for 5 minutes to separate the phases. After a clear phase separation, the aqueous phase was carefully removed from the system and analyzed for the concentration of levulinic acid using NaOH solution (0.01 or 0.1 N) as titrant and phenolphthalein as indicator. The amount of levulinic acid adsorbed onto fly ash was determined by mass balance around the aqueous phase.

For kinetic studies, fixed amount of FA (0.2 g) was weighed and added into 100 mL glass flasks containing 10 mL of 0.25 M LA. Samples were taken every 5 minutes for 3 hours, centrifuged and analyzed for LA amount left in the aqueous phase, as explained above.

## RESULTS AND DISCUSSION

The adsorption experiments were carried out for different time intervals (0-180 min) and the results are plotted in Figure 1. According to the results, it can be suggested that equilibration of the solid and liquid phases for less than an hour is sufficient for reaching the equilibrium for LA adsorption onto FA adsorbents. A 31.2% recovery of levulinic acid was achieved when levulinic acid concentration and fly ash dosage were 0.25 M and 0.2 g, respectively. However, equilibrium studies were performed by shaking the phases for 2 hours for the safety of the data.

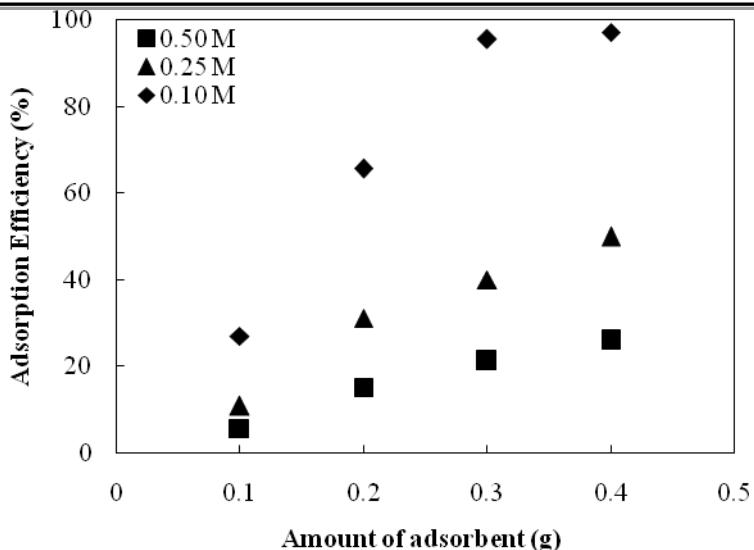
Apparently, adsorbent rate is fast at initial, and then it slows down near the equilibrium. This is due to the fact that initially a large number of vacant surface sites are available for levulinic acid adsorption. After a time, because of the repulsive forces in between levulinic acid molecules, it is hard to occupy the remaining vacant surface sites. This caused a decrease in the increase of the adsorption efficiency.



**Figure 1.** Effect of contact time on the adsorption of levulinic acid onto fly ash. ([LA]=0.25 M, [FA]=0.2 g/10 mL)

The effect of solute adsorption was investigated for FA doses from 0.1- to 0.4 g and for LA concentrations between 0.1 and 0.5 M at 298 K. Figure 2 shows that adsorption efficiency increases with the increase in FA amount. It is most probably due to the increase in the surface area or active sites for LA adsorption with the increase in FA dosages. For example, the recovery was 27% for 0.1 g fly ash and it increased up to 97.1% with 0.4 g fly ash for 0.10 M levulinic acid.

Figure 2 also shows that an increase in the solute concentration negatively affects the adsorption efficiency. It is clearly seen that the highest efficiencies were obtained with 0.1 M LA for all FA dosages. With 0.4 g fly ash, an increase in the levulinic acid concentration from 0.5 to 0.1 M decreased the adsorption efficiency from 97.1% to 26%. The present data show consistency with the related literature [5].



**Figure 2.** Effects of fly ash dose (0.1-0.4 g) and solute concentration (0.1-0.5 M) on the levulinic acid adsorption.

## CONCLUSION

Equilibrium and kinetic studies on the adsorption of levulinic acid from dilute aqueous solutions were performed. An industrial waste material, fly ash (FA), was used as the adsorbent. At constant solute concentration, the level of adsorption increases with the increase in FA doses. However, the efficiency decreased with an increase in the LA concentration. These results are consistent with those reported in the literature. As a next step, several equilibrium and kinetic models are planned to be applied to the present data to understand the adsorption characteristics. In addition, effect of temperature will be studied and thermodynamic parameters will be determined using the appropriate data.

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**REACTIVE EXTRACTION OF FORMIC ACID USING ALAMINE 336 IN SUNFLOWER OIL**

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**ABSTRACT**

Formic acid has essential functions in several applications. It is widely used in textile, tanning, rubber processing and pharmaceutical industries. It can be produced as a by-product by biotechnological methods and appears in the aqueous solutions following the pretreatment of biomass. However, its recovery from dilute aqueous solutions is a challenging problem. Several methods have been tested for the purpose; however, none of them presented a satisfactory solution. Reactive extraction is a promising technique for the recovery of carboxylic acids; however, it suffers from toxicity of the organic phases used. In the present study, efficiency of an organic phase prepared by combination of a non toxic organic phase diluent, sunflower oil, and an extractant, Alamine 336, was tested. The equilibrium experiments were performed at different concentrations of formic acid and Alamine 336 at 298 K. The distribution coefficients and degree of extraction values were calculated using the data. The recovery was observed to increase with the concentrations of Alamine 336 and formic acid in the aqueous phase. A  $K_D$  of 4.79 (a recovery of 82.7%) was obtained using Alamine 336 in sunflower oil when formic acid concentration and extractant amount were 1.0 M and 50% (v/v), respectively.

**Keywords:** Reactive Extraction, Formic Acid, Nontoxic Solvents, Tertiary Amines, Sunflower Oil

**INTRODUCTION**

Carboxylic acids are organic compounds contain carboxyl group(s). Currently, the interest on them is increasing due to their significant roles in several industries such as food, pharmaceutical, agriculture and polymer industries. Formic acid is a colorless carboxylic acid soluble in water and widely used as a preservative and antibacterial agent in livestock feed, as a miticide against to specific mites in the related applications (Uslu et al., 2009).

Recovery of carboxylic acids from aqueous solutions is still a challenging problem. The traditional methods are inefficient and cause environmental pollutions. Moreover, significant costs, low recovery rates and high energy demands prevent the commercialization of several separations techniques such as solvent extraction, membrane bioreactor, liquid surfactant membrane extraction, adsorption, direct distillation, electrodialysis, reverse osmosis, anion exchange. On the other hand, reactive liquid–liquid extraction is shown to be a promising method for the recovery of carboxylic acids from dilute aqueous solutions such as biological production media or wastewaters. In addition to its high recovery rates and low energy demands, simplicity and thermal stability are other advantages of the method (Kertes and King, 1986; Wasewar et al., 2004; Marti et al., 2011). It consists of an ion pair formation between the target acid and extractant besides the physical extraction of the solute by the diluent. The reaction between the reactants occurs at the interface and the recovery was affected by the nature of the acid, type of the organic phase components and their concentrations. Long chain aliphatic amines are proposed to be the most effective extractants while alcohols and ketones are effective diluents for the stabilization of the ion pair formation (Kertes and King, 1986).

Selection of the organic phase component is the most important step in reactive extraction. Effectiveness and cost are the main parameters. However, contrary to its significant advantages, toxicity of the organic phase components is the main problem of reactive extraction. Maximum efficiency with minimal toxicity is preferred for the selected extractant and diluent. Especially, when the recovery is carried out in situ from the biological production media, the organic phase may inhibit or eliminate the synthesis of the carboxylic acid (Keshav et al., 2008).

The toxicity of the organic phase can be minimized or eliminated by the combined use of an extractant with a non toxic diluent (Keshav et al., 2008, Uslu et al., 2014). Natural non toxic solvents, vegetable oils, were proposed to be used for this purpose to replace widely used organic diluents in the separations. In the present study, formic acid was extracted from aqueous solutions using Alamine 336 dissolved in sunflower oil. The efficiency of the system was determined using the extractive separation parameters. Mainly, the effects of the concentrations of formic acid and Alamine 336 were investigated.

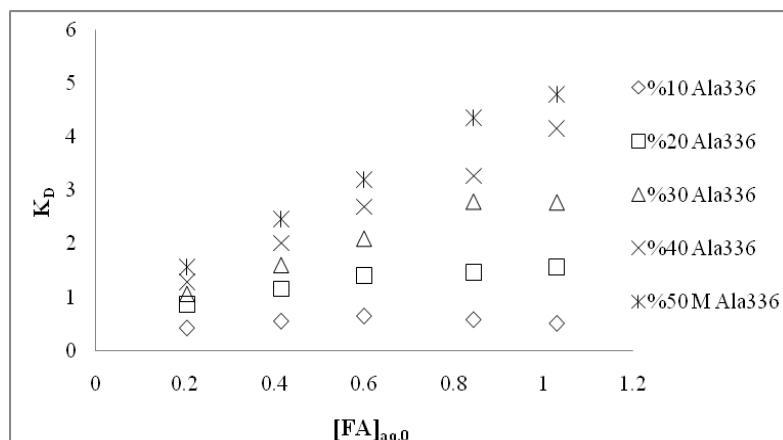
## MATERIALS AND METHODS

Formic acid (purity 99%) was supplied from Merck while Alamine 336 was purchased from Cognis. The sunflower oil was obtained by local sources. A constant temperature shaker bath was used during the equilibrium experiments.

Aqueous solutions of formic acid with varying concentrations (0.2-1.0 M) were prepared using ultra high pure water, obtained from Millipore UHP Water System. Organic phases were prepared volumetrically using Alamine 336 (0-50% v/v) and sunflower oil. 10 mL of each of the solutions were equilibrated in a 100 mL erlenmeyer at 150 rpm for overnight. Preliminary results show that it is sufficient to reach the equilibrium between the two phases for formic acid. Following equilibrium, the mixture was then centrifuged at 6000 rpm for 15 minutes and settled to separate the phases. After a clear phase separation, the aqueous phase was carefully removed from the system and analyzed for the concentration of formic acid using NaOH solution (0.1 N) as titrant and phenolphthalein as indicator. The amount of formic acid transferred from aqueous to organic phase was determined by mass balance around the aqueous phase. Average values were utilized to determine the distribution coefficients and extraction efficiencies.

## RESULTS AND DISCUSSION

To reduce the toxicity effect of the extractant, lower volume percentages (10-50% (v/v)) of Alamine 336 was preferred in the organic phase. In addition, third phase formation was reported when tertiary amines present at high concentrations in the organic phase (Marti et al., 2011). On the other side, aqueous solutions of formic acid were prepared at the concentration range of 0.2 to 1.0 M to simulate the biological production media and wastewaters.

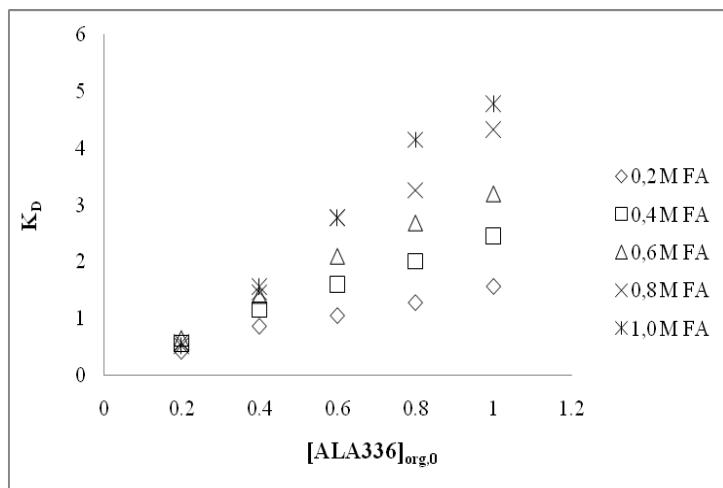


**Figure 1.** The effect of initial formic acid concentration in the aqueous phase.

The effect of the initial concentration of formic acid in the aqueous phase can be seen in Figure 1. It shows that the change in extraction efficiency is variable depending on the initial Alamine 336 amount in the organic phase. When the initial amine concentration is equal or more than 30% (v/v), the  $K_D$  increases with the increase in initial solute concentration, which is consistent with the results reported for some other carboxylic acids and extractants (Keshav et al., 2008; Uslu et al., 2014). This is an opposite trend to that generally observed with active diluents, i.e. 1-octanol and 1-decanol. However, also a similar trend was seen for some inert diluents (data not shown). Considering the polarity of the sunflower oil, this result could be expected due to the low polarity and activity of sunflower oil for ion pair formation. However, for an initial Alamine 336 level of 50% (v/v), the  $K_D$  increased from 1.56 to 4.79 with an increase in the initial formic acid amount in the aqueous phase from 0.2 to 1.0 M. This means a recovery of 82.7 was achieved at the conditions mentioned.

Figure 2 demonstrates the effect of Alamine 336 concentration in the organic phase on the formic acid distribution. According to the results, an increase in the amine concentration positively affects the extraction efficiency (Figure 2). The effect was not clear before a tertiary amine concentration of 0.6 M. However, for all initial formic acid levels, highest  $K_D$  values were obtained with 50% Alamine 336 (v/v). At a constant formic acid concentration of 1.0 M, a decrease in extractant concentration from 50 to 10% (v/v) decreased the  $K_D$  from 4.79 to 0.51. The data implies that with the decrease in amine extractant concentration, the

possibility of the ion pair formation decreases and the reaction is affected by the solubility limit of the diluent used. The present data show consistency with the related literature (Kertes and King 1986; Wasewar et al., 2004; Marti et al., 2011).



**Figure 2.** The effect of initial Alamine 336 concentration in the organic phase.

### Conclusion

The toxicity problem of reactive extraction can be minimized or eliminated by combined use of a natural non-toxic solvent with an efficient extractant. In this study, Alamine 336, a tertiary amine mixture, was used as extractant and dissolved in sunflower oil at varying percentages to form organic phases. The  $K_D$  of formic acid was observed to increase with concentrations of both reactants (formic acid and Alamine 336) in each phase. The results show consistency with those in the literature using non toxic solvents for other carboxylic acids. As a next step, effects of other extractants and non toxic solvent type are planned to be studied.

### Acknowledgement

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**REMOVAL OF TEXTILE DYES FROM AQUEOUS SOLUTIONS USING AN  
INDUSTRIAL BASED LOW COST ADSORBENT**

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**ABSTRACT**

The color effluents generated from textile industry should be removed prior to the discharge. Several techniques have been tested for the purpose; however, adsorption is proposed to be one of the most appropriate ones. Cost of the adsorbent is critical for the application of the process. In this study, fly ash, an industrial based waste material was utilized for the removal of methylene blue from aqueous solution. The experiments were performed at different concentrations of methylene blue for various fly ash amounts. The effects of several adsorption parameters such as contact time, aqueous phase concentration and adsorbent dosage on the adsorption parameters were experimentally determined. According to the results, adsorption efficiency increased with an increase in the adsorbent dosages while decreased with an increase in solute concentration. This study shows that an industrial based waste material; fly ash can be used as an adsorbent for the removal of methylene blue, a basic dye widely used in the textile industry, and to clean the wastewaters. A 90% removal of methylene blue was obtained using fly ash when the solute concentration and adsorbent dosage was 50 ppm and 0.4 g, respectively.

**Keywords:** Adsorption, Low cost adsorbents, Methylene blue, Fly ash, Textile dyes

**INTRODUCTION**

With the invention of dyeing technique, the color effluents have been produced from several industries and various types of synthetic dyestuffs appear in the effluents (Doğan et al., 2007). The contaminated water effluents resulting from factories that use dyes such as paints plants, paper, fabric, leather etc. must be dealt with properly before throwing outside factory (Ravikumar et al., 2007; Alzaydien, 2009). There are more than 700,000 tons of dyestuffs produced annually and this amount comes from about 100,000 types of dyes (Al-Degs et al., 2008).

The most prevalent of them is methylene blue, which have a negative impact on human life such as vomiting and inflammation of the stomach and eye burns etc. (Ravikumar et al., 2007; Alzaydien, 2009). The removal of methylene blue from wastewater is necessary and there are several techniques such as ozone treatment, ion exchange, flocculation, rain and microbial decomposition can be used for the purpose. However, adsorption process is proposed to be one of the most efficient methods for the removal of textile dyes due to its simplicity of design, ease of operation and low cost (Azargohar and Dalai, 2005; Lata et al., 2007). The total cost of the separation process can even be reduced with the use of low cost adsorbents. This will also facilitate the commercialization of the technique.

**MATERIALS AND METHODS**

Methylene blue, purchased from Sigma, is a heterocyclic aromatic chemical compound with the molecular formula C<sub>16</sub>H<sub>18</sub>N<sub>3</sub>CIS. It is a basic dye and its molecular weight is 373.91 g/mol. Fly ash as adsorbent was obtained from a local sugar factory.

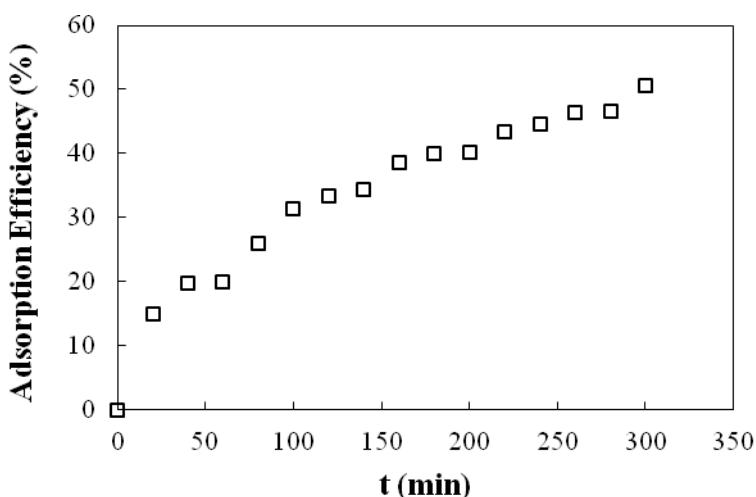
Aqueous solutions of methylene blue with different initial concentrations (50, 100 and 200 ppm) were prepared using ultra high pure water, obtained from Millipore UHP Water System. 10 mL of each of these solutions were shaken with known amounts of FA (0.05, 0.2 and 0.4 g) in a 100 mL conical flask at 150 rpm speed. A constant temperature shaker bath was used for the whole experimental studies and the temperature was kept constant as 298 K. After 5 hours, the mixture was centrifuged at 5000 rpm for 5 minutes to separate the liquid and solid phases. A clear phase separation was achieved and the aqueous phase was carefully removed from the conical flask. Aqueous phase was analyzed for the MB concentration using an UV–Vis spectrophotometer (Shimadzu UVmini-1240) at the wavelength of maximum absorbance ( $\lambda_{max}$ ) of 661 nm. Using material balance, the amount of dye kept by the adsorbent was determined.

For kinetic studies, a fixed amount of fly ash (0.2 g) was added into 100 mL glass flasks containing 10 mL of 200 ppm methylene blue. Samples were taken every 20 minutes for 5 hours, centrifuged and analyzed for methylene blue concentration in the aqueous phase.

## RESULTS AND DISCUSSION

The previous results show that removal of textile dyes was directly related to the contact time. Thus, adsorption of methylene blue was studied for 0-300 min. Effect of contact time on the adsorption rate is shown in Figure 1 when methylene blue concentration was 200 ppm and fly ash dosage was 0.2 g. As mentioned, agitation rate and temperature were held constant as 150 rpm and 298 K, respectively.

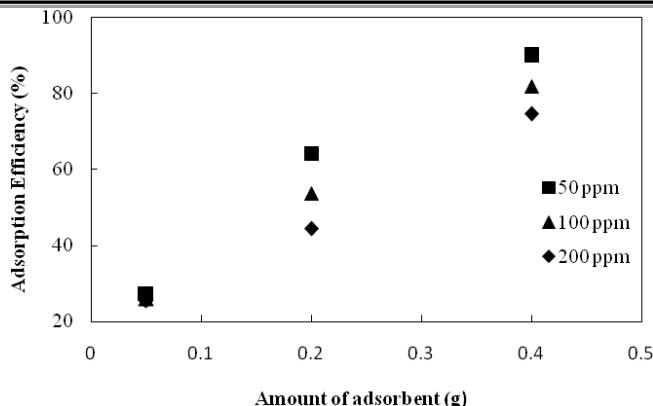
The uptake of adsorbate species was rapid in the initial stages of the contact period and became slow after 160 min. Between these two stages of the uptake, the rate of adsorption was not found to be constant but decreasing. This result is expected because a large number of surface sites are available for adsorption at the initial stages and after a lapse of time, the remaining surface sites are difficult to occupy because of repulsion between the solute molecules of the solid and bulk phases (Poots et al., 1976). After 5 hours, a 50.6% removal was obtained; however, the system still could not reach equilibrium in this time period. Since over 5 hours is not a conventional time for the process in terms of the operational costs; for the rest of the study, effects of the parameters were investigated for 5 hours experimental studies.



**Figure 1.** Effect of contact time on the adsorption of methylene blue onto fly ash. ([MB]=200 ppm, [FA]=0.2 g/10 mL)

Removal of methylene blue using fly ash was also investigated for the adsorbent doses of 0.05, 0.2 and 0.4 g and for methylene concentrations of 50, 100 and 200 ppm at 298 K. Figure 2 shows that adsorption efficiency increases with the increase in fly ash amount. It is most probably due to the increase in the surface area or active sites for methylene blue adsorption with the increase in fly ash dosages. For 50 ppm methylene blue level, the removal was 27.4% for 0.05 g fly ash while it increased up to 90.6% with 0.4 g fly ash.

According to the results, an increase in the solute concentration negatively affects the adsorption efficiency (Figure 2). For all fly ash doses, the maximum efficiencies were obtained with 50 ppm methylene blue. An increase in the methylene blue concentration from 50 to 200 ppm decreased the adsorption efficiency from 90.6% to 74.7% with 0.4 g fly ash. The present data show consistency with the related literature (Azargohar and Dalai, 2005; Lata et al., 2007; Poots et al., 1976).



**Figure 2.** Effects of fly ash dose (0.05, 0.2 and 0.4 g) and solute concentration (50, 100 and 200 ppm) on the methylene blue adsorption.

## CONCLUSION

In this study, an industrial waste material, fly ash, was used as adsorbent for the removal of a textile dye from aqueous solutions. Effects of contact time, solute concentration and adsorbent dose on the adsorption of methylene blue using fly ash from aqueous solutions were investigated. At a constant methylene blue concentration, adsorption efficiency increases with the increase in fly ash dosage. However, the efficiency decreased with an increase in the methylene blue concentration. These results are consistent with those reported in the literature. As a next step, effect of temperature will be studied and thermodynamic parameters will be determined with the appropriate data.

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## SUSTAINABILITY IN KONYA CLOSED BASIN AND WETLANDS

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### ABSTRACT

Sustainability of the land and water resources is indispensable for humanity. Despite the rich land resources of Konya Closed Basin, depending on the central Anatolian low and erratic rainfall regime has a limited capacity in terms of water resources. In the region, ongoing drought conditions, increasing urban and industry water needs, and overirrigation has led a significant reduction in the level of groundwater. This phenomenon threaten the sustainability of the agricultural potential and wildlife in wetlands.

The purpose of the study is to introduce the problems in terms of sustainability farmland and the wetlands in Konya Closed Basin in the future and to discuss the ways to minimize of the problems. Significant declines (up to 30 m) were observed in groundwater levels because of the reasons such as insufficient and irregularity of precipitation, over water application on irrigation, the use of irrigation systems and methods with low - efficiency, increase in the cultivation area of crops that consume more water. In the study, rainfall data (1960-2011), scientific literature, the changes in the level of groundwater and the surveys with farmers have been evaluated. According to the survey, the farmers accept that they have overirrigation but have refused to give up the sugar beet cultivation because of its sales warranty and profitability. Surface irrigation system were established in 42% of irrigation area of 279 irrigation cooperatives in 29 provinces in Konya which has 32 provinces.  $1890 \times 10^6 \text{ m}^3$  water could be saved, by transition to pressurized irrigation in 70% of irrigated area. Transfer of  $550 \times 10^6 \text{ m}^3$  water from the neighboring watersheds is possible economically. In these condition, if additional area is not opened to irrigation, and  $188 \times 10^6 \text{ m}^3$  of water is saved by changing the cropping pattern and limited irrigation, it is calculated to ensure of irrigation without falling of the groundwater level in 920.000 hectares area that irrigated area in 2011. The water resources and wetlands will be preserved significantly in case of achieving these subjects mentioned above.

**Keywords:** Konya Closed Basen, land resources and wetlands, sustainability, climate change, water conservation.

### INTRODUCTION

Although, KonyaClosed Basin (KCB) has the least amount of rainfall in Central Anatolia (Turkey), it has very important parts of the wetlands and 1.9 million hectares of arable land, and 1.6 million hectares of it is suitable for irrigation. There are 16 important bird areas and 6 major plant sites KCB. It is also breeding grounds to 8 out of 13 birds which are in danger of extinction all over the world. Over the last few decades, the basin experienced huge non renewable GW abstraction for irrigation, which caused approximately a had decline of 1 m year<sup>-1</sup> (Bayarı et al. 2009), 3 meters annually and in some places even faster. In 2002, there were approximately 45.000 wells in the KCB. There are now over 100.000. Natural functions are being lost, including the evaporation of wetlands. The pace and rate of loss of biodiversity especially in wetlands is daunting ( FAO, 2014).

Estimated average yearly ET (2005-2009) in KCB by Surface Energy Balance System (SEBS) and Soil Moisture Integrated SEBS is 709,6 mm. The irrigation water use, within the water -limited Konya Plain ranged up to 500 mm year<sup>-1</sup> with a mean -308 mm year<sup>-1</sup>. In the case of croplands, the mean P-ET deficits are -308mm year<sup>-1</sup> and -230 mm year<sup>-1</sup> for irrigated and non irrigated croplands respectively (Gökmen, 2013). In 2011, according to calculations made in cropping pattern in irrigated areas; while, yearly of irrigation water requirement was estimated 4.319 billion m<sup>3</sup>year<sup>-1</sup>, the actual water use was estimated 6.628 billion m<sup>3</sup>year<sup>-1</sup>. For irrigating all of the available agricultural land (compared to the average of 500 mm of irrigation water) approximately 15 billion m<sup>3</sup> net irrigation water are needed (Topak et. al. 2008). There is the risk of not irrigation % 56 of existing irrigated area economically (Şahin, et al. 2013). According to Dua ( 1995), yield increase and water saving with drip irrigation methods compared to other conventional irrigation methods 72 % and 47% on potatoes, 25% and 33% on onions respectively. According to Magar (1995), %4,8 and %30 on tomatoes, %8,8 and %59,6 on pumpkin respectively. 1.43 (decare) da of vegetables and sugarbeet, 1,52 da maize, 1,82 da sunflower, 1,96 da potato, 2,08 da beans, 4,08 da wheat and 5,00 da barley can be irrigated with water that is used for 1 da alfalfa in KCB condition. (Kara et al. 2008). The ratio of sugar

beet cultivation in the Konya plain is 21.66%, net irrigation water requirement, is 32.2% of the Konya plain needs. Total water use of maize Konya basin is at the level of 6.2% in 2000 (Topak et al. 2008 ).

Under the Ramsar Convention, 13 sites in Turkey have been listed as Ramsar Sites: Sultan Marshes in Kayseri, Kuş Lake in Balıkesir, Seyfe Lake in Kırşehir, Göksu Delta in Mersin, Burdur Lake in Isparta in 1994; Kızılırmak Delta in Samsun, Uluabat Lake in Bursa, Gediz Delta in İzmir, Akyatan Lagoon in Adana in 1998; Yumurtalık Lagoons in Adana, Meke Maar in Konya in 2005; Kızören Obruk in Konya in 2006; Kuyucuk Lake in Kars in 2009; adding up to a total of 179.898 hectares. Therefore, 14th Ramsar Site of Turkey, namely Nemrut Caldera will be announced by 2013 (Çağırankaya and Meriç, 2013). When evaluated the current status of wetlands in Konya; Eregli Marshes, Akşehir Lake, Tersakan Lake and Hotamış Marshes are completely dry. Kulu Lake, was seen again after heavy rainfall but Salt Lake, Seyfe Lake, Sultan Marshes and Eber Lake have been damaged significantly. Hotamış marshes were disappeared completely (WWF-Turkey,2010).

In this paper, soil and water capacity and irrigation techniques in the KCB, potentiality of water transfer from neighboring basins, were investigated. Additionally, current irrigation practices of farmers were investigated by Face-to-face interviews, and was concentrated on the way of sustainable use of water resources in the KCB.

## 2. MATERIAL AND METHODS

The KCB area is located at the south of Ankara in the heart of Turkey (fig. 1). The area consists of two closed sub-basins that will further be referred to as Tuz Basin and Konya Basin (Camur & Mutlu,1995, Schipper and Schot 2004). The area is surrounded by mountains (Schipper and Schot 2004), and the high mountains in the south belong to the Toros range, made up of Devonian, Permo-Carboniferous limestones, schists and Cretaceous limestones (De Meester, 1971). The central parts of the area are characterized by the presence of plains at an elevation of 900 – 1000 m. The area covered space of 65.322 km<sup>2</sup>, and located in the Aksaray, Ankara, Antalya, Isparta, İçel, Konya, Karaman, Nevşehir, Niğde provinces which consist of 8.3% of Turkey's land area, and 12.14% (2.889.500 ha) of the agricultural area (Table 1). The study area is characterized by a semi-arid continental climate: summers are hot and dry whereas winters are cold and moist (De Meester, 1971). Precipitation ranges between 280 and 640 mm year<sup>-1</sup> and is considerably lower in the centre of the study area than in the surrounding mountains.

Cultivation Areas of grain and similar Crops are 17.990.932 decares (da), following lands are 9.323.59 da, Cultivation Areas of vegetables are 8.271.142 da, Planting area of fruits and medicinal plant are 1.091.375 da, Pasture Area is 15.844.950 da, totally farmlands are 44.739.951 da in KCB (Şahin et al, 2013). Total irrigated land is 923 569 hectares (ha) and available water resources Potential is 4365 hm<sup>3</sup> year<sup>-1</sup> (Şahin et al, 2013 and KOP, 2012).

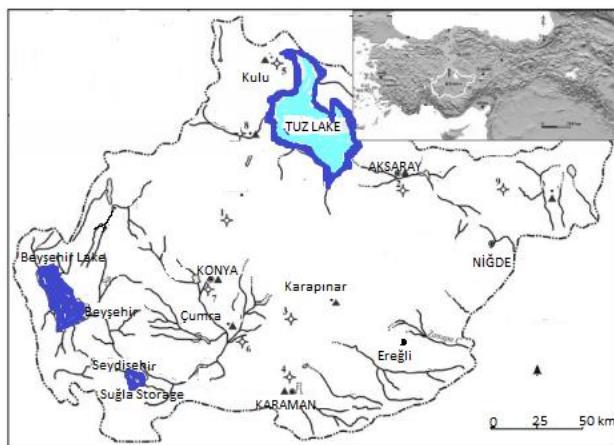


Figure 1 - Position of Konya Closed Basin.

**Table 1. The provinces located in the Konya Closed Basin (TUBITAK MAM, 2011-2013)**

Provinces	Total area (ha)	Basin area in the province (ha)	The ratio of provincial area in the basin (%)	Distribution of the basin by province (%)
Aksaray	799.700	682.879	85%	14%
Ankara	3.071.500	213.963	7%	4%
Antalya	2.072.300	33.690	2%	1%
Isparta	893.300	123.978	14%	2%
İçel	1.585.300	35.405	2%	1%
Konya	3.825.700	2.810.988	73%	56%
Karaman	959.000	572.668	60%	12%
Nevşehir	546.700	64.619	12%	1%
Niğde	1.429.400	440.467	31%	9%

The survey was conducted in Çumra County in Konya. The following questions were asked to the subjects: whether have the farmer use of water excessively, Reasons of farmers about they do not to use drip irrigation. Irrigation facilities were evaluated in terms of irrigation methods for all irrigation cooperatives in Konya. The 2012 data of Secretary General of Special provincial Administration of Konya was used on the evaluation. The savings rate with transition to pressurized irrigation systems was calculated based on the data.

### **3. RESULTS AND DISCUSSION**

#### **3.1. Current Status of Wetland in Konya Closed Basin**

Some of the wetlands, such as, Hotamış marshes and Eşmekaya marshes got completely dry. In addition, Ereğli marshes, Tuz Lake, Beyşehir Lake, Meke maar (Lake) and Samsam Lake, Kozanlı Lake, Bolluk Lake, Kulu Lake, Tersakan Lake decreased by 30-90% (WWF-Türkiye, 2010). This case is also a result of abstraction of water more than feeding as mentioned by İşçiogl (2008). Suğla Lake (16.500 ha) was also converted into storage area by General Directorate of State Hydraulic Works (DSI).

#### **3.2. Water and soil potential and, water used in the KCB**

Originally, agriculture was based on rain-fed crops together with semi-nomadic sheep husbandry. Today, irrigation is leading to the development of other crops (sugar beets, lentils) and decreasing cereals (Fontugne et al. 1999). Average gross precipitation for January (top) and July (bottom). Distinct differences between winter and summer precipitation are present, with a maximum of 120 mm in January whereas maximum precipitation in July does not exceed 13 mm. Land classifications are as follows: 41% agricultural lands, 34% pastures / rangelands, 13% forest lands, 8% wetlands, and 4% rock and sand dunes. A great deal of the KCB is being converted from steppe and wetland to crops. In the last 10 years, more than 250.000 hectares have been put under cultivation. This is an increase of 42% (FAO. 2014).

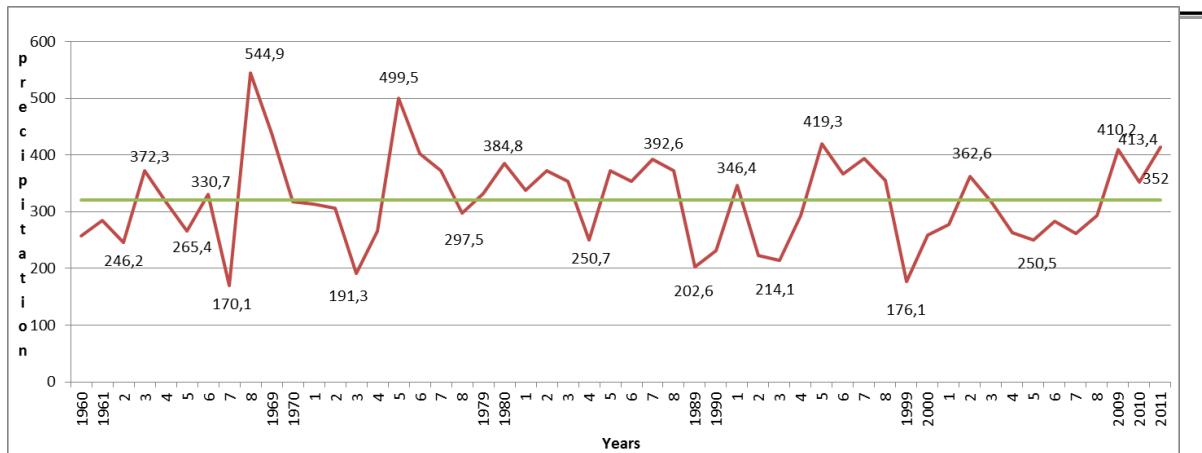


Figure 2. Precipitation in Konya belonging to the station No. 17244 (1960-2011)

Annual precipitation between 1960-1978 has shown fluctuation a wide range of fluctuation between 170 mm-550 mm in every 6-7 years (Figure 2). However after 1978 a significant change has been observed in minimum and maximum precipitation values, annual precipitation is followed by a fluctuating trend in the range of 176- 400 mm in the period. Average precipitations is 320.7 mm between 1960-2011, 326.0 mm between of 1960-1978, 317.7 mm between 1978-2011. The average rainfall in the next 33 years after 1978 decreased by 8.3 mm, compared to the 1960-1978 period. Data are consistent with Şen and Başaran (2008). However, datafor a longer period is required requires a precise judgment.

**Table 2. Irrigation methods in the IC area which finished irrigation facility in Konya**

Number of wells	Total number of irrigation cooperatives	Total flow L s <sup>-1</sup>	Irrigated area (ha)	Irrigation methods in the irrigation cooperatives area which finished irrigation facility (Totally 268 facility)
3216	279	118036	112836	Surface irrigation system 42% springer irrigation system 54% drip irrigation 4%

Surface irrigation system is widely used in the KCB region (Table 2). The areas that can be irrigated with the available 4,000 x106m<sup>3</sup> irrigation water potential by different irrigation methods were calculated: 377.458 ha with flooding method, 704.514 ha with check flooding and row irrigation, 1.006.399 ha with springer irrigation system and 1.132.373 ha with drip irrigation(Kara et al. 2008). Increasing rate in irrigated area by other irrigation methods compared with flooding method are 87%, 167%, 200% respectively. According to the data, when irrigated area with the unit water by flooding method is accepted 1.0, 1.87 unit, 2,67 unit, 3,0 unit area can be irrigated by check flooding and row irrigation, springer irrigation system, drip irrigation respectively. In this case, while average (1.0 + 1.87 / 2)= 1.44 unit area can be irrigated by the surface irrigation with unit water, average 2.84 per unit area can be irrigated by pressurized systems. In these circumstances, the transition to pressurized irrigation from surface irrigation (2.84-1.44 / 1.44) = 97% water savings can be achieved. Calculated water-saving and water budget is given in table 2. by transition to the pressurized irrigation 50% of the area which irrigated with surface irrigation systems (table 2). Irrigation area of 279 cooperatives in the Konya province were considered to measure up proportionally to represent the KCB area. In the calculations; available in total annual agricultural water supply, water savings with transition to pressurized irrigation, the area ratio considered transition to the pressurized irrigation are taken as 4 billion m<sup>3</sup> (Kara et al. 2008, KOP 2012), as 97%, as 70% respectively. The actual quantity of water in use was adopted 6,628x10<sup>9</sup> m<sup>3</sup> (Şahin et al.2013).

It is believed that the sustainability can be achieved if water consumption is reduced about 188 x10<sup>6</sup> m<sup>3</sup> by less water consuming crops are subsidized, of 550 x10<sup>6</sup> m<sup>3</sup> additional water is brought from other basins and additional irrigation areas are not opened.

**Table 3. Total savings by transition from surface irrigation system to pressure irrigation systems.**

The actual quantity of water in use↓ (1)	Rate of irrigated area by surface irrigation technique (2)	the savings by transition from surface irrigation system to pressure irrigation systems in 70% of areas (3)	Total savings by transition from surface irrigation system to pressure irrigation systems in 70% of areas ( $10^6$ m <sup>3</sup> ) 4=1x2x3
$6628 \times 10^6$ m <sup>3</sup>	0,42	$0,97 \times 0,70$	1890
Overuse quantity→	$(6628-4000) \times 10^6$ m <sup>3</sup> = $2628 \times 10^6$ m <sup>3</sup>		
Needed additional water quantity	$2628 \times 10^6$ m <sup>3</sup> - $1890 \times 10^6$ m <sup>3</sup> = $738 \times 10^6$ m <sup>3</sup>		
Economical Water transfer possibilities from neighboring basins.	From Emenek river $250 \times 10^6$ m <sup>3</sup> From Kızılırmak river $200 \times 10^6$ m <sup>3</sup> From Seyhan river $100 \times 10^6$ m <sup>3</sup> Total: $550 \times 10^6$ m <sup>3</sup>		
Needed water savings through the other approaches without increasing irrigated area	The approaches: turn to new plant designs which consume less water by Government subsidies mechanisms, increase the value of productions creating a trademark, develop marketing capabilities of the farmers. $738 \times 10^6$ m <sup>3</sup> - $550 \times 10^6$ m <sup>3</sup> = $188 \times 10^6$ m <sup>3</sup>		

If the consumption is reduced using the methods mentioned in Table 3 and the irrigation area is not increased, it is believed that sustainability can be achieved.

Responses of the farmers about overirrigation and whether they consider giving up the sugar beet production are given in table 4 and 5.

**Table 4. Responses of the farmers about overirrigation**

Have excessive use of water?		yes	No	Total
Farmers	Number	146	82	228
	%	64.0	36	100
Cooperatives managers	Number	45	35	80
	%	56.2	43.8	100
Total	Number	191	117	308
	%	62.0	38.0	100.0

As given in the table, 64% of farmers, %56.2 of cooperative managers have stated that excessive water was used for irrigation.

**Table 5. Reasons of farmers not to use drip irrigation,**

Reasons↓	Farmer number and % →	Number	%
Do not believe in the benefits		13	10.8
System is expensive		36	30.0
I have a trickle irrigation system and I have not money for it.		58	48.4
I do not have information about the system		13	10.8
Total		120	100.0

Sprinkler irrigation systems is more widespread in the region. The presence of sprinkling material makes transition to drip irrigation difficult. Views on drip irrigation of farmers are given the Table 4. Farmers gave a reason for drip irrigation systems to be more expensive and not find funding for it. According to farmers, drip irrigation systems are more expensive and they can not fund it. The results indicate that if income of farmers is increased and sufficient financial support is supplied supply, drip irrigation will becomes widespread.

### 3.4. Conclusion

An independent organization do not depend on political and bureaucratic structure like California may be charged with the operation of the region's water resources. Measuring the water taken from the system, it may be charged for the portion of water consumption exceeding the standard. For operability on the fee process, a debit card can be use. The starting time to watering, the quantity of water applied and the duration of irrigation can be determined by the Ministry of Agriculture through measurement system and team. Deficit irrigation can be applied for suitable plants.

The transition to new plants have higher income and less dependent to water by agricultural support mechanism, the contract farming and organic farming practices, approaches such as create a brand can contribute to the solution of the problem.

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**KATI ATIKLARIN ÇEVREYE VE SAĞLIĞA ETKİSİ KONUSUNDА BIREYLERİN  
BILİNÇ DÜZEYİNİN BELİRLENMESİ ÜZERİNE BIR ARAŞTIRMA (TOKAT İL  
MERKEZİ ÖRNEĞİ)**

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**ÖZET**

Bu araştırmada Tokat merkez ilçede yaşayan bireylerin katı atıkların çevreye ve sağlığa etkisi hakkında bilinç düzeyi, tutum ve davranışları incelenmiştir. Oransal örnekleme sonucu hesaplanan 380 bireye uygulanan anket sonucu alınan veriler araştırmanın ana malzemeleri oluşturmuştur. Bireylerin bilinç düzeyi anket verileri doğrultusunda puanlama yaparak belirlenmiştir. Bilinç düzeyini belirlendikten sonra bilinç düzeyini istatistik olarak etkileyen faktörler incelenmiştir. Katı atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyini etkilemesi olasılıklı olan değişkenler analize alınmış ve binary logit analizi sonucunda görüşülen kişinin cinsiyeti, ilk ve orta okul mezunu olma, çevre kirliliği ile ilgili herhangi bir toplantıya katılma ve faktör analizi sonucunda elde edilen geri dönüşüm ve bilinç başlığı altındaki faktörler bilinç düzeyi etkilemesi olası olduğu belirlenmiştir. Araştırma sonucunda görüşülen bireylerin eğitim seviyesinin ve toplantılaraya katılmanın bilinçli olmada olasılıklı etkisi olduğu belirlenmiştir. Temelde bireylerin çevre konusunda duyarlı olduğu ancak katı atıklar konusunda bilinçli ancak duyarlı olmayıp çevrelerindeki bireylerin ya da devletin duyarlı olması beklentiği bu araştırmanın sonucunda elde edilmiştir.

**Anahtar Kelimeler:** Bilgi Düzeyi, Bilinç Düzeyi, Çevre, Katı Atık, Tokat

**A STUDY ON THE DETERMINATION OF LEVELS OF CONSCIOUSNESS  
INDIVIDUALS ABOUT ENVIRONMENTAL AND HEALTH IMPACT OF SOLID WASTE  
(THE CASE OF TOKAT CENTER)**

**ABSTRACT**

This research investigated that individuals who live in the central district of Tokat environmental and health impact of solid waste about the level of awareness, attitude and behavior. Proportional sampling results calculated in 380 individuals applied the survey and survey data received have been the result of research material. Awareness of individuals in line with survey data have been determined by scoring. After determining the level of consciousness, it was statistically analyzed factors affecting the level of consciousness. Variables that affect the probability of awareness of the impact of solid waste on the environment and health were taken for analysis and as a result of the binary logit analysis, the gender of person, primary and secondary school graduates, participate in any meetings about environmental pollution and recycling obtained as a result of factor analysis and awareness under the heading factors was determined to be likely to affect the level of consciousness. As a result of the research, the education level and attending meetings of the individuals interviewed has been determined that the effect of the possibility in the absence of consciousness. Result of this study was obtained that basically individuals are sensitive about the environment and they are consciously about the solid waste but are not sensitive to the solid waste however are expected to be sensitive their environment individuals or state to it.

**Keywords:** Knowledge Levels, Consciousness Levels, Environment, Solid Waste, Tokat

**1.GİRİŞ**

Nüfus artışına paralel olarak katı atık miktarları da artmaktadır, özellikle büyük kentlerde tüketim alışkanlıklarının değişimine paralel olarak atık kompozisyonu da hızla değişmektedir. En yalan tanımıyla evsel, ticari ve endüstriyel işlevler sonucu oluşan ve tüketicisi tarafından artık işe yaramadığı gereklisiyle atılan ancak çevre ve insan sağlığı yanında diğer toplumsal faydalalar nedeniyle düzenli biçimde uzaklaştırılması gereken maddeler olarak tanımlanan katı atıklardan kaynaklanan problemler Türkiye'nin en önemli çevre sorunları haline gelmektedir (Yılmaz ve Bozkurt, 2010). Türkiye'de 2012 yılında oluşan kişi

başı katı atık miktarı ÇEVKO verilerine göre 1,0 kg/kİŞİ-gün, TÜİK verilerine göre 1,37 kg/kİŞİ-gün, ABD'de yayımlanan The Atlantic dergisinde ise 1,77 kg/ kişi gün olarak verilmektedir.

2012 yılında bulunan tesisler 903 belediyede 44,5 milyon nüfusa hizmet verilmekte ancak, Türkiye'de 7 ilde Katı Atık Birliği bulunmaktadır (Anonim, 2012).

Tokat il merkezi ve ilçelerinde yazın 493,13 ton/gün, kışın 512,77 ton/gün katı atık oluşmaktadır. Kişi başına oluşan atık miktarı ise 1,3 kg/kİŞİ-gündür (TUİK, 2012).

Tokat-Turhal-Zile-Pazar Katık Atık Yönetim Birliği, 2 adet düzenli Katı Atık Düzenli Depolama tesisi (Tokat Katı Atık Ve Tıbbi Atık Sterilizasyon Tesisi, Erbaa Katı Atık Depolama Tesis) ve 1 adet Atık Su arıtma tesisi olmak üzere 3 tesis bulunmaktadır. Tokat İli Atık Kompozisyonuna (2012) bakıldığında organik atıkların %48, kül atıkların %24, plastik atıkların %13, kağıt atıkların %9, cam ve metal atıkların %3 olduğu belirlenmiştir.

Buradan yola çıkarak Tokat ilindeki bireylerin katı atıklar hakkında bilinc düzeyi belirlemek ve katı atıkların çevreye ve sağlıklarına etkisi konusunda ki duyarlıklarını belirlemek amacıyla bu araştırma yapılmıştır.

## 2. MATERİYAL Ve METOT

### 2.1. Materyal

Bu araştırmanın materyalini, Tokat ili Merkez ilçe kentsel alandaki bireylerden anket yoluyla elde edilen veriler oluşturmuştur.

### 2.2. Verilerin toplanması aşamasında izlenen yöntem

Ana kitlenin en iyi düzeyde temsil edilecek örnek sayısının belirlenmesinde oransal yaklaşımından yararlanılmıştır (Miran, 2003).

$$n = \frac{Np(1-p)}{(N-1)\sigma_p^2 + p(1-p)}$$

n= örnek büyüklüğü (380),

N= populasyon büyülüğu (2011 adresle dayalı nüfus kayıt sistemine göre, merkez ilçede yaşayan nüfus dikkate alınmıştır.),

p= tahmin oranı (0,5 maksimum örnek büyülüğu için),

$\sigma_p^2$ = oran varyansı (maksimum örnek hacmine ulaşmak için %95 güven aralığında çizelge değeri 1,96 ve %5 hata payı ile).

Ana kitleyi oluşturan bireylerin özellikleri başlangıçta bilinmediği için, örnek hacmini maksimum kılacak şekilde p=0,5 olarak alınmış ve örnek hacmi 380 birey olarak bulunmuştur. Görüşülecek bireylerin sayısının belirlenmesinde, yerleşim birimlerinin toplam popülasyon içindeki payları esas alınmış (Kızılıoglu ve Kızılıaslan, 2013) ve örneğe alınan bireyler tesadüfi olarak belirlenmiştir.

### 2.3 Verilerin analizi aşamasında izlenen yöntem

Bu araştırmada Tokat ili merkez ilçesindeki bireylerin katı atıkların çevreye ve sağlığa etkisi konusunda bilinc düzeyini belirmek için anket sırasında 'konu hakkında bilginiz var mı?' gibi soruya bireylerin bilinc düzeyini ölçmek yerine, bilinc düzeyini belirleyici bir takım sorular sorulmuştur. Sorulan her bir sorunun doğruluğuna göre puan verilmiştir. Verilen her bir doğru cevabin toplam puanı olarak 34 puan hesaplanmıştır. 34 puanı tam puan olarak kabul edilip ve bu puanın %60'na denk gelen 20 puan üstü puan alan bireyler bilinçli olarak değerlendirilmiş ve bağımlı değişken olarak modelde 1 olarak kodlanmıştır. 20 puan ve altı puan olan bireyler bilinçsiz olarak değerlendirilmiş ve 0 olarak kodlandırılmıştır. Bilinc düzeyini belirleyici sorular ve puanları Çizelge 1'de verilmiştir.

**Çizelge 1. Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda Bilinç Düzeyini Belirleyici Sorular ve Puanları**

Sorular	Cevaplar	Puanlar	Frekans	%
Bireylerin Karşılaştığı Çevre Kirlilikleri	Hava kirliliği	1	87	22.89
	Su kirliliği	1	87	22.89
	Gürültü kirliliği	1	97	22.53
	Çöp ve katı atık	1	144	37.89
	Hepsi	5	136	35.79
Görüşülen Bireylerin Belediyenin Çevre Kirliliği Konusun Da Yaptığı Çalışmalardan Memnuniyet Durumu	Evet	1	114	30.00
	Hayır	0	266	70.00
Bireylerin Doğal Dengenin Bozulmasına Gösterdiği Tepkiler	Çok kızma	1	144	37.89
	İlgilileri uyarmaya çalışma	1	109	28.68
	Gerekli kurumlara şikayette bulunmama	1	74	19.47
	Pek ilgilenmemem	0	87	22.89
Bireylerin Katı Atık Deyince İlk Akla Gelen	Cam atıklar	1	242	63.68
	Plastik	1	333	87.63
	Kâğıt	1	267	70.26
	Metal atıklar	1	225	59.21
	Tekstil ürünleri	1	212	55.79
Bireylerin Çöplerini Attığı Yerler	Evin yakınında çöp toplanan alana	0	121	31.84
	Evin yakınındaki çöp bidonuna	2	199	52.37
	Apartman çöp atma boşluğununa	0	7	1.84
	Kapıcı tarafından götürülmek üzere kapının önüne atma	1	53	13.95
Bireylerin Gazete/dergi Alma Durumu ve Alım Sıklığı	Satin Almayan	0	114	30.00
	Haftada Bir Satın Alan	1	36	9.47
	Her gün Alan	1	116	30.53
Bireylerin Kağıt/Karton Atıklarını Değerlendirme Şekilleri	Yakma	0	103	27.11
	Satma	1	10	2.63
	Evde kullanma	1	212	55.79
Bireylerin Alış Verişte Kullandıkları Taşıma Aracı Tercihи	Plastik poşet	0	281	73.95
	Pazar çantası	1	105	27.63
Bireylerin Plastik Poşetleri Değerlendirme Yöntemleri	Sağlam temiz olanları yeniden kullanma	1	289	76.05
	Sağlam temiz olmayanları çöpe atma	0	117	30.79
	Diğer	0	31	8.16
Bireylerin Cam Atıkları Değerlendirme Yöntemleri	Satma veya başkasına verme	1	27	7.11
	Çöpe atma	0	218	57.37
	Tekrar kullanma	1	153	40.26
	Toplama kumbaralarına atma	1	25	6.58

**Çizelge 1. Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda Bilinç Düzeyini Belirleyici Sorular ve Puanları (Devamı)**

Sorular	Cevaplar	Puanlar	Frekans	%
Bireylerin Düzenlenen Cam, Kağıt, İlaç ve Benzeri Toplama Kampanyalarına Katılımın Az Olması Hakkındaki Düşünceleri	Halkın eğitim seviyesinin düşük olması	1	171	45.00
	Mahalli basın ve yayın kuruluşlarında konuya hiç veya yeterli yer verilmemesi	1	127	33.42
	Kampanyayı düzenleyenlerin yeterli denetimi sağlayamamaları	1	107	28.16
Bireylerin Doğada En Uzun Süre Kalan Katı Atık Hakkındaki Düşünceler	Plastik	1	286	75.26
	Kola kutusu	2	40	10.53
	Kağıt	0	4	1.05
	Çiklet	2	50	13.16
Bireylerin Doğada En Kısa Süre Kalan Katı Atık Hakkındaki Düşünceler	Plastik	0	11	2.89
	Kola kutusu	0	48	12.63
	Kağıt	1	275	72.37
	Çiklet	0	46	12.11
Bireylerin Çevreye Zararlı Atıklar Hakkındaki Düşünceler	Piller	2	324	85.26
	Yemek atıkları	1	6	1.58
	Kağıt	1	3	0.79
	Metal atıklar	2	47	12.37
Bireylerin Ambalaj Atıkları İçerisinde En Az Zarar Veren Atıklar Hakkındaki Düşünceler	Plastik	0	50	13.16
	Kağıt	1	50	13.16
	Cam	1	132	34.74
	Alüminyum	0	148	38.95
Bireylerin Geri Dönüşüm Sembolünü Tanıma Durumu	Tanıyanlar	1	272	71.58
Bireylerin Çevre Koruma Vakfı ( ÇEVKO) Tanıma Durumu	Tanıyanlar	1	217	57.11
Bireylerin Günlük Atık Miktarı Konusunda Bilgiye Sahip Olma Durumu	Bilgi sahibi olanlar	1	44	11.58
Toplumun çevre kirliliği ve temizliği konusunda daha bilinçli olmasını İsteme Durumu	İsteyenler	1	371	97.63
İnsanların Geri Dönüşüm Hakkında Bilgili Olup-Olmama Durumunu Değerlendirmesi	Bilgili olduğunu düşünenler	1	37	9.74
Bireylerin Yörede Çöp ve Katı Atık Depolama Tesisi Varlığından Haberdar Olma Durumu	Haberdar olanlar	1	111	29.21
Bireylerin Geri Dönüşümü Önemli Bulup-Bulmama Durumu	Bulanlar	1	371	97.63
Bireylerin Geri Dönüşüme Kazandırılabilcek Ürünler Hakkındaki Bilgilerinin Olma Durumu	Bilgisi olanlar	1	259	68.16
Bireylerin Çöplerini Atma Şekilleri	Ayrarak atanlar	1	80	21.05

Bireylerin katı atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyini etkileyen sosyo-ekonomik faktörler Binarry Logit modeli kullanılarak analiz edilmiştir. Logit modelinde bağımlı değişken Dummy ve tahmin edilen olasılık değerleri 0 ile 1 arasında değişmektedir. Bu araştırma için kullanılabilecek metotlardan birisi de Probit modeli olup Logit ile probit modelleri arasındaki temel farklılık modellerin olasılık dağılımlarına ilişkin varsayımin farklı olmasından kaynaklanmaktadır (Greene, 2011). Diğer taraftan, Logit modelinde bağımsız değişkenlerin bağımlı değişkeni daha iyi açıkladığı kabul edildiği yani lojistik regresyon analizi ile yapılan çözümlemeden elde edilen matematiksel modelin yorumlanması daha kolay olduğu (Kalaycı, 2010) için bu

araştırmada Logit modelinin kullanımı tercih edilmiştir (Cankurt ve ark., 2010).

Lojistik regresyonun üç temel yöntemi vardır. Bunlar, İkili Lojistik Regresyon (Binary Logistic Regression); Sıralı Lojistik Regresyon (Ordinary Logistic Regression); İsimsel Lojistik Regresyondur (Nominal Logistic Regression) (Stephenson, 2008). Bu araştırmada İkili Lojistik Regresyon yöntemi kullanılmıştır. Oluşturulan modelin P değeri 0.05'den küçük olduğundan model %95 güven aralığında kabul edilebilir.

Çizelge 2'de analizde kullanılan bağımlı ve açıklayıcı değişkenlere ait açıklamalar ve tanımlayıcı istatistikler verilmiştir.

Bireylerin katı atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışlarında ki özelliklerine verdikleri önem düzeyini belirleyen soruların cevapları 5'li likert ölçeği ile ölçülümuştur. Ölçeklendirilen satın alma davranışını ve tutumlarını gösteren durumlar sayıca fazla olduğu için açıklayıcı değişken olarak her birinin kullanılması mümkün değildir. Bu nedenle, değişkenlerin özet halde gösterilmesi gerekmektedir (Kızıloğlu ve ark., 2013).

Araştırmada değişkenlerin özetlenmesi faktör analizi yardımcı ile yapılmıştır ve LOGIT analizinde açıklayıcı değişken olarak bu faktörler kullanılmıştır (Dölekoğlu ve Yurdakul, 2004).

### **3. Araştırma Bulguları**

#### **3.1.Bireylerin genel özellikleri**

**Çizelge 2. Bireylerin Genel Özellikleri ve Bazı İstatistiksel Sonuçlar**

Değişken, Gruplar ve Açıklaması	Frekans	%	Standart Sapma	Ortalama		
<b>Bağımlı Değişken</b>						
Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda Bilinç Düzeyi Yüksek Olan:1	248	65.26	0.653			
Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda Bilinç Düzeyi Düşük ya da Olmayan:0	132	34.74				
<b>Açıklayıcı Değişkenler</b>						
Yaş	Sürekli Değişken					
Cinsiyet	Kadın:0	184	48.42	0.500		
	Erkek:1	196	51.58			
Medeni Durum	Bekar:0	117	30.79	0.462		
	Evli:1	263	69.21			
İlkokul Mezunu Olma Durumu	Mezun değilse:0	77	20.26	0.406		
	Mezunsa:1	303	79.74			
Ortaokul Mezunu Olma Durumu	Mezun değilse:0	46	12.11	0.327		
	Mezunsa:1	334	87.89			
Lise Mezunu Olma Durumu	Mezun değilse:0	118	31.05	0.463		
	Mezunsa:1	262	68.95			
Yüksekokul Mezunu Olma Durumu	Mezun değilse:0	47	12.37	0.330		
	Mezunsa:1	333	87.63			
Üniversite Mezunu Olma Durumu	Mezun değilse:0	92	24.21	0.430		
	Mezunsa:1	288	75.79			
Çalışma Durumu	Çalışmıyor (Emekli, İşsiz, İş arıyor, öğrenci): 0	96	25.26	0.435		
	Çalışıyor: 1	284	74.74			
Çocuk Sahibi Olma Durumu	Çocuk sahibi değilse: 0	127	33.42	0.472		
	Çocuk sahibi ise: 1	253	66.58			
Satın Alınan Ürünün Ambalajının Geri Dönüşümüne Dikkat Etme Durumu (AMBALAJ)	Dikkat etmiyorsa: 0	253	66.58	0.472		
	Dikkat ediyorsa: 1	127	33.42			

Çevre Kirliliği İle İlgili Bir Toplantı veya Seminere Katılma Durumu (TOPLANTI)	Katılmadıysa: 0	273	71.84	0.450		
	Katıldıysa: 1	107	28.16			
Çöp ve Katı Atıklarınız Düzenli Toplanma Durumu (TOPLANMA)	Toplanmıyorsa: 0	111	29.21	0.455		
	Toplanıyorsa: 1	269	70.79			
Gelir	Sürekli Değişken				2.677 38	
Faktör 1: DONUSUM	Sürekli Değişken					
Faktör 2: KIRLilik	Sürekli Değişken					
Faktör 3: TASARRUF	Sürekli Değişken					
Faktör 4: BILINC	Sürekli Değişken					

Görüşülen kişiler bazı sosyo-ekonomik ve demografik özellikleri Çizelge 2'de incelenmiştir. Görüşülen kişilerin %48.42'si kadın, %51.58'i erkektir. Bireylerin %69.21'i evli, %30.79'u bekar oldukları belirlenmiş ve %66.58'nin çocuk sahibi olduğu görülmektedir. Görüşülen kişilerin ortalama yaşı 36.56 olarak bulunmuştur. Görüşülen kişilerin eğitim durumları incelendiğinde ise yarısından fazlasının (%68.95) lise mezunu olduğu belirlenmiştir. Bu bağlamda çalışma oranında yüksek olduğu (%74.74) gözlenmiştir. Araştırma kapsamında görüşülen kişilerin %25.26'sının emekli, iş den ayrılmış ya da iş aradığı ve öğrenci olduğu tespit edilmiştir. Görüşülen kişilerin ortalama aylık geliri 2.677 38 TL olarak belirlenmiştir. Bireylerin %66.58'i satın aldığı ürünün ambalajının geri dönüşümüne dikkat etmezken %33.42'si dikkat ettiği Çizelge 2'den anlaşılmaktadır. Bireylerin %71.84'lük gibi büyük yüzdesi herhangi bir çevre kirliliği ile ilgili bir toplantı veya seminere katılmadığı belirlenirken %28.16'lık gibi az bir kısmın katıldığı belirlenmiştir. Bireylerin %70.79'u gibi büyük bir çoğunluğu çöp ve katı atıklarını düzenli topladığı gözlenmiştir.

### 3.2. Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda ki Bilinç Düzeyleri

Araştırma kapsamında görüşülen bireylerin karşılaştı en önemli çevre kirliliği olarak çöp ve katı atık (%37.89) kirliliği bulunduğu Çizelge 1'den anlaşılmaktadır.

Görüşülen bireylerin %70.00'i belediyenin çevre kirliliği konusun da yaptığı çalışmalardan memnun olmadığı gözlenmiştir. Bireylerin %37.39'luk kısmı doğal dengenin bozulmasına çok kızgın oldukları Çizelge 1'de görülmektedir. Bireylerin katı atık deyince ilk akla gelenler incelendiğinde; Plastik (87.63), Kâğıt (70.26) ve Cam atıklar (63.68) geldiği Çizelge 1'den incelenmiştir. Bireylerin yarısından fazlasının (%52.37) evin yakınındaki çöp bidonuna çöplerini attıklarını söylemişlerdir. Bireylerin %30.00'u gazete/dergi satın almazken alanların alım sıklığı incelendiğinde %30.53'ü günlük olarak satın aldığı belirlenmiştir. Bireylerin yarısından fazlasının (%55.79) kağıt/karton atıklarını evde kullanarak değerlendirmektedir.

Bireylerin alış verişlerinde en fazla plastik poşeti (73.95) tercih ettikleri Çizelge 1'den anlaşılmaktadır. Bireylerin %76,05 plastik poşetler eğer sağlam temizse yeniden kullanarak değerlendirmektedir. Bireylerin yarısından fazlasının (%57.37) cam atıkları değerlendirme yerine ya da geri dönüşüm olarak değerlendirmek yerine çöpe attıkları tespit edilmiştir. Bireylerin düzenlenen cam, kağıt, ilaç ve benzeri toplama kampanyalarına katılımın az olmasının nedenin en fazla oranla (%45.00) halkın eğitim seviyesinin düşük olması olarak görülmektedir. Bireylerin %75.26'sı doğada en uzun süre kalan katı atık olarak plastikleri görürken en kısa süre kalan katı atık olarak kağıt (%72.37) görülmektedir. Ayrıca bireylerin %85.26'lık gibi büyük bir oranı katı atıklardan pillerin çevreye en fazla zarar verdiği görüşündedir. Bireylerin ambalaj atıkları içerisinde en az zarar veren atık olarak %38.95'lik oranla alüminyum bulmuşlardır.

**3.3. Bireylerin katı atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışlarının belirlenmesi**

**Çizelge 3. Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Hakkındaki Bilgi, Tutum ve Davranışları İçin Dönüşümlü Faktör Yükleri (Rotated Component Matrix)**

	1	2	3	4
<b>Faktör 1: Geri Dönüşüm</b>				
Katı atıkların geri dönüşüme kazandırılması ile çöp depolama yerlerinde yer tasarrufu sağlanmış olur	<b>0.835</b>	0.161	0.164	0.112
Katı atıkların geri dönüşümü ile ekonomiye hammadde sağlanmış olur	<b>0.832</b>	0.153	0.135	0.002
Katı atıkların geri dönüşümü ile kaynak tasarrufu sağlanmakta	<b>0.802</b>	0.153	0.169	0.079
Katı atıkların dönüşümü ile çevremizde kirlilik yaratması ve diğer canlılarında yaşamını tehlkiye atması önlenmiş olur	<b>0.620</b>	0.191	0.302	0.203
Değerlendirilebilir nitelikteki atıkların oluşturdukları kaynakta çöp ile karışmadan ve kirlenmesine izin verilmeden toplanması gerekmekte	<b>0.577</b>	0.141	0.209	0.405
<b>Faktör 2: Kirlilik ve Hastalık</b>				
Çöp depolama olanaklarında oluşan sızıntı suları ve gazlar kimyasal ve biyolojik olumsuzluklara neden olmaktadır	0.172	<b>0.867</b>	0.204	-0.029
Katı atıkların doğrudan veya ara hayvanlarla bulaşabilen kolera, dizanteri, tüberküloz gibi hastalıklar biyolojik olumsuzluklara örnek verilebilir	0.135	<b>0.856</b>	0.205	0.028
Yetersiz temizlik ve atık yöntemi uygulamaları ile çevre ve insan sağlığı arasındaki ilişki kalkınamamış ve/veya kalkınmakta olan ülkelerde açıkça gözlenmektedir	0.260	<b>0.700</b>	-0.046	0.312
<b>Faktör 3: Tasarruf</b>				
Zorunlu olmadıkça tek kullanımlık ürünlerden kaçınılmalı	0.205	0.070	<b>0.835</b>	0.113
Bir kere kullanılabilecek poşetler yerine sürekli kullanılabilecek bez torba, sepet ve fileler tercih edilmeli	0.243	0.105	<b>0.825</b>	0.141
Katı atıkların büyük bir kısmını evsel atıklar oluşturmaktır	0.148	0.334	<b>0.525</b>	0.056
<b>Faktör 4: Biliñcli Olma</b>				
Katı atıklar çevreye zarar verir	0.045	0.150	0.051	<b>0.840</b>
Herhangi bir ürünü alırken geri dönüşümlü olmasına dikkat edilmeli	0.339	-0.054	0.372	<b>0.611</b>

Bireylerin katı atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışlarını belirlemek üzere 5'li likert ölçüği kullanılmıştır. Tutum ve davranışlarını belirlemek üzere 13 özellik kendi içlerinde gruplandırma yapılanabilir mi diye faktör analizi yapılmıştır. Analiz sonucunda 13 özellik; Geri Dönüşüm, Kirlilik ve Hastalık, Tasarruf ve Biliñcli Olma adı altında 4 faktör altında toplanabileceği anlaşılmıştır.

Örneklemde yeterli olup olmadığına bakmak için ise KMO değerine bakılmaktadır. Başka bir ifadeyle modelin kabul olup olmadığını anlamak için KMO testi sonucuna bakılır. Bu değerin 0.600'dan büyük olması gerekmektedir. KMO 1'e yaklaşıkça verilerin analize uygun olduğu, 1 olmasında ise mükemmel bir örneklem sayısına sahip olduğunu göstermektedir. Bu araştırmada KMO katsayısının 0.859 olması için örneklem çok iyi olduğunu (Kızıloğlu ve ark., 2013; Kızıloğlu ve ark., 2014) göstermektedir.

13 başlık altında sıralanan bireylerin “katı atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışları”, faktör analizinde özdeğer (eigen value) ve yamaç eğim grafiği (scree plot) incelemesi sonucunda 4 faktör altında toplanmıştır. İlk faktör toplam varyansın %23.89'nu, ikinci faktör %17.36'ını, üçüncü faktör %16.06'ını ve dördüncü faktör ise %11.07'sini açıklarken, birikimli varyans, toplam varyansın %68.38'ni açıkladığı görülmüştür.

“Katı Atıkların Çevreye ve Sağlığa Etkisi Hakkındaki Bilgi, Tutum ve Davranışları”; Geri Dönüşüm, Kirlilik ve Hastalık, Tasarruf ve Biliñcli Olma başlıklarının altında yani 13 değişkeni 4 faktör yükünde toplanabilecegi Çizelge 3'den anlaşılmaktadır. 1. Faktör yükünde yani Geri Dönüşüm başlığı altında 5 değişken bulunurken, Kirlilik ve Hastalık başlığı altında 3 değişken, Tasarruf başlığı altında da üç değişken ve 4. faktör olan Biliñcli Olma başlığı altında iki değişkeni toplaya bilenebileceğini dönüsümlü faktör yükleri matrisi göstermiştir.

### **3.4. Bireylerin katı atıkların çevreye ve sağlığa etkisi konusunda ki bilinç düzeyini etkileyen bazı faktörler**

Bireylerin katı atıkların çevreye ve sağlığa etkisi konusunda ki bilinç düzeyini etkileyen bazı sosyo-demografik özellikleri ve analiz sonucundaki ekleri Çizelge 4'de verilmiştir. Bilinç düzeyini belirlendikten sonra bilinç düzeyini istatistik olarak etkileyen faktörler incelenmiştir. Bireylerin katı atıkların çevreye ve sağlığa etkisi konusunda ki bilinç düzeyini etkilemesi olasılıklı olan değişkenler analize alınmış ve Binary logit analizi sonucunda görünen bireylerin cinsiyeti, ilk ve orta okul mezunu olma, çevre kirliliği ile ilgili herhangi bir toplantıya katılma ve faktör analizi sonucunda elde edilen geri dönüşüm ve bilinç başlığı altındaki faktörler bilinç düzeyi etkilemesi olası olduğu belirlenmiştir.

**Çizelge 4.** Bireylerin Katı Atıkların Çevreye ve Sağlığa Etkisi Konusunda ki Bilinç Düzeylerini Etkileyen Faktörlerin Binary Logit Analiz Sonucu

	Kat Sayı	Standart Hata	z		Marjinal Etki
sabit	0.75343	0.90766	0.83	0.4065	
YAS	-0.00091	0.01426	-0.06	0.9490	-0.00016
CINSIYET	-0.95618***	0.28618	-30.34	0.0008	-0.16767***
MD	0.48800	0.43323	10.13	0.2600	0.08525
ILK	-10.45858***	0.51488	-20.83	0.0046	-0.28664***
ORTA	-10.34057***	0.50929	-20.63	0.0085	-0.25560***
LISE	-0.45768	0.44297	-10.03	0.3015	-0.08122
UNV	0.09253	0.49353	0.19	0.8513	0.01647
CALISMA	-0.08027	0.36229	-0.22	0.8247	-0.01420
GELIR	0.1498 $ z  > Z^*$	0.11617	10.29	0.1971	0.02669
COCUK	0.45251	0.45034	10.00	0.3150	0.08097
AMBALAJ	0.31062	0.29639	10.05	0.2946	0.05548
TOPLANTI	0.65613**	0.33279	10.97	0.0487	0.11539**
TOPLANMA	0.10991	0.27074	0.41	0.6848	0.01970
DONUSUM	0.32866***	0.12710	20.59	0.0097	0.05854***
KIRLilik	0.05366	0.12848	0.42	0.6762	0.00956
TASARRUF	-0.02252	0.12668	-0.18	0.8589	-0.00401
BILINC	0.30572**	0.12762	20.40	0.0166	0.05446**
Not: ***, **, * ==> Önem seviyesinde temsili %1, %5, %10					
log likelihood: -202.169, Chi kare [17 d.f.]:86.470, Önem Seviyesi: 0.00000, McFadden R <sup>2</sup> : 0.176					

%5 önem seviyesinde anlamlı bulunan çevre kirliliği ile ilgili herhangi bir toplantıya katılma ve faktör4 (bilinç) pozitif yönde bilinç düzeyini etkilemektedir. Yani çevre kirliliği ile ilgili herhangi bir toplantıya katılmadaki bir birimlik artış bilinçli olma olasılığını %12 artırması beklenmektedir. Ya da bilinçlilikteki bir birimlik değişme bilinç düzeyinde %5 değiştirmesi olasıdır. %1 önem seviyesinde anlamlı bulunan cinsiyet değişkeni; kadınların, erkeklerle oranla %17 daha duyarlı olması beklenmektedir. Genellikle bekendiği gibi eğitim seviyesi arttıkça bilinç artar teorisi bu çalışmada da ortaya konuldu çünkü %1 önem seviyesinde anlamlı bulunan ilk ve orta okul mezunu olumundaki bireylerdeki bir birimlik artış, katı atıkların çevreye ve sağlığa etkisi konusunda ki bilinç düzeyinde sırasıyla %28 ve %26 oranında azalısa sebep olması beklenmektedir. Yani ilk ve orta okul mezunu olma bireylerdeki katı atıkların çevreye ve sağlığa etkisi konusunda duyarlılığın daha az olması olasıdır. %1 önem seviyesinde önemli bulunan bir başka değişkende faktör analizi sonucu bilinç başlığı adı altında toplanan faktör yüküdür. Bilinç ile katı atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyi arasında pozitif bir ilişki olasıdır. Bu da bilinç seviyesindeki bir birimlik artış, katı atıkların çevreye ve sağlığa etkisi konusunda ki bilinç düzeyini %5 seviyesinde artışa sebep olması beklenmektedir. Yani bilinç seviyesi yükselmesi, bilinçliliği artıracağı anlamına geldiği bu araştırma ile söylenebilir.

#### 4. SONUÇ

Bu araştırmada, Tokat ili merkez ilçe kentsel alandaki bireylerin katı atıkların çevreye ve sağlığa etkisi hakkındaki bilgilerini görüşlerini ve tutumlarını belirlemek amaçlanmıştır. Bu amaca ulaşabilmek için oransal örnekleme yöntemi ile belirlenen tesadüfen seçilen 380 bireyle ile görüşerek veriler elde edilmiştir. Elde edilen veriler doğrultusunda, Tokat İli merkez İlçesi'nde kentsel alanda görüşen kişilerin %51.58'i erkek olup ortalama yaşıları 36.56 ve ortalama aylık gelirleri 2.677 38 TL olarak belirlenmiştir. Bireylerin katı atıkların çevreye ve sağlığa etkisilarındaki bilinc düzeyleri belirlenmesi için yapılan puanlama sonuçlarına göre yarısından fazlasının (%65.26) bilinc düzeyinin yüksek olduğu belirlenmiştir. Ve bu araştırma ile eğitim seviyesinin de bilinc düzeyine etkisi bir daha orta konulmuştur. Yani b.logit analizi sonucunda %1 önem seviyesinde anlamlı bulunan bireylerin ilk ve orta okul mezunu olanlar daha üst seviyeli mezunlarına göre mezunlara göre daha az duyarlı olduğu ortaya konulmuştur. Başta devlet olmak üzere özel firmalar kurum ya da kuruluşların katı atıklar hakkında bilinçlendirmek üzere yapacağı çalışmaların bireyler üzerine pozitif etki yapacağı bu araştırma ile ortaya konulmuştur. Çünkü yapılan analiz sonucunda %5 önem seviyesinde anlamlı bulunan çevre ile ilgili herhangi bir toplantıya katılan bireyler katılmayanlara göre daha duyarlı olduğu söylenebilir. Faktör analizi sonucu geri dönüşüm ve bilinc faktörü yükü altında toplanan değişken de logit analizi sonucunda pozitif etkili olduğu ortaya konulmuştur.

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**KIMYASAL ATIKLARIN ÇEVRE VE SAĞLIĞA ETKISI KONUSUNDAYA BIREYLERIN  
BILİNÇ DÜZEYİNİN BELİRLENMESİ ÜZERİNE BIR ARAŞTIRMA (KARABÜK İL  
MERKEZİ ÖRNEĞİ)**

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Bu araştırma da Karabük merkez ilçede yaşayan bireylerin kimyasal atıkların çevreye ve sağlığa etkisilarındaki bilinç düzeyi, tutum ve davranışları incelenmiştir. Oransal örnekleme sonucu hesaplanan 380 bireye uygulanan anket sonucu alınan veriler araştırmanın ana materyali oluşturmuştur. Bireylerin bilinç düzeyi anket verileri doğrultusunda puanlama yapılarak belirlenmiştir. Puanlama sonucu bireylerin bilinç düzeyi düşük olduğu ortaya konulmuştur. Faktör analizi sonucu 19 değişken 5 başlık altında toplanabileceği ortaya konulmuştur. Bunlar; bireylerin bilgi, üreticiyi bilinçlendirme, satın alınan ürünlerde dikkat edilen özellikler, kimyasal atık olan pil ve tehditlerdir. Araştırma sonucunda görüşülen bireylerin eğitim seviyesinin, toplantılara katılmanın bilinçli olmada olasılıklı etkisi olduğu belirlenmiştir. Temelde bireylerin çevre konusunda duyarlı olduğu ancak kimyasal atıklar konusunda bilinçli ancak duyarlı olmayıp çevrelerindeki bireylerin ya da devletin duyarlı olması beklentiği bu araştırmanın sonucunda elde edilmiştir.

**Anahtar Kelimeler:** Bilgi Düzeyi, Bilinç Düzeyi, Çevre, Karabük, Kimyasal Atık

**A STUDY ON THE DETERMINATION OF LEVELS OF CONSCIOUSNESS INDIVIDUALS  
ABOUT ENVIRONMENTAL AND HEALTH IMPACT OF CHEMICAL WASTE (THE CASE  
OF KARABÜK CENTER)**

**ABSTRACT**

This research investigated those individuals who live in the central district of Karabük environmental and health impact of chemical waste about the level of awareness, attitude and behavior. Proportional sampling results calculated in 380 individuals applied the survey and survey data received have been the result of research material. Awareness of individuals in line with survey data have been determined by scoring. Scoring result has been found to be low awareness of individuals. Factor analysis result has been demonstrated 19 variables could be collected to under 5 titles. These are individuals for information, producer awareness, considerations properties in purchased products, chemical waste which batteries and threats. Result of this study was obtained that basically individuals are sensitive about the environment and they are consciously about the solid waste but are not sensitive to the chemical waste however are expected to be sensitive their environment individuals or state to it.

**Keywords:** Consciousness Levels, Knowledge Levels, Environment, Karabük, Chemical Waste

**1.GİRİŞ**

İnsanın varoluşu ile birlikte atık oluşumu da başlamıştır. İnsanoğlunu temel ihtiyaçları başında gelen yiyecek, giyecek ve barınma ihtiyaçlarını karşılayabilmek için kullanılan hammaddelerin kalıntıları ve kullanılan hammaddelerden zamanla oluşan kalıntılar atıkları oluşturmaktadır. Ve de insanoğlunun tüketim ve üretim kalıplarının değişmesi, kimyasal madde kullanımında artıslara neden olmakta, bu durum tehlikeli atık miktarında yükselişe yol açmaktadır (Yılmaz ve Bozkurt, 2010).

Kimyasal atıklar, üreten ve tüketen tarafından degersiz olarak sınıflandırılan, bu amaçla elden çıkarılan sanayi yan-ürünü ve evsel kökenli tehlikeli ve zararlı maddelerdir (Anonim, 2015).

Endüstrinin hızla gelişmesi, insanoğlunun yaşam düzeyinin yükselmesini sağlarken, doğal dengelerin giderek bozulmasına da neden olmaktadır. Sürdürülebilir olmayan sosyal ve ekonomik kalkınma, kaynakların geri dönüşü olmayacak şekilde tahrif edilmesi sonucunu ortaya çıkarmaktadır.

Türkiye geneli tehlikeli atık dağılımına (2011) bakıldığından geri kazanımın % 70.00, bertaraf %9.00, tesis içi kullanımın %20.00 ve stok olarak kullanımın %1.00 olduğu Çevre ve Şehircilik İl Müdürlüğü 2011 raporunda yer almaktadır. Çevre ve Şehircilik İl Müdürlüğü 2012 raporuna göre araştırma gölgesi olan Karabük ili kükürdioksit ( $\mu\text{g}/\text{M}^3$ ) miktarı ölçümleri aylar itibariyle bakıldığından 2010 yılında ( $31.67 \mu\text{g}/\text{m}^3$  yılın ortalaması)

2011 yılına ( $18.67 \mu\text{g}/\text{m}^3$  yılın ortalaması) göre  $\text{SO}_2(\mu\text{g}/\text{M}^3)$  miktarı ölçümünde azalış görülmektedir. 2012 yılına gelindiğinde ( $196.08 \mu\text{g}/\text{m}^3$  yılın ortalaması) ise  $\text{SO}_2(\mu\text{g}/\text{M}^3)$  miktarında önemli bir artış görülmüştür.

Buradan yola çıkarak Karabük ilindeki bireylerin kimyasal atıklar hakkında bilinç düzeyi belirlemek ve kimyasal atıkların çevreye ve sağlıklarına etkisi konusunda ki duyarlılıkları belirlemek amacıyla bu araştırma yapılmıştır.

## 2. MATERİYAL VE METOT

### 2.1. Materyal

Bu araştırmanın materyalini, Karabük ili Merkez ilçe kentsel alandaki bireylerden anket yoluyla elde edilen veriler oluşturmuştur.

### 2.2. Verilerin toplanması aşamasında izlenen yöntem

Ana kitlenin en iyi düzeyde temsil edilecek örnek sayısının belirlenmesinde oransal yaklaşımından yararlanılmıştır (Miran, 2003).

$$n = \frac{Np(1-p)}{(N-1)\sigma_p^2 + p(1-p)}$$

n= örnek büyüklüğü (380),

N= populasyon büyülüğu (2011 adrese dayalı nüfus kayıt sistemine göre, merkez ilçede yaşayan nüfus dikkate alınmıştır.),

p= tahmin oranı (0.5 maksimum örnek büyülüğu için),

$\sigma_p^2$ = oran varyansı (maksimum örnek hacmine ulaşmak için %95 güven aralığında çizelge değeri 1.96 ve %5 hata payı ile).

Ana kitleyi oluşturan bireylerin özellikleri başlangıçta bilinmediği için, örnek hacmini maksimum kılacak şekilde p=0.5 olarak alınmış ve örnek hacmi 380 birey olarak bulunmuştur. Görülecek bireylerin sayısının belirlenmesinde, yerleşim birimlerinin toplam popülasyon içindeki payları esas alınmış (Kızılıoglu ve Kızılaslan, 2013) ve örneğe alınan bireyler tesadüfi olarak belirlenmiştir.

### 2.3 Verilerin analizi aşamasında izlenen yöntem

Bu araştırmada Karabük ili merkez ilçesindeki bireylerin kimyasal atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyini belirmek için anket sırasında ‘konu hakkında bilginiz var mı?’ gibi soruya bireylerin bilinç düzeyini ölçmek yerine, bilinç düzeyini belirleyici bir takım sorular sorulmuştur. Sorulan her bir sorunun doğruluğuna göre puan verilmiştir. Verilen her bir doğru cevabin toplam puanı olarak 27 puan hesaplanmıştır. 27 puanı tam puan olarak kabul edilip ve bu puanın %50’ne denk gelen 14 puan ve üstü puan alan bireyler bilinçli olarak değerlendirilmiş ve 14 puan altı puan olan bireyler bilinçsiz ya da bilinç düzeyi düşük olarak değerlendirilmiştir. Bilinç düzeyini belirleyici sorular ve puanları Çizelge 1’de verilmiştir.

Bireylerin kimyasal atıkların çevreye ve sağlığa etkisilarındaki bilgi, tutum ve davranışlarında ki özelliklerine verdikleri önem düzeyini belirleyen soruların cevapları 5’li likert ölçü ile ölçülmüştür. Ölçeklendirilen satın alma davranışını ve tutumlarını gösteren durumlar sayıca fazla olduğu için açıklayıcı değişken olarak her birinin kullanılması mümkün değildir. Bu nedenle, değişkenlerin özet halde gösterilmesi gerekmektedir (Kızılıoglu ve ark., 2013).

**Çizelge 1. Bireylerin Kimyasal Atıkların Çevreye ve Sağlığa Etkisi Konusunda Bilinç Düzeyini Belirleyici Sorular ve Puanları**

Sorular	Cevaplar	Puanlar	Frekans	%
Kımyasal atık denildiğinde bireylerin aklına gelenler	Deterjanlar	1	111	29.21
	Piller	1	135	35.53
	Tarım ilaçları	1	108	28.42
	Elektronik eşyalar	1	28	7.37
	Hepsi	5	227	59.74
Görüşülen bireylerin geri dönüşümü mümkün olarak bildiği maddeler	Metal kutular	1	125	32.89
	Ampuller	1	60	15.79
	Cam şişeler	1	185	48.68
	Tüm plastik kutular	1	163	42.89
	Naylon poşetler	1	134	35.26
Bireylerin kimyasal atıkların doğada yok olma sürelerini bilme durumu	Hepsi	5	184	48.42
	Bilen	1	176	46.32
Bireylerin enerji tasarrufu sağlayan lambalar/ ampuller kimyasal madde içermeyi bilme durumu	Bilmeyen	0	204	53.68
	Bilen	1	211	55.53
Bireylerin lamba için kullanılan gaz yağı zararlı kimyasal madde içeren ürünler arasında olup olmamayı bilme durumu	Bilmeyen	0	169	44.47
	Bilen	1	248	65.26
Bireylerin deodorant ve oda spreyleri kimyasal madde içermeyi bilme durumu	Bilmeyen	0	132	34.74
	Bilen	1	369	97.11
Bireylerin sineksavarlar ve benzeri ilaçlar kimyasal madde içermeyi bilme durumu	Bilmeyen	0	11	2.89
	Bilen	1	367	96.58
Bireylerin kullandığı piller kimyasal madde içermeyi bilme durumu	Bilmeyen	0	13	3.42
	Bilen	1	371	97.63
Bireylerin kullandıkları pilleri normal çöp bidonuna atma durumu	Bilmeyen	0	9	2.37
	Atmayanlar	1	231	60.79
Bireylerin sağlık için kullanılan ilaçlar ve enjeksiyon ıgneleri kimyasal madde içermeyi bilme durumu	Atanlar	0	149	39.21
	Bilen	1	250	65.79
Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyi yüksek olan	Bilmeyen	0	130	34.21
			183	48.16
Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyi düşük ya da olmayan			197	51.84

### 3. BULGULAR VE TARTIŞMA

#### 3.1.Bireylerin genel özellikleri

Görüşülen kişiler bazı sosyo-ekonomik ve demografik özellikleri Çizelge 2'de incelenmiştir. Görüşülen kişilerin %42.63'ü kadın, %57.37'si erkektir. Bireylerin %72.89'u evli, %27.11'i bekar oldukları belirlenmiş ve %65.26'sının çocuk sahibi olduğu görülmektedir. Görüşülen kişilerin ortalaması yaşı 36.74 olarak bulunmuştur. Görüşülen kişilerin eğitim durumları incelendiğinde ise yarısından fazlasının (%26.84) lise mezunu olduğu belirlenmiştir. Bu bağlamda çalışma oranında yüksek olduğu (%77.11) gözlenmiştir. Araştırma kapsamında görüşülen kişilerin %22.89'nun emekli, iş den ayrılmış ya da iş aradığı ve öğrenci olduğu tespit edilmiştir. Görüşülen kişilerin ortalama aylık geliri 2.681 34TL olarak belirlenmiştir.

**Çizelge 2. Bireylerin genel özellikleri ve bazı istatistiksel sonuçlar**

Gruplar ve Açıklaması		Frekans	%	Ortalama
Yaş				36.74
Gelir (ay/TL)				2.681 34
Cinsiyet	Kadın	162	42.63	
	Erkek	218	57.37	
Medeni Durum	Bekar	103	27.11	
	Evli	277	72.89	
İlkokul Mezunu Olanlar		50	13.16	
Ortaokul Mezunu Olanlar		37	9.74	
Lise Mezunu Olanlar		102	26.84	
Yüksekokul Mezunu Olanlar		92	24.21	
Üniversite Mezunu Olanlar		99	26.05	
Çalışma Durumu	Çalışmıyor (Emekli, İşsiz, İş arıyor, öğrenci)	87	22.89	
	Çalışıyor	293	77.11	
Çocuk Sahibi Olma Durumu	Çocuk sahibi olmayanlar	132	34.74	
	Çocuk sahibi olanlar	248	65.26	

**3.2. Bireylerin Kimyasal Atıkların Çevreye ve Sağlığa Etkisi Konusunda ki Bilinç Düzeyleri**

Araştırma kapsamında görüşülen bireylerin en fazla olarak kimyasal atık denildiğinde pillerin (%35.53) akla gelirken bireylerin büyük çoğunluğunun cam şişelerin (%48.68) geri dönüşümü mümkün olan madde olarak bulduğu Çizelge 1'de görülmektedir. Ve bireylerin %97.63'ü kullandığı pillerin kimyasal madde içerdigini bilmektedir. Görüşülen bireylerin %53.68'i kimyasal atıkların doğada yok olma sürelerini bilmediği gözlemlenmiştir. Bireylerin %55.53'luk enerji tasarrufu sağlayan lambalar/ ampuller kimyasal madde içermediğini bildiği Çizelge 1'de görülmektedir. Bireylerin yarısından fazlasının (%65.26) lamba için kullanılan gaz yağı zararlı kimyasal madde içeren ürünler arasında olduğunu bilmektedirler. Görüşülen bireylerin hemen hepsi (%97.11) deodorant ve oda spreyleri kimyasal madde içerdigini bilmektedirler. Bireylerin %96.58'luk gibi büyük bir kısmı sineksavarlar ve benzeri ilaçlar kimyasal madde içerdigini bilmektedir. Bireylerin yarısından fazlasının (%65.79) sağlık için kullanılan ilaçlar ve enjeksiyon iğneleri kimyasal madde içerdigini bildiğini Çizelge 1'den anlaşılmaktadır.

**3.3. Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi hakkında bilgi, tutum ve davranışlarının belirlenmesi**

Örneklemde yeterli olup olmadığına bakmak için ise KMO değerine bakılmaktadır. Başka bir ifadeyle modelin kabul olup olmadığını anlamak için KMO testi sonucuna bakılır. Bu değerin 0,600'dan büyük olması gerekmektedir (Tabachnick ve Fidell, 2001). KMO 1'e yaklaşıkça verilerin analize uygun olduğu, 1 olmasında ise mükemmel bir örneklem sayısına sahip olduğunu göstermektedir. Bu araştırmada KMO katsayısının 0.848 olması için örneklem çok iyi olduğunu (Kızılıoglu ve ark., 2013; Kızılıoglu ve ark., 2014) göstermektedir (Çizelge 3).

**Çizelge 3. Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi hakkında bilgi, tutum ve davranışları için KMO ve Barlett testi**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.848
Approx. Chi-Square	1783.496
df	171
Sig.	0.000

19 başlık altında sıralanan bireylerin “kimyasal atıkların çevreye ve sağlığa etkisi hakkında bilgi, tutum ve davranışları”, faktör analizinde özdeğer (eigen value) ve yamaç eğim grafiği (scree plot) incelemesi sonucunda 5 faktör altında toplanmıştır. İlk faktör toplam varyansın %26.28'ni, ikinci faktör %9.84'nü, üçüncü faktör %7.83'nü, dördüncü faktör %6.22'sini ve beşinci faktör ise %5.37'sini açıklarken, birikimli varyans, toplam varyansın %55.55'ni açıkladığı görülmüştür (Çizelge 4).

**Çizelge 4. Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışları için özdeğer istatistiğine bağlı faktör sayısı ve varyansı**

Bileşenler	Başlangıç Özdeğerleri			Karesi Alınmış Yüklerin Rotasyon Toplamı		
	Toplam Özdeğer	Varyans Oranı (%)	Birikimli Varyans Oranı (%)	Toplam Özdeğer	Varyans Oranı (%)	Birikimli Varyans Oranı (%)
1	4.995	26.287	26.287	2.427	12.774	12.774
2	1.870	9.841	36.128	2.194	11.550	24.324
3	1.488	7.829	43.957	2.190	11.525	35.849
4	1.181	6.217	50.174	2.136	11.241	47.090
5	1.021	5.372	55.547	1.607	8.457	55.547

Son olarak rotasyon matrisi (dönüştürülmüş matris) oluşturulmuştur. Bu matris faktör analizinin nihai sonucudur. Matriste orijinal değişen ile onun faktörü arasındaki korelasyon verilmektedir. Bir değişken hangi faktör altında mutlak değer olarak büyük ağırlığa sahip ise o değişken o faktör ile yakın ilişki içerisindeidir (Kalaycı, 2010).

“Kimyasal Atıkların Çevreye ve Sağlığa Etkisi Hakkındaki Bilgi, Tutum ve Davranışları”; Bireylerin Bilgisi, Üreticiyi Bilinçlendirme, Satın Alınan Üründe Dikkat Edilen Özellikler, Kimyasal Atık Olan Piller ve Tehditler başlıklarında altında yani 19 değişkeni 5 faktör yükünde toplanabileceği Çizelge 5’den anlaşılmaktadır. 1. Faktör yükünde yani Bireylerin Bilgisi başlığı altında 6 değişken bulunurken, Üreticiyi Bilinçlendirme başlığı altında 3 değişken Satın Alınan Üründe Dikkat Edilen Özellikler ve Kimyasal Atık Olan Piller başlığı altında da dörder değişken ve 5. faktör olan Tehditler başlığı altında iki değişkeni toplaya bilenebileceğini dönüşümlü faktör yükleri matrisi göstermiştir.

**Çizelge 5. Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi hakkındaki bilgi, tutum ve davranışları için dönüşümlü faktör yükleri (Rotated Component Matrix)**

	1	2	3	4	5
<b>Faktör 1: Bireylerin Bilgisi</b>					
Endüstri ve kozmetik sanayisinde kullanılan kimyasallar atmosferin ozon tabakasını zayıflatması					
0.737	0.167	0.187	0.104	0.136	
Kimyasal atıkların çevreyi tahrif ettiğinin düşünülmesi	0.676	-0.005	0.188	0.245	-0.062
Pek çok kimyasal madde, tehlikesinden habersiz olarak evlere; iş yerlerine, gıdalara ve vücuda girmekte	0.620	0.062	0.047	0.296	-0.312
Kullanılan her deodorant veya sprey ozon tabakasının incelmesine bu da cilt kanserlerinin artmasına yol açmaktadır	0.599	0.367	-0.011	-0.068	0.354
Zararsız zannedilen ağrı kesici ilaçların fazla kullanımı sonucu böbrek yetmezliğine yol açtığı görülmekte	0.596	0.155	0.148	-0.017	0.401
Çevrede ne kadar kimyasal madde varsa sağlık o derece tehlike	0.575	0.110	0.164	0.239	0.130
<b>Faktör 2: Üreticiyi Bilinçlendirme</b>					
Tarım ilaçları kalıntılarının çevreye ürüne ve insana verebileceği zararlar koruyucu önlemler konusunda düzenli eğitimin verilmesini ortaya çıkarmak.	0.087	<b>0.719</b>	0.079	0.189	0.048
Tıbbi atıklar kimyasal atıkların en önemli ve bertarafı en zor olan üyesi	0.139	<b>0.717</b>	0.056	-0.019	0.268
Tarım ilaçlarını çiftçiye zamanında ve uygun koşullarda ulaştırmak iyi bir pazarlama organizasyonu ile mümkün	0.106	<b>0.690</b>	0.105	0.216	-0.078
<b>Faktör 3: Satın Alınan Üründe Dikkat Edilen Özellikler</b>					
Bulaşık ve çamaşır deterjanlarını alırken çevreye zararlı olup olmadıklarına dikkat edilmesi	0.232	0.111	<b>0.762</b>	0.060	0.052
İçecek satın alırken metal kutuda olanlar tercih edilmeli	0.192	-0.138	<b>0.731</b>	0.085	0.134
Çevreye zarar veren bir ürünü alma durumu	0.010	0.303	<b>0.715</b>	0.045	0.031
Deterjanlarda bulunan kimyasal maddelerin insan sağlığına zararı	0.117	0.097	<b>0.558</b>	-0.102	0.392

<b>Faktör 4: Kimyasal Atık Olan Piller</b>					
Atık haldeki piller bir yerde (naylon torba, kutu, kavanoz vs) biriktirilerek atık pil toplama kutularına atılmalı	0.146	0.143	-0.010	<b>0.783</b>	0.049
Pil atıkları içerdikleri zararlı maddeler sebebiyle tehlikeli özellikler taşımak	0.128	0.186	0.069	<b>0.750</b>	-0.014
Çevreyi ve sağlığı tehdit eden kimyasal maddelerin üretimini en aza indirmek için geri dönüşüme kazandırılması gerekmek	0.188	-0.138	-0.079	<b>0.548</b>	0.437
Pillerin yapısında bulunan kadmiyum, kurşun ve çinko zehirli maddeler içermekte	0.244	0.342	0.140	<b>0.538</b>	0.189
<b>Faktör 5: Tehditler</b>					
Dünya çapında çevreye verilen zararların giderilmesi ve kalıcı çözümler üretmek için çalışmalar yapılmalı	-0.120	0.007	0.236	0.148	<b>0.599</b>
Antimon ağır metali daha çok pillerde ve boyaya maddelerinde bulunur. Yüksek oranda bu metale maruz kalan kişilerde kanserojen etkisinin olduğuna inanılmaktır	0.184	0.347	0.151	0.159	<b>0.584</b>

#### 4. SONUÇ

Bu araştırmada, Karabük ili merkez ilçe kentsel alandaki bireylerin kimyasal atıkların çevreye ve sağlığa etkisilarındaki bilgilerini görüşlerini ve tutumlarını belirlemek amaçlanmıştır. Bu amaca ulaşabilmek için oransal örnekleme yöntemi ile belirlenen tesadüfen seçilen 380 bireyle ile görüşerek veriler elde edilmiştir. Elde edilen veriler doğrultusunda, Karabük İli merkez İlçesi'nde kentsel alanda görüşülen kişilerin %57.37'si erkek olup ortalama yaşıları 36.746 ve ortalama aylık gelirleri 2.681 34 TL olarak belirlenmiştir.

Bireylerin kimyasal atıkların çevreye ve sağlığa etkisi hakkında bilgi, tutum ve davranışlarını belirlemek üzere 5'li likert ölçüği kullanılmıştır. Tutum ve davranışlarını belirlemek üzere 19 özellik kendi içerisinde gruplandırma yapılanabilir mi diye faktör analizi yapılmıştır. Analiz sonucunda 19 özellik; Bireylerin Bilgisi, Üreticiyi Bilinçlendirme, Satın Alınan Üründe Dikkat Edilen Özellikler, Kimyasal Atık Olan Piller ve Tehditler adı altında 5 faktör altında toplanabileceği anlaşılmıştır.

Araştırma kapsamında görüşülen bireylerin en fazla olarak kimyasal atık denildiğinde pillerin akla geldiği ve bireylerin hemen hepsinin, kullandığı pillerin kimyasal madde içerdigini bilmesine karşın bireylerin yarısından fazlasının (%60.79) kullandıkları pilleri normal çöp bidonuna atmadığı bu araştırma ile ortaya konulmuştur. Bireylerin büyük bir çoğunluğunun kimyasal maddelere karşı sorumlu ve bilgili olduğu ortaya konulmuştur. Ancak bilgili olmaları bilinç anlamına gelmemektedir. Nitekim yapılan bilinç puanlaması sunucu olarak bireylerin kimyasal atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyi yüksek olan %48.16 olarak hesaplanırken geriye kalan yarısından fazla olan bireylerin (%51.84) kimyasal atıkların çevreye ve sağlığa etkisi konusunda bilinç düzeyi düşük ya da olmayan olarak ortaya konulmuştur. Buradan çıkarılacak sonuç yapılan reklamlar, TV/radyo programları ya da gazete/dergi/magazin haberlerinden bireylerin kimyasal maddeler hakkında bilgilendiği ancak bilinçlenme olmadığı yani kimyasal maddelerin zararının azaltmak için yapılabilecek önlemler hakkında bilinçlendirme yapılması üzerine politikalar geliştirilmelidir.

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## TÜRKİYE TARIMINDA JAPON SENDROMU YAŞANIR MI? IS IT POSSIBLE TO HAVE “JAPAN SYNDROME” IN TURKISH AGRICULTURE?

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### ÖZET

Hızla sanayileşmeye başlayan yoğun nüfusa sahip ülkelerde onları ağır biçimde tahıl ithalatçısı yapan üç unsur göze çarpıyor : Gelirler arttıkça; tahıl tüketimi artar, tarım arazileri azalır,tahıl üretimi düşer.

Çevrebilimci Lester R. Brown, gelişmekte olan ülkelerin yaşamakta olduğu bu süreci, Japonya'nın yaşadığı “örnek” deneyim nedeniyle “Japon Sendromu” kavramı ile adlandırır. Japonya, 1955-1980 yılları arasında yaşadığı endüstrileşme süreci ile 1950'li yılların başlarında tahıl üretiminde kendine yeten bir ülke konumundan hızla uzaklaşmış ve 1980'li yıllarla birlikte tahıl tüketiminin yüzde 70'ini ithal eden bir ülke konumuna gelmiştir.

Son dönemlerde Dünyada ve Türkiye'de beslenme ve gıda alanında yaşanan sıkıntılardır, hayli ilgi çekici ve karamsar öngörülerin gündeme gelmesine neden olmaktadır. Küresel bir sorun olarak özellikle yoksul ve gelişmekte olan ülkeleri derinden etkileyen bu sorunun, farklı iç dinamiklerinden dolayı Türkiye'yi de etkileyebileceğinin bir gerçektir.

Bu çalışma kapsamında konu “Gelişmekte Olan Bir Ülke Olarak Türkiye” örneğinde irdelenirken, Japonya'nın yaşadığı deneyimi anımsatan benzer gelişmeler, sanayileşme süreciyle birlikte Türkiye'de de ortaya çıkar mı? “sorusuna cevap aranmaya çalışılmıştır.

**Anahtar Kelimeler:** Japon sendromu, Sanayileşme, çevre, tarım, gıda güvenliği

### ABSTRACT

Densely populated nations became heavily dependent on grain imports due to the rapid industrialization. Three main factors behind this are; increase on the grain consumption as incomes rise, decrease on the available agricultural lands and grain production.

Lester R. Brown, environmental analyst, named this change as “Japan Syndrome” due to the fact that Japan was the first case he observed this transformation as a developing country. Between 1955-1980, Japan was in rapid industrialization period. At the beginning of 1950s, Japan changed rapidly from being self-sufficient on grain production to grain importing. In 1980s, country became importer of 70 percent of its grain consumption.

Recently, there are serious issues on the field of nutrition and food in all over the World and also in Turkey. These issues result in the increase of attention on very interesting and pessimistic previsions. As a global problem, these issues will mostly effect poor and developing countries. It is inevitable that Turkey will also be affected as a developing country due to the different internal dynamics.

The nutrition and food problems that are seen in Turkey are influenced by two main reasons: Internal dynamic issues and global climate and environmental issues. Under the scope of this study, these issues will be considered “Turkey as a Developing Country” and the question whether Turkey will have the similar set of sequential events as Japan had during the industrialization period will be addressed.

**Keywords:** Japan Syndrome, industrialization, environment , agriculture, food safety

### 1-JAPONYA' NIN DURUMU

Japonya 127 milyon nüfus ile dünyanın kalabalık ülkeleri arasında yer alır. Yüz ölçümü 377.801 km<sup>2</sup> olup, km<sup>2</sup> ye 342 kişi düşmektedir. Japonya'da sanayinin gelişmesine bağlı olarak hızlı bir şehirleşme görülmektedir. Nüfusun yaklaşık %79'u şehirlerde yaşamaktadır. Japonya'nın büyük bir bölümünü dağlarla kaplı olduğundan tarım alanı azdır. Toplam arazisinin ancak %13.3'ünde tarım yapılmaktadır. Bu nedenle Japonya tarımda dışa bağımlıdır ve dünyanın en çok tarımsal ürün ithal eden ülkelerinden biridir.

Japonya, 1955-1980 yılları arasında yaşadığı endüstrileşme süreci ile 1950'li yılların başlarında tahıl üretiminde kendine yeten bir ülke konumundan hızla uzaklaşmış ve 1980'li yıllarla birlikte tahıl tüketiminin yüzde 70'ini ithal eden bir ülke konumuna geldi.

## 2-JAPON SENDROMU NEDİR?

Yogun nüfusa sahip ülkeler hızla sanayileşmeye başladıklarında, onları ağır bir biçimde tahıl ithalatına bağımlı kılan üç unsur ortaya çıkmaktadır: Gelirler arttıkça:

Tahıl tüketimi artıyor

Tarım arazileri azalıyor

Tahıl üretimi düşüyor.

Günümüzde tahıl ihtiyacının % 70'ini ithal eden Japonya'da yukarıdaki üç etki birlikte görülen örnek bir ülke olduğundan olayların bu şekilde gelişmesine Çevrebilimci Lester R Brown "Dünyayı nasıl tükettiğim" adlı eserinde bu durumu "Japon Sendromu" olarak değerlendiriyor.

## 3-TÜRKİYE 'NIN DURUMU

Türkiye'nin Nüfusu adrese bağlı nüfus verilerine göre 2014 sonu itibarıyla 77.695.904; yüz ölçümü 783,562 km<sup>2</sup> olup km<sup>2</sup> ye 101 kişi düşmektedir. Toplam arazisinin %30.3 ü tarım alanıdır. Türkiye'de son yirmi yılda sanayileşme ve tarım hızlı bir değişimden geçiyor.

Gıda Tarım ve Hayvancılık Bakanlığı'nın Çiftçi Kayıt Sistemi verilerine göre 2002 yılında Türkiye'de yaklaşık 2.6 milyon çiftçi varken, bu rakam 2013 yılı itibarıyle 2.2 milyona geriledi. 2002 yılında toplam istihdamın %34,9'u (7,4 milyon) tarımda çalışmakta iken 2012 yılında toplam çalışan sayısının yüzde 24,6'ya (5,7 milyon) tarım sektöründe çalışmaktadır.

**Sonuç: Tarımda istihdam geriliyor; Köylü toprağını terk ediyor; kırsaldan kentlere göç artıyor.**

2000'de 26.4 milyon hektar büyüklüğündeki tarım alanları 2014 yılına gelindiğinde 23.8 milyon hektara geriledi. Tarım alanlarımızın neredeyse yüzde 10'luk kısmı nasıl kayboldu?. Tarımsal ürünlere talep artarken, ekilebilen tarım arazileri her geçen gün azalıyor. Amaç dışı kullanımın en yaygın görüldüğü alanlar sanayi, inşaat, turizm, madencilik ve ulaştırma amaçlı kamu yatırımları olarak dikkat çekiyor.

**Sonuç: En güzel, en verimli topraklar başka amaçlar için kullanılıyor.**

TÜİK verilerine göre Türkiye, 2002 yılında 115 ülkeden tarımsal ürün ithal ederken 2014 sonu itibarıyle 153 ülkeden tarımsal ürün alır duruma geldi. GSMH gelirlerimiz arttıkça Tüketim alışkanlıklarını değişiyor. Tüketim alışkanlıklarımızın değişmesi, eğitim ve gelir artışı arasında gözlenen farklılıklar, tarım ürünlerini ithalatında artışlara neden olmuştur. 2002 sonunda yıllık tarım ürünlerini ithalatı 1 milyar 693 milyon dolar iken, Nisan 2014-Mart 2015 dönemini kapsayan son 1 yıllık dönemde 8 milyar 621 milyon dolara yükseldi.

Gıda, Tarım ve Hayvancılık Bakanlığı Avrupa Birliği ve Dış İlişkiler Genel Müdürlüğü tarafından yayınlanan verilere göre, trmda ihracatla ithalat başa baş noktada. TÜİK verilerinden derlenen Uluslararası Standart Ticaret Sınıflaması'na (SITC Rev 3) göre 2014 yılında Türkiye'nin tarım ürünlerini ihracatı 18 milyar 759 milyon dolar oldu. Aynı dönemde tarım ürünlerini ithalatı ise 18 milyar 58 milyon dolar olarak gerçekleşti. Dış ticaret dengesi 700 milyon dolar fazla verdi. Tarımsal ihracatın ithalatı karşılık orası yüzde 103,9 oldu.

**Sonuçta: Tarım ürünleri tüketimi arttı; Tarım ürünleri ithalatı arttı; ve kendine yeten ülkeden, tarım ürünlerini dışarıdan ithal eden ülke konumuna geldik.**



#### **4-TÜRKİYE – JAPONYA GELİŞMİŞLİK DEĞERLENDİRMESİ**

Dünya ekonomisinde ülkelerin ne kadar paylarının olduğu ve ülke ekonomilerinin büyümeye hızları doğrultusunda gelecekte ne kadar etkili olabilecekleri, ekonomi dergilerinin en çok önem verdiği konulardandır. 2015 yılı itibariyle IMF verilerine dayanarak dünya ekonomisine baktığımızda Gayrisafi milli hasıla açısından Amerika Birleşik Devletleri'nin 18.125 milyar dolar ile dünya ekonomisinin zirvesinde olduğu, Japonya'nın 4.210 milyar dolar ile Çin Halk Cumhuriyeti'nin ardından üçüncü sırada yer aldığı görülmektedir. Türkiye 753 milyar dolar ile on yedinci sırada yer almaktadır. Yani Japonya çok gelişmiş bir ülkedir. Türkiye ise gelişmiş ve gelişmekte olan bir ülkedir.

Türkiye'nin yüz ölçümünün neredeyse yarısı büyülüüğünde ancak nüfus yoğunluğu, Türkiye'nin üç katı kadar olan Japonya, halkın besleyebilecek tarım ürünlerinin % 70'sini ithal etmektedir. Türkiye'de ise bu oran % 11 seviyesindedir. Japonya'da ülkenin çok büyük bir kısmı dağlık tarım alanı sınırlı olduğundan modern yöntemler kullanılarak tarım yapılmaktadır, bu nedenle ülkede tarım giderek daha maliyetli bir hal alıyor. Japonya'da bazı tarım ürünleri mevcut tarım alanlarının yanı sıra, topraksız, su içinde (hidrofonik yöntem) üretilmektedir.

Türkiye'de ise tarıma elverişli alanlar daha geniş ve buralarda toprağa dayalı tarım yapılmaktadır. Her ne kadar başka ülkelerden tarım ürünü ithal edilse de, tarım ürünü ihracatı yapılan ithalatı karşılamaktadır.

#### **5-SONUÇ**

**"Japon Sendromu"** olarak adlandırılan süreç, gelişmekte olan bir ülke olarak Türkiye'de de benzer bir şekilde yaşanmaya başladı. Yani Tarıma elverişli araziler azalıyor, tarım ürünleri tüketimi artıyor ve tarım ürünleri üretimi azalıyor buna bağlı olarak tarım ürünü ithali her geçen yıl artıyor. Ancak ekonomik göstergeler ve mevcut beşeri durum ile ülkemizin tarım potansiyeli dikkate alındığında Türkiye'nin tarım ürünlerini ithalatının önmümüzdeki birkaç on yılda çok aşırı bir artış göstereceği beklenmemektedir.

Bu konuda dünya'nın geleceğini tehdit eden çevresel faktörlerin başında gelen küresel ısınma ve beraberindeki kuraklık, çölleşme ya da aşırı yağışların neden olduğu sel, fırtına ve aşırı soğuk -donlu günler- gibi doğal afetlerin risk değerlendirmesinin yapılması ve hazırlanan ulusal eylem planlarının dikkatle uygulanması, sürdürülebilir kalkınma için sürdürülebilir tarım ve sürdürülebilir çevre ilkesine her alanda uyulması hayatı önem taşımaktadır.

Sonuçta Türkiye'nin, Japonya'nın yaşadığı deneyimlerden yararlanması ve gıda güvenliği açısından konunun üzerinde dikkatle durulması, incelenmesi, araştırılması ve gelecek planlamasını buna göre yapması gereklidir.

Unutmamalıdır ki; **hiçbir ülke kendi geleceğini dünyadan çevresel geleceğinden ayrı düşünemez.**

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## SÜRDÜRÜLEBİLİR TOPRAK YÖNETİMİ MÜMКÜN MÜ? SUSTAINABLE LAND MANAGEMENT POSSIBLE?

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### ÖZET

Topraklar; sürdürülebilir tarımsal kalkınma, temel ekosistem işlevleri ve gıda güvenliği için bir dayanak teşkil ediyor. Toprak yenilenebilir değildir. Toprak kaybının insanın yaşam süresi boyunca telfisi mümkün değildir.

Sürdürülebilir toprak yönetimi için yapılacak yatırımlar, sonradan yapılacak onarımdan daha ucuzdur. Toprak için verilecek her çaba, tarıma bağlı sürdürülebilir kalkınma, gıda güvenliği, beslenme, iklim değişikliği, ekosistemin geleceğini konusunda büyük önem taşımaktadır.

Gıda Tarım ve Hayvancılık Bakanlığı toprağın tarımsal amaçlı kullanımına yönelik mevzuat açısından devletimiz adına en geniş ve en büyük yetkiye sahip kurumdur. Çevre ve Şehircilik Bakanlığı, Orman ve Su İşleri Bakanlığı, Kültür ve Turizm Bakanlığı, Enerji ve Tabii Kaynaklar Bakanlığı, Bilim Sanayi ve Teknoloji Bakanlığı, Ulaştırma Denizcilik ve Haberleşme Bakanlığı, Maliye Bakanlığı, İç İşleri Bakanlığı ve dolayısıyla illerde Valilikler ve Belediye Başkanlıkları, çıkardıkları pek çok mevzuat hükümleriyle konuya doğrudan veya dolaylı olarak ilgilenmektedirler. Bu konuda yaşanan yetki ve sorumluluk karmaşası toprakla uğraşanların aklını karıştırmaktadır.

Bir şeyi sürdürmek için o şeyi korumak ve ona değer vermek gerekir. Birleşmiş Milletler 2015 Uluslararası Toprak Yılında toprağın derdini dinlemek ve ona çare olmak herkesin görevi olmalıdır. Bu çalışmada ülkemizde mevcut mevzuat uygulamalarıyla sürdürülebilir toprak yönetimi irdelenecektir.

Anahtar kelimeler; Toprak, Sürdürülebilir Yönetim, Bakanlıklar, Mevzuat uygulamaları

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### ABSTRACT

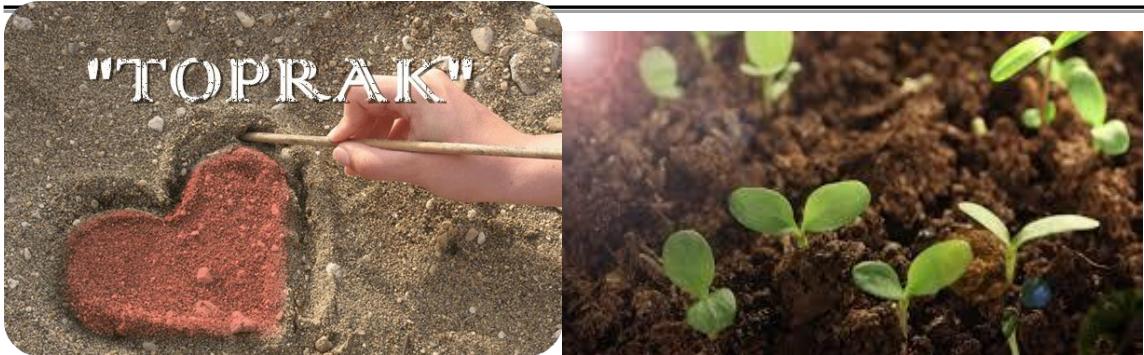
Soils; sustainable agricultural development, poses a fundamental basis for food security and ecosystem functions. Soil is not renewable. It is not possible to compensate for loss of land during the period of human life.

Investments to be made for sustainable land management, it is cheaper than repairs to be made later. Every effort will be given to land, sustainable development depends on agriculture, food security, nutrition, climate change is crucial to the future of the ecosystem.

Ministry of Food, Agriculture and Livestock on behalf of our government in terms of regulations for the use of land for agricultural purposes, is the largest and most large organizations with authority. Environment and Urban Planning, Ministry of Forestry and Water Affairs, Ministry of Culture and Tourism Ministry, the Ministry of Energy and Natural Resources, Science, Industry and Technology, Ministry of Transport, Maritime Affairs and Communications, Ministry of Finance, the Ministry of Internal Affairs and therefore Prefectures and Municipalities in the provinces, so they make the subject of much legislation are interested directly or indirectly. Competent and experienced in this respect is the responsibility of dealing with soil confuse confusion.

In order to continue to protect that thing and something must give value to him. United Nations 2015 International Earth Year and listen to the troubles of the soil should be everyone's duty to remedy it. This study will examine sustainable land management practices with current legislation in our country.

**Keywords:** Soil, Sustainable Management, Ministries, Regulatory Applications



## 1- SÜRDÜRÜLEBİLİR TOPRAK YÖNETİMİ?

Tarımsal anlamıyla toprak, üzerinde ve içersinde geniş bir canlılar topluluğu barındıran, , hiç kuşkusuz insanoğlunun yaşamını devam ettirebilmesi vazgeçilmez bir doğal kaynaktır . Tarih boyunca medeniyetlerin gelişmişlikleri ve insanların yaşam standardı toprak-insan ilişkisinden büyük ölçüde etkilenmiştir

Bugünkü teknolojik koşullarda toprağın arzı arttırılamayacağına ve topraktan yararlanmada azalan verim kuralı geçerli olduğuna göre, özellikle geleceğin güvencesi olan üretken tarım topraklarının çok iyi değerlendirilmesi, niteliklerine uygun olarak kullanılması ve tabii ki sürdürülebilirliği önemlidir.

Sağlıklı topraklar, sadece gıda, yakıt ve tıbbi ürünlerin knağı olmanın yanı sıra suyun filtrelenmesi, karbon döngüsü ve karbon depolanması gibi konularda, sel ve kitlik gibi felaket zamanlarında kritik öneme sahip doğal bir kaynaktır.

Türkiye’de toprak kaynaklarının korunması ve doğru planlanması amacıyla çıkarılan 5403 sayılı Toprak Koruma ve Arazi Kullanım Kanunu önemli bir gelişmedir. Toprak kaynaklarının korunması amacıyla çıkarılan 5403 sayılı Toprak Koruma ve Arazi Kullanım Kanununa rağmen toprakların yanlış kullanımı devam etmektedir.

Bir şeyi südürebilmek için o şeyi korumak ve ona değer vermek gereklidir. Bir şeyin sürdürülebilir olması demek o şeyin belirli bir yaşam döngüsü içerisinde devam etmiş olmasını gerektirmektedir.

## 2- TÜRKİYE'DE YETKİLİ KAMU KURUM VE KURULUŞLARI VE İLGİLİ MEVZUATLARI

Türkiye’de tarımsal arazi yönetimi ve toprakla doğrudan ve dolaylı olarak ilgili olan resmi ve özel pek çok kamu kurum ve kuruluşu ile Sivil toplum örgütleri bulunmaktadır.Bu çalışmamızda ilgili Bakanlıklar ve yürütükleri hizmetlerin kaynağı olan mevzuatlardan bazı kanunlar ve önemli yönetmelik başlıkları aşağıya çıkarılmıştır.

### 2.1 Gıda Tarım Ve Hayvancılık Bakanlığı:

- 5403 Sayılı Toprak Koruma Ve Arazi Kullanımı Kanunu (Resmi Gazete tarihi 19/7/2005 sayı : 25880)
- 3083 sayılı Sulama Alanlarında Arazi Düzenlenmesine Dair Tarım Reformu Kanunu (Resmi Gazete tarih 01.12.1984 sayılı: 18592 )
- Sulama Alanlarında Arazi Düzenlenmesine Dair Tarım Reformu Kanunu Uygulama Yönetmeliği (Resmi Gazete tarih : 29.06.1985, sayı : 18796)
- 5488 sayılı Tarım Kanunu (Resmi Gazete tarih: 25/04/2006 sayı : 26148)
- 5262 Sayılı Organik Tarım Kanunu (Resmi Gazete tarih : 3/12/2004 sayı :25659)
- Toprak Koruma Ve Arazi Kullanımı Kanunu Uygulama Yönetmeliği (Resmi Gazete tarihi: 15.12.2005 sayılı: 26024)
- Tarım Havzaları Yönetmeliği (Resmi gazete tarih 27 Eylül 2010 sayılı: 27695)
- Tarımsal Kuraklık Yönetiminin Görevleri, Çalışma Usul Ve Esaslarına Dair Yönetmelik (Resmi Gazete tarih: 2 Mart 2008 sayılı: 26804)
- Tarımsal Arazilerin Mülkiyetinin Devrine İlişkin Yönetmelik (Resmi Gazete tarih: 31.12.2014 sayılı: 29222)
- İyi Tarım Uygulamaları Hakkında Yönetmelik (Resmi Gazete tarih: 07.12.2010 sayısı: 27778)

## **2.2.Çevre Ve Şehircilik Bakanlığı:**

- Çevre Ve Şehircilik Bakanlığının Teşkilat Ve Görevleri Hakkında 644 Nolu Kanun Hükmünde Kararname (Resmi Gazete tarihi : 4/7/2011, sayı : 27984 Mükerrer)
- 2872 Sayılı Çevre Kanunu (Resmi Gazete : Tarih : 11/8/1983 Sayı : 18132 / değişiklik 26.04.2006 tarihli 5491 sayılı kanun)
- 3402 sayılı Kadastro Kanunu (09.07.1987 Tarih ve 19512 sayılı RG)
- 3194 Sayılı İmar Kanun (Resmi Gazete tarih 09.05.1985 sayı 18749 /Değişiklik 12.07.2013 tarihli 6495 sayılı Kanun)
- Kum Çakıl Ve Benzeri Maddelerin Alınması, İşletilmesi Ve Kontrolü Yönetmeliği (Resmi Gazete tarihi: 08.12.2007 sayısı: 26724)
- Atıkların Düzenli Depolanmasına Dair Yönetmelik (Resmi Gazete tarihi: 26.03.2010 sayısı: 27533)
- Atık Yönetimi Yönetmeliği (Resmi Gazete 02.04.2015 tarih ve sayı : 29314)
- Toprak Kirliliğinin Kontrolü Ve Noktasal Kaynaklı Kirlenmiş Sahalara Dair Yönetmelik (Resmi Gazete Tarihi: 08.06.2010 ,sayısı: 27605 )
- Evsel Ve Kentsel Arıtma Çamurlarının Toprakta Kullanılmasına Dair Yönetmelik (Resmi Gazete tarihi: 03.08.2010 ,sayısı: 27661)
- Çevresel Etki Değerlendirmesi Yönetmeliği (Resmi Gazete tarihi: 25.11.2014 sayı: 29186)
- Çevre İzin Ve Lisans Yönetmeliği (Resmi Gazete tarihi: 10.09.2014 ,sayı: 29115)
- Hafriyat Toprağı, İnşaat Ve Yıkıntı Atıklarının Kontrolü Yönetmeliği (Resmi Gazete tarihi: 18.03.2004 ,sayı: 25406)
- Yüksek Çevre Kurulu Ve Mahalli Çevre Kurullarının Çalışma Usul Ve Esaslarına İlişkin Yönetmelik (Resmi Gazete tarihi: 03.08.2013, sayı :28727)
- Planlı Alanlar Tip İmar Yönetmeliği(Resmî Gazete tarih: 02/11/1985 ve sayı /18916 mükerrer/ Değişiklik 08.09.2013, 28759)
- Mekânsal Planlar Yapım Yönetmeliği (Resmi Gazete tarihi: 14.06.2014 sayı: 29030)
- Tabiat Varlıklarını Koruma Komisyonları Kuruluş Ve Çalışma Usul Ve Esaslarına Dair Yönetmelik (Resmi Gazete : Tarih:18 Ekim 2011, Sayı: 28088/Değişiklik 23 .08 2013, 28744)
- Korunan Alanların Tespit, Tescil Ve Onayına İlişkin Usul Ve Esaslara Dair Yönetmelik (Resmi Gazete tarih:19 Temmuz 2012, Sayı: 28358/ Değişik 19 .02. 2013, 28564)
- Korunan Alanlarda Yapılacak Planlara Dair Yönetmelik (Resmî Gazete tarih:23 Mart 2012, sayı : 28242)

## **2.3 . Orman Ve Su İşleri Bakanlığı:**

- 645 Sayılı Orman Ve Su İşleri Bakanlığının Teşkilat Ve Görevleri Hakkında Kanun Hükmünde Kararname (Resmi Gazete tarihi : 4/7/2011, sayı : 27984 Mükerrer)
- 6831 Sayılı Orman Kanunu (Resmi Gazete tarih : 8/9/1956, sayı : 9402 )
- 6292 Sayılı Orman Köylülerinin Kalkınmalarının Desteklenmesi Ve Hazine Adına Orman Sınırları Dışına Çıkarılan Yerlerin Değerlendirilmesi İle Hazineye Ait Tarım Arazilerinin Satışı Hakkında Kanun (Resmi Gazete tarih: 26.04.2012 ,sayı 28275)
- 4122 sayılı Milli Ağaçlandırma Ve Erozyon Kontrolü Seferberlik Kanunu (Resmi Gazete tarih 26.07.1995 ,sayı 22355 )
- 4342 sayılı Mera Kanunu (Resmi Gazete tarih 28.02.1998, sayı 23272 )
- 2873 Milli Parklar Kanunu ( Resmi Gazete tarih : 11/8/1983, sayı : 18132)
- Su Havzalarının Korunması Ve Yönetim Planlarının Hazırlanması Hakkında Yönetmelik (Resmî Gazete tarih :17 Ekim 2012 sayı : 28444)
- Milli Ağaçlandırma Ve Erozyon Kontrolü Seferberliği Yönetmeliği (Resmi Gazete tarih: 27.09.1996 sayı: 22770)

**2.4. Enerji Ve Tabii Kaynaklar Bakanlığı:**

-3213 Maden Kanunu (Resmi Gazete tarih : 15/6/1985, sayı : 18785 Değişik: 26/5/2004 – 5177 sayılı Kanun)  
-Maden Kanununun I (A) Grubu Madenleri İle İlgili Uygulama Yönetmeliği  
( Resmi Gazete tarih: 03.02.2005, Sayı 25716 / Değişiklik 29/5/2013-28661 sayılı)

**2.5. Kültür Ve Turizm Bakanlığı:**

2863 sayılı Kültür Ve Tabiat Varlıklarını Koruma Kanunu ( R.Gazete : Tarih : 23/7/1983 Sayı : 18113 )

**2.6 Bilim Sanayi Ve Teknoloji Bakanlığı:**

-Organize Sanayi Bölgeleri Uygulama Yönetmeliği( Resmi Gazete tarih: 22.08.2009 sayı 27327)

**2.7 Maliye Bakanlığı :**

-2942 Kamulaştırma Kanunu (R.Gazete : Tarih : 8/11/1983 Sayı : 18215)

-4070 sayılı Hazineye Ait Tarım Arazilerinin Satışı Hakkında Kanun, (19 Şubat 1995 tarih ve 22207 sayılı Resmi Gazete)

- 4706 Sayılı Kanun Hazineye Ait Taşınmaz Malların Değerlendirilmesi Ve Katma Değer Vergisi Kanununda Değişiklik Yapılması Hakkında Kanun (18.07.2001 Tarih ev 2446 sayılı RG /değişiklik 03.07.2003 tarihli 4916 sayılı kanun/değişiklik 03:04.2013 T 6456 sayılı K)

-6292 sayılı Orman Köylülerinin Kalkınmalarının Desteklenmesi ve Hazine Adına Orman -Sınırları Dışına Çıkarılan Yerlerin Değerlendirilmesi ile Hazineye Ait Tarım Arazilerinin Satışı Hakkında Kanun" (26.04.2012 tarih ve 28275 sayılı RG)

**2.8. İç İşleri Bakanlığı:**

-6360 Sayılı On Dört İlde Büyükşehir Belediyesi Ve Yirmi Yedi İlçe Kurulması İle Bazı Kanun Ve Kanun Hükmünde Kararnamelerde Değişiklik Yapılmasına Dair Kanun (Resmi Gazete Tarihi: 06.12.2012 Sayısı: 28489 )

-5216 Sayılı Büyükşehir Belediyesi Kanunu (Resmi Gazete tarihi: 23.07.2004 Sayı 25531 )

-5393 Sayılı Belediye Kanunu (Resmi Gazete Tarihi: 13.07.2005 Sayısı: 25874)

-442 sayılı Köy Kanunu (07 Nisan 1024 tarih ve 68 sayılı resmi gazete/değişiklik 02.06.2007 tarihli 5673 sayılı kanun)

-3202 sayılı Köye Yönelik Hizmetler Hakkında Kanun (22.05.1985 tarih ve 18761 sayılı RG)

-Köy Yerleşme Alanı Uygulama Yönetmeliği (Resmi Gazete tarih: 20.08.1987,sayı 19550)

-Belediyelerin Arsa, Konut Ve İşyeri Üretimi, Tahsisi, Kiralaması Ve Satışına Dair Genel Yönetmelik (Resmi Gazete tarihi: 29.09.2005 sayı 25951)

**3- KALKINMA BAKANLIĞI ONUNCU KALKINMA PLANI (2014-2018)**

Bakanlık Tarım Özel İhtisas Komisyonu "Tarım Arazilerinin Sürdürülebilir Kullanımı Çalışma Grubu" tarafından, ülkemizde konu ile ilgili olarak belirlenen temel sorunun ana başlıklarını şu şekildedir:

- Tarım arazilerinin kabiliyetlerine uygun kullanılmaması ve amaç dışı kullanımlar
- Kurumlar arası koordinasyon eksikliği ve yetki karmaşası,
- Yürürlükteki mevzuattaki çelişki ve yetersizlikler,
- İşletme yapılarından kaynaklanan sorunlar,
- Topografa ve toprağın yapısından kaynaklanan kısıtlar
- İklim değişikliği ve küresel ısınma
- Erozyon ve Çölleşme
- Kırsal alandan şehirlere göç .

Yine aynı komisyonun raporuna göre ülkemizdeki en az 24 Kamu kurumu, Toplam 15 ana başlıkta 122 faaliyyette toprak ve arazi yönetimi ile yetkili ve ilgilidir. Bu durum söz konusu raporda aşağıdaki Tablo 9 da gösterilmiştir. Buradan da anlaşılacığı gibi toprak ve arazilerin sürdürülebilirliği farklı kurum ve kuruluşların yetki ve sorumluluğundadır.

#### 4. SONUÇ

Tarımın en önemli üretim faktörü hiç kuşkusuz topraktır. Toprağı bu denli önemli yapan husus ise, daha önce de altı çizildiği üzere, onun yeniden üretilmemeyen bir kit kaynak olmasıdır. Bu kapsamda, insanlarınımızın yeterli ve güvenilir gıda ulaşabilmeleri, kalkınmamızın teminatı olan sağlıklı gelecek nesillerin yetiştirilmesi, kırsal kalkınmanın sağlanması, ekonominin gelişimi ve yaşanabilir bir çevre için verimli tarım toprakları sürdürülebilir bir şekilde kullanılmalıdır.

Türkiye'de Sürdürülebilir Toprak Yönetimi için yukarıda belirtilen yetki ve sorumluluk dağılımı ve ülke tarımının durumu dikkate alındığında bu haliyle ne kadar mümkündür? **Sürdürülebilir toprak yönetimi** adına yürürlüğe onulan kapasite gelişimi ve eğitim programlarını güçlendirmeli, yetki ve sorumluluk karmaşası giderilmelidir.

Sonuç olarak ülkemizin geleceğinde önemli bir yeri olan toprak ve tarım konusundaki mevzuat uygulamaları başta olmak üzere yeniden ele alınıp değerlendirilmelidir.

Gıda ve Tarım ve Hayvancılık Bakanlığı'nın son yıllarda kullandığı "**Toprak Varsa Hayat Vardır**" sloganı her şeyi anlatmaktadır. Toprağı sürdürülebilir kılmak hayatı südürebilmektedir.

İnsanlığın "**Sessiz Dostu**" Olan toprağa yeterince önem verilmediğini belirten **FAO Genel Direktörü José Graziano da Silva'nında** dediği gibi:

Herkes için ve hep birlikte yürütülen sürdürülebilir bir kalkınma hedefi doğrultusunda 2015 toprak yılı boyunca :

#### TÜM INSANLARI TOPRAKLAR İÇİN AKTİF ROL ALMAYA DAVET EDİYORUZ

**Tablo 9: Kamu Kurum ve Kuruluşlarının Faaliyet Alanları İtibarıyla Arazi Yönetimi'ne İlişkin Yetki ve Görevleri**

KURUM VEYA KURULUS	FAALİYET ALANI										FAALİYET SAYISI	
	Hariç Yapımı	Kamulaştırma	Cevre ve Toprak Koruma	Taşınmaz Değerlemesi	Planlama	Alyapı Hizmetleri	İskan Düzenleme	Hazine Arazilerinin İdaresi	Arsı ve Konut Üretimi	Kadastro	Omanların İdaresi	
Belediyeler												11
İl Özel İdareleri												8
GTHB												9
DSİ Genel Müdürlüğü												8
Toplu Konut İdaresi												8
Orman Genel Müdürlüğü												6
Afet ve Acil Durum Yönetimi Bşk.												6
BOTAŞ Genel Müdürlüğü												7
Karayolları Genel Müdürlüğü												6
Teknik Araştırma ve Uyg. Gen.Md.												6
Tapu ve Kadastro Genel Müd.												6
İller Bankası Genel Müdürlüğü												5
Türkiye Kömür İşletmeleri Kurumu												4
Vakıflar Genel Müdürlüğü												4
Maden İşleri Genel Müdürlüğü												4
Kültür Varlıklarları ve Müzeler Gn.M.												4
GAP Bölge Kalkınma İdaresi Bşk.												3
Yatırım ve İşletmeler Genel Müd.												3
Maden Tektik Arama Genel Müd.												3
TEDAŞ Genel Müdürlüğü												3
Ozelleştirme İdaresi												3
Milli Emlak Genel Müdürlüğü												3
Çevre Yönetimi Genel Müd.												1
Su Yönetimi Gen.Mud.												1

Kaynak: TRGM

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## NEW TECHNOLOGIES TO REDUCE ENVIRONMENTAL IMPACTS OF COAL-FIRED POWER PLANTS

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### ABSTRACT

Coal is the largest source of power globally and given its wide availability and relatively low cost, it is likely to remain so for the foreseeable future. The High-Efficiency, Low-Emissions Coal-Fired Power Generation is to generate the same amount of electricity, with a more efficient coal-fired unit which burns less fuel, emit less carbon, release less local air pollutants, consume less water and have a smaller carbon footprint. High-efficiency, low emissions (HELE) technologies in operation already. A range of advanced coal combustion technologies have been developed to improve the efficiency of coal-fired power generation approaching 50% or even higher. New, more efficient coal-fired combustion technologies reduce emissions of CO<sub>2</sub>, as well as pollutants such as NOx, SOx and particulates.

Increases in the efficiency of electricity generation are essential in tackling climate change. A one percentage point improvement in the efficiency of a conventional pulverised coal combustion plant results in a 2-3% reduction in CO<sub>2</sub> emissions.

Moving the current average global efficiency rate of coal-fired power plants from 33-35% to 40-43% by deploying more advanced technology could cut two gigatonnes of CO<sub>2</sub> emissions now, while allowing affordable energy for economic development and poverty reduction.

In this study description and evaluation of high efficiency low emission coal fired power generation and comparison with conventional power generation technologies in terms of environmental impacts with special emphasize on emission levels, especially contribution to green house gas (GHG) emissions were studied. Additionally key actions required to keep 2°C global warming scenario and mitigation potential of high efficiency and low emission power generation towards a Sustainable Energy Future are also evaluated.

**Keywords:** advanced coal combustion Technologies, high-efficiency- low-emission, tackling climate change

### INTRODUCTION

As worldwide populations and industrial growth reach new heights, electricity demand is projected to increase substantially. Fossil fuels, particularly coal, will continue to be a vital energy source for the power sector in many countries. At the same time, fossil fuel fired power generation is one of the largest sources of global CO<sub>2</sub> emissions. High-efficiency, low-emissions coal technologies can help reduce the carbon emissions produced by coal-fired power generation while enabling the energy source to continue to meet growing power demand (Clean Energy Ministerial, 2015).

Today, coal-fired power plants produce over 44 % of the world's electricity (BP, 2015). Looking to the future, if no new policies are implemented, global demand for coal used in power generation is projected to rise by more than one-third by 2035. In light of rising international concerns over the build-up of greenhouse gases in the earth's atmosphere, and the fact that coal-fired power plants currently produce, carbon dioxide (CO<sub>2</sub>) emissions per unit of electrical output, the need for greater efficiency is clear.

The global average efficiency of coal-fired power plants currently in operation is roughly around 33% much lower than for power plants that rely on other fossil fuel sources and significantly lower than the 45% efficiency possible with modern, ultra-supercritical coal-fired power plants (IEA, 2009).

Over the operational lifetime of a typical coal-fired power generation unit, each percentage point increase in efficiency results in reduced CO<sub>2</sub> emissions totalling many millions of tonnes.

If coal-fired units currently in operation around the world could be upgraded to operate at an average of 42% efficiency, annual CO<sub>2</sub> emissions would fall by more than 2 billion tonnes. In addition, for each unit of electricity generated, higher efficiency coal-fired plants consume less fuel, emit fewer local pollutants, and use less water (NETL, 2008).

Within the power sector of many countries, the expectation is higher standards will continue to be tightened and regulations introduced to ensure better environmental performance from coal, covering local pollutants, CO<sub>2</sub> emissions and water consumption.

In this regard, several practices are relevant to countries that utilize coal for power generation:

- Better quality control of coal supplies and high quality coal to power plants is necessary, and preferably an increased use of lower ash, washed coal, high calorific value as this reduces heat losses due to the otherwise high Emissions Reduction through Upgrade of Coal-Fired Power Plants
- Losses from transmission and distribution systems need to be kept to a minimum for a well integrated national grid system.
- More stringent emissions standards generally lead to better, more efficient plant operation. Where tighter emissions standards have been introduced, effective monitoring and verification is essential, with heavy penalties for non-compliance.
- More efficient units consume less water. While it is important to reduce water consumption through the whole coal chain, from mining to utilisation, improving both the efficiency and operation of generation units can have a significant impact.
- Power Plants needs to be equipped with high efficiency emission control technologies
- Utilization of Coal Combustion Products is necessary instead of considering them as waste.

### **NEW TECHNOLOGIES to REDUCE ENVIRONMENTAL IMPACTS of COAL-FIRED POWER PLANTS**

New Technologies to reduce impact of power plants mainly “Clean coal technologies” are a collection of technologies being developed to mitigate the environmental impacts of energy generation.

When coal is used as a fuel source, the gaseous emissions generated by burning of the coal include sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NOx), carbon dioxide (CO<sub>2</sub>), and other chemical byproducts that vary depending on the type of the coal being used. These emissions have a negative impact on the environment and human health, contributing to acid rain, etc. As a result, new clean coal technologies are being developed to remove or reduce pollutant emissions to the atmosphere and increase the efficiency of boilers to produce more electricity with less amount of fuel and less emissions (IEA, 2014).

Some of the techniques that would be used to accomplish this include;

#### **HIGH EFFICIENCY BOILERS (SUPER CRITICAL and ULTRA SUPER CRITICAL)**

Most of new coal-fired power plants used high-efficiency, low-emissions technologies, predominantly supercritical (SC) and ultra-supercritical (USC) pulverized coal combustion units. USC pulverized coal combustion is currently the most efficient technology: some units reach efficiency of 45%, reducing global average emissions to 740 grams of carbon dioxide per kilowatt hour (gCO<sub>2</sub>/kWh). Efforts to develop advanced USC technology could lower emissions to 670 gCO<sub>2</sub>/kWh (a 30% improvement) (IEA, 2015, Mao, 2011).

Plant Type	PCC*	PCC*	PCC*	IGCC**
Steam Cycle	Subcritical	Supercritical	Ultra- Supercritical (best available)	Triple Pressure Reheat
Net Efficiency (%)	< 40	>43	>44	>45
CO <sub>2</sub> emitted (tonnes/MWh) net	0.83	0.80	0.77	0.74

\*PCC: Pulverized Coal Combustion; \*\*IGCC: Integrated Coal Gasification Combined-Cycle.

Certain differences (approximately 3-4%) are due to ambient climatic condition and quality of coal available.

**Table 1 - Performance summary for different coal-fired power plants (IEA, 2008)**

## INTEGRATED GASIFICATION COMBINED CYCLE (IGCC)

An integrated gasification combined cycle (IGCC) is a technology that uses a gasifier to turn coal and other carbon based fuels into gas-synthesis gas (syngas). It then removes impurities from the syngas before it is combusted. Some of these pollutants, such as sulfur, can be turned into re-usable byproducts. This results in lower emissions of sulfur dioxide, particulates, etc. With additional process equipment, the carbon in the syngas can be shifted to hydrogen via the water-gas shift reaction, resulting in nearly carbon free fuel.

The resulting carbon dioxide from the shift reaction can be compressed and stored. Excess heat from the primary combustion and syngas fired generation is then passed to a steam cycle, similar to a combined cycle gas turbine. This results in improved efficiency compared to conventional pulverized coal. It offers the prospect of using the syngas for chemicals and transportation fuels and a comparatively easier way to separate CO<sub>2</sub>, which is emitted as a concentrated gas stream at high pressure—in this form, it can be captured and sequestered more easily and at lower costs (Major Economies Forum, 2009).

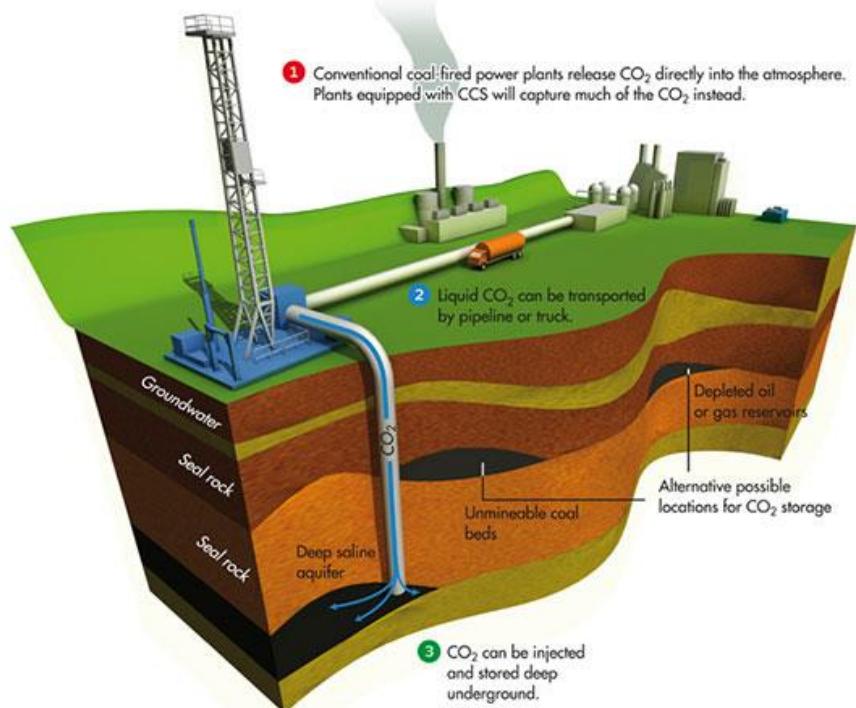


Figure 1- Comparison of current and future power plant emissions and efficiencies (IEA, 2015)

## CARBON CAPTURE and STORAGE (CCS)

Carbon Capture and Storage (CCS) is a technology that can capture up to 90% of the carbon dioxide (CO<sub>2</sub>) emissions produced from the use of fossil fuels in electricity generation and industrial processes, preventing the carbon dioxide from entering the atmosphere.

The CCS chain consists of three parts; capturing the carbon dioxide, transporting the carbon dioxide, and securely storing the carbon dioxide emissions, underground in depleted oil and gas fields or deep saline aquifer formations.

First, capture technologies allow the separation of carbon dioxide from gases produced in electricity generation and industrial processes by one of three methods: pre-combustion capture, post-combustion capture and oxyfuel combustion.

Carbon dioxide is then transported by pipeline or by ship for safe storage. Millions of tonnes of carbon dioxide are already transported annually for commercial purposes by road tanker, ship and pipelines. The carbon dioxide is then stored in carefully selected geological rock formation that are typically located several kilometers below the earth's surface (Smallcapvoice, 2015).

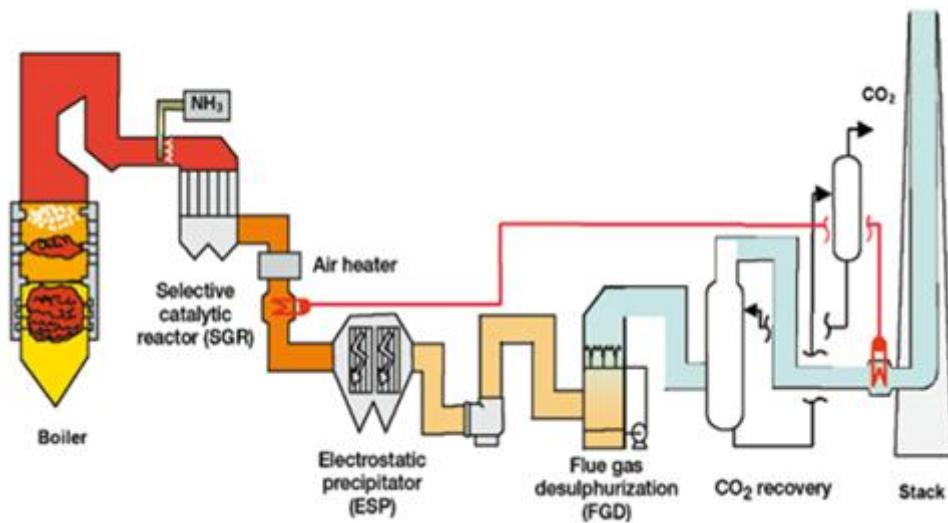


Figure 2- Carbon capture and storage (Transition Networks, 2014)

## EMISSION CONTROL TECHNOLOGIES

Clean coal technology usually addresses atmospheric problems resulting from burning coal. Historically, the primary focus was on  $\text{SO}_2$  and  $\text{NO}_x$ , the most important gases in causation of acid rain, and particulates which cause visible air pollution and deleterious effects on human health. More recent focus has been on carbon dioxide (due to its impact on global warming). In order to minimize the effects of emissions different technologies for different emissions are used (Union of Concerned Scientists, 2015).

Some of those technologies can be summarized below (VGB, 2015):

NO<sub>x</sub> emission control technologies (DeNO<sub>x</sub>)

**Methods:** Selective Catalytic Reduction (SCR); Selective Non-Catalytic Reduction (SNCR), Low NO<sub>x</sub> Burners

Dust abatement techniques (DeDust)

**Methods:** Electrostatic separation, wet / dry (ESP); Filtering separation (Bag-filter)

SO<sub>2</sub> emission control technologies (DeSO<sub>x</sub>)

**Methods:** limestone/lime based, bicarbonate; Wet scrubber (FGD), spray-drying and absorption

Emission reduction of unburned organic compounds, aerosols, gaseous and particle-bound heavy metals is possible with these technologies.

## COAL COMBUSTION BYPRODUCTS (CCBs)

The removal of fly ash, sulfur dioxide, and other species from flue gas results in the production of solid materials, referred to as coal combustion by-products (CCBs). CCBs have many useful properties. However, due to the limited number of proven utilization options, electricity generators worldwide have historically preferred to landfill CCBs rather than try to sell them. With increased focus on cost cutting and environmental concerns of landfilling, electricity generators have become more interested in utilizing CCBs. Value-added CCB applications can reduce the overall cost of environmental control and help maintain lower-waste power production. In addition, utilization of CCBs can reduce CO<sub>2</sub> emissions by avoiding the energy needed. (Smouse et al., 2015)

## KYOTO PROTOCOL

According to United Nations Intergovernmental Panel on Climate Change, the burning of fossil fuel, is a major contributor to global warming. As 68 % of the world's electrical generation is from fossil-fuel generation, reaching the carbon dioxide reduction targets of the Kyoto Protocol will require modifications.

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), which commits its Parties by setting internationally binding emission reduction targets.

Recognizing that developed countries are principally responsible for the current high levels of Green House Gas

Emissions (GHG) in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities defining path to keep the world and its people under a 2 degree C temperature rise."

With this growing demand for fossil-based comes an increasing production of emissions.

To realize sustainable development, and this 2 degree °C scenario both electricity demand and global emissions issues need to be addressed simultaneously. Improving the efficiency of existing fossil fuel facilities or replacing them with more advanced technologies can aid in this overall reduction, providing substantial CO<sub>2</sub> mitigation while ensuring that power needs are met.

Currently, the average efficiency of coal-fired power plants varies significantly from roughly 31–42%. This difference comes from diverse factors such as technology of the power plant, climatic conditions, coal quality, the operations and maintenance skills at existing plants, and uptake of advanced technologies (Major Economies Forum, 2009). So in order to reach this 2 degree scenario, it is a urgent neccesity to apply new technologies to reduce GHG and environmental impacts of power plants.

## CONCLUSION

- Fossil Fuels will remain as the main source of energy for the world so the clean and new technolgies should be used for the generation of electricity
- Conventional boiler technologies should be replaced by advanced boiler technologies with higher efficiencies because 1% increase in efficiency is equal to 2% decrease in CO<sub>2</sub> emissions
- Rehabilitation in the existing power generation facilities is very important step to increase capacity and to decrease emissions
- All existing and new power generation facilities should be equipped with high efficiency emission control technologies
- Usage of Coal Combustion Byproducts (CCBs) has to become common.

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## ENVIRONMENTALLY SENSITIVE AGRICULTURAL MANURE NUTRIENT MANAGEMENT

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### ABSTRACT

An agricultural manure nutrient management requires multiple components to maintain adequate fertility for crop growth and development while minimizing soil and water quality impacts. The major threat against the water quality is an eutrophication. It is simply the overgrowth of an algae, cyanobacteria or phytoplankton. When these things decompose they consume the oxygen in water body. A well designed soil sampling plan including proper soil testing interpretations along with manure sampling, manure nutrient analysis, equipment calibration, appropriate application rates, timing, and application methods are necessary components of the manure nutrient management. Implementing these components allows manure to be recognized and used as a credible nutrient resource, potentially reducing input costs and minimizing environmental impacts. Necessary measures against the excessive feed of the water bodies by the manure nutrients such as nitrogen, phosphorus and potassium were dealt with. This research also covers the efficient usage of the poultry litter in agricultural practices.

**Keywords:** Agriculture; eutrophication; manure nutrient management; poultry litter; water quality

### INTRODUCTION

Manure is known by many names, some find it defensive for crops, and others regard it as brown gold, a valuable soil builder in plant fertilizing. For those who use it, manure has become a valuable commodity. Farmers use even satellite technology for manure application. Science, various methods, and emerging equipment have made manure management a high tech business. Farmers need to learn how to make manure more effective and farms more profitable. Industry professionals and educators need to show the latest in technology to protect the environment and cut costs.

Manure is at the end and beginning of the nitrogen cycle (Maeda et al., 2011). Cattle, swine and other animals feed on corn, soybeans and pre mixes of phosphorus, iron and other minerals and vitamins essential for growth. The animals then convert feed into manure rich in nitrogen, phosphorus, potassium and other nutrients beneficial to soil biology. Today, Turkish livestock and poultry farming potential is high enough for supplying demanded fertilizer for cultivated lands throughout the country. Which is used to grow corn, soybeans and other crops for another group of animals as the cycle begins again.

Crops need nutrients to grow, after crop harvest and before the next growing season, those nutrients which were depleted in the soil from the previous season need to be replenished (Torstensson et al., 2006). Until recently many growers gravitated to commercial fertilizers when they are placing nitrogen, phosphorus, potassium and other nutrients in the soil. Benefits of manure are no longer ignored. There is so much demand in fact that some farmers who have animals but no cropland can sell manure to farmers who only raise crops and need fertilizer. Why spend scads of money on what's technically a waste product. The soil productivity can be identified by observing crops on field. Edmedes (2003) observed growth of two crops; one was grown without manure, and the other was enriched with a manure. The productivity of the soil is higher if the manure is used (Edmeades, 2003; Hass et al., 2012). Manure is also a cheap option when high fertilizer prizes are considered. What happens below the soil makes calculating the worth of manure even more difficult because manure improves soil quality and soil structure. Manure makes the soil system works for us during agricultural process. It means better water infiltration, less runoff and less erosion. This means more precipitation and irrigation stays in the soil for the crop production and with less runoff pure nutrients rich surface water. That is if the manure is applied correctly.

### MATERIALS and METHODS

Livestock breeding is widespread in whole watersheds of Turkey. Besides cattle and sheep/goat breeding, poultry is among the major activities, as well. In the existing situation, the annual animal numbers are being increased steeply according to the Ministry of Agriculture (Tan et al., 2015). The information recommended to be registered together with the number of animals, and other issues which should be taken into consideration are listed below:

- 
- Shelter sizes and sheltering conditions,
  - Number of animals in the shelters,
  - Breeding and sheltering processes according to regarding animal types,
  - Analyzing the fodders and medications used in animal breeding, and their suitability,
  - Warning the farmers or producers for misapplications,
  - Applying animal manure in control as natural fertilizer, after waiting under appropriate conditions for a while following its collection,
  - Taking the mobility of animals under control for collecting the manure easily,
  - Keeping the animals far especially from the wetlands and stream banks during grazing,
  - Constraining the contact of farms with its vicinity as much as possible by digging ditches, and reducing the amount of animal waste reaching to its vicinity and ultimately to the receiving media, especially with surface run-off,
  - Conducting poultry in closed places as limited by the regulations,
  - Providing regular conditions in the shelters,
  - Taking care of the limitations in animal breeding.

Agriculture and livestock operations are considered to be an important source of N, P (Hoorman, 2008). Improper disposal of the large amount of excreta from the livestock and poultry could be a risk to the environment (Gerber et al., 2005). Pollution control in the traditional sense can be described as shifting from small scale husbandry to the large scale livestock and poultry farming units (Gu et al., 2008).

Nutrient management plan (NMP) helps manure applicators determine the correct amount of manure to distribute over a field, first by understanding the soil composition (Sharpley et al., 2012). Soil testing not only shows which nutrients various soils need but also to what extent. Crops need certain nutrients such as nitrogen to grow, however too much nitrogen will be detrimental to crops and the environment. Farmers have to use manure examples to determine how much and what nutrients are available in the manure.

Poultry litter can be used for the agricultural purposes. Turkey is one of the top five poultry producing countries in the world and poultry is currently Turkey's number one agricultural commodity. This growing industry offers numerous economic benefits. But along with the benefits, comes to concern proper waste utilization. Poultry litter a kind of mixture consists of the poultry manure mixed and some of the bedding material. Currently estimates indicate annual litter production behind the Turkey's broiler industry is approximately hundreds of thousands tonnes (Dalkilic and Ugurlu, 2013). Biogas and electricity production using litter is now a common practice for Turkey and it is applied by many municipalities (Topal and Arslan, 2008).

Litter removal rates vary depending on broilers. But all litter must be removed at regular intervals. Hence waste utilization can become a concern for producers. The good news is this litter is an excellent fertilizer. Spreading litter on pastures is a common farming practice but the application of litter requires proper management to lessen environmental concerns. Poultry litter is a mixture of pine shavings, bedding material and poultry manure. The litter contains nitrogen, phosphorus and potassium which are valuable fertilizer nutrients. Pullet, breeder and broiler operations produce litter that has different fertilizer values. These variances are the result of the diet and the shavings to manure ratio and the number of birds grown between litter removals. The best way to determine the fertilizer value of the poultry litter is to take a litter sample (Hass et al., 2012). The sample must be representative of all the litter in poultry house, not just one small area. It should be taken close to the time of application. Random samples should be taken throughout the poultry house.

It is possible to limit the environmental side effects of an agricultural poultry litter application. Storage of dry waste is often necessary. Storage facilities allow farmers to use the litter to meet the crops' nutrient requirements at the time it is needed. A permanent structure often called a dry stack is the best method for storing litter and avoiding runoff. If there is no permanent structure, litter may be stored outdoors in a well drained area away from flood plains and other water bodies. The pile should be protected from runoff by a diversion to prevent leaching. Overheating can be prevented by keeping piles less than 1 – 4 meters deep and waste stored more than six days has to be completely covered by a water proof plastic to prevent fly breeding (Graham et al., 2009). Proper storage is also important for composting dead birds. Composting is a controlled natural process in which organic wastes are transformed by beneficial microorganisms into useful soil additives. Proper poultry composting is achieved by placing the poultry carcasses in the compost bin along with cake litter removed from

the poultry house. Microorganisms will then transform the poultry carcasses into rich organic matter. Just like poultry litter, the compost can be applied to fields as fertilizer.

Best management practices are applied to prevent diffuse pollution. The major sources of diffuse pollution are; commercial fertilizers and residual pesticides from agricultural activities and the uncontrolled use of manure from livestock breeding, reaching to the receiving water body through surface run-off and/or infiltration. Diffuse pollution should better be monitored on land rather than in water. The nutrient analysis of the compost should be obtained from a lab before applying it to fields. Lab results from the compost and litter samples indicate nutrient values along with the soil test from the field indicates nutrient requirements. This information is used to apply poultry litter to the pasture. Use of best management practices (BMPs) is critical at this time. Began by making sure application equipment is properly calibrated. This will ensure accurate and even distribution of the litter. Also the weather forecast must be checked before applying litter since heavy rains can cause runoff and transport nutrients to surface water.

## RESULTS and DISCUSSION

A wide range of research about the diffused pollution resources in Black Sea is a good example to see the potential of poultry manure production. Data about livestock number in whole country was gathered from Government Statistics Institute of Turkey. It was used to find the recent estimates about manure production. This research shows that it is too high and very close to excreted manure from the dairy cattle. Data for livestock farming in coastal administration areas, along the Black Sea, has been given for beef cattle, dairy cattle, sheep-goats, and poultry. Data for manure production and total nitrogen (TN) total phosphorus (TP) production; biochemical oxygen demand (BOD); and chemical oxygen demand (COD) are given in ton/y, and ton. Total livestock nutrients in coastal administrative areas of the Black Sea (GEF, 2007) and in 2011 values for whole Turkey (TurkStat, 2011) are given in Table 1.

In traditional livestock breeding, the first priority is having the maximum amount and economic production per unit area; thus, ecological balance and health criteria in product quality, and environmental pollution takes the second place. Organic livestock production is being promoted within the last years. Principles of Organic Agriculture and its Application Regulation, dated on October 17, 2006 and No: 26322 (Anonymous, 2014), includes the details of the required applications.

This regulation states the ages of the animals, and transfer process regarding the animal type and efficiency, which will be transferred from traditional enterprises to form organic herd, status of the shelters, area required for each animal type, breeding and feeding of animals, use of water and fodder, the additives to be included into the fodders. Besides, it gives information as a guide for the collection of manure, waiting conditions and applicability as fertilizer.

Usually litter meets the nitrogen requirements of the field, however there is probably over application of phosphorus. This is where environmental problems may occur. Phosphorus normally moves very little in the soil but it does move with the soil. When rainfall carries sediment from a field to surface water, phosphorus is transported with the sediment particles. The increased supply of phosphorus in the water fosters the growth of undesirable species such as algae. This undesirable species deplete the oxygen level of the water and decrease its ability to support life. This situation is called eutrophication and it is tremendously hazardous to habitat in water body (Akkoyunlu and Akiner, 2010).

The lab report provides a detailed explanation of the nutrient value of the poultry litter. In addition to a litter sample it is also needed to determine the soil characteristics of the fields where it is planned to apply the litter. A good soil testing system will help to avoid over application of poultry litter. This is important because the litter has a high phosphorus and nitrogen ratio.

Litter should not be applied to wet soil. This will help avoid runoff and soil compaction. Wind direction should be taken into account, this can help to control odor when applying animal waste. Mid to late morning application usually reduces the spread of odors because the air is more likely to be rising. It should not be applied to the pasture grasses during germination and seedling stages. The best time for application is after a hay harvest (Eghball and Power, 1999).

**Table 1. Total Livestock nutrient/organic load in coastal administrative areas in Black Sea region and in whole Turkey (only for 2011).**

Category	Year	Total Number	Total Manure ton/y	Total Nutrient/organic load			
				ton			
				TN	TP	BOD	COD
Beef Cattle (Domestic +Cultured)	1988	4,301,641	15,898,422	120,828	71,543	188,794	660,778
	1997	3,492,474	14,181,310	107,778	63,816	168,403	168,403
	2004	2,653,102	1,197,997	84,345	49,941	131,789	131,789
	2011 (Whole Turkey)	9,957,168	36,800,667	279,717	165,622	437,058	1,529,701
Dairy Cattle	1988	1,244,756	3,236,366	16,182	11,651	25,284	88,494
	1997	1,131,134	2,940,949	14,705	10,587	22,976	80,417
	2004	859,280	2,234,129	11,171	8,043	17,454	61,089
	2011 (Whole Turkey)	2,429,169	6,317,386	31,587	22,743	49,354	172,740
Sheep-Goat	1988	13,226,460	7,935,876	43,647	24,601	68,199	238,696
	1997	7,494,474	4,496,684	24,732	13,940	38,643	135,252
	2004	4,544,480	2,726,688	14,997	8,453	23,432	82,014
	2011 (Whole Turkey)	32,158,427	19,292,115	106,107	59,805	165,792	580,270
Poultry	1988	16,282,962	325,659	4,559	2,931	7,124	24,933
	1997	60,078,918	1,201,578	16,822	10,814	26,285	91,996
	2004	110,116,511	2,202,330	30,833	19,821	48,176	168,616
	2011 (Whole Turkey)	237,873,469	4,757,552	66,606	42,818	104,072	364,250

Water quality is protected by maintaining a vegetative buffer zone between waterways and application areas. This helps to prevent animal waste pollutants from being washed into ponds and streams. Air quality can be protected by maintaining vegetative screens. This screen should consist of grasses, tall shrubs and rapidly maturing trees.

## CONCLUSION

The manure sampling analysis and application components of a manure nutrient management were discussed. It is important to review current situation to make sure that manure nutrient being properly accounted for. Accurate application rates, proper timing ensure the manure nutrients are adequate for crop growth and reduce the risk of over application that can lead negative impacts over water quality. Utilizing low disturbance equipment can improve the quality of a soil while leaving high level of residue on a soil surface. Residue protects the soil erosion which keeps nutrients in the field when they are needed for crop growth. Findings in the application rates, methods, and timing can potentially reduce the input costs while maintaining crop yields. As the livestock and poultry industry continues to grow in Turkey the need for proper management of waste products becomes increasingly important. Implementation of BMPs is a simple, economical, common sense method ensuring the poultry waste is properly managed and the environment is protected. Hence, with the application of appropriate BMPs, Turkey's livestock and poultry industry can become both an economic and an environmental success. A well thought manure nutrient management program can keep excess nutrients and sediments out of rivers, streams and lakes.

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## A PRELIMINARY SURVEY OF PUBLIC WILLINGNESS AND ACCEPTANCE OF SEGREGATION AND USE OF HUMAN-URINE AS FERTILIZER IN TURKEY

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### SUMMARY

Nitrogen, phosphorus and potassium constitute the main ingredients of fertilizers which are essential for plant growth. Interestingly, these elements are the main constituents of human urine. Studies have shown that the potential of global urine production is equivalent to about one third of the global fertilizer use and one person's urine is sufficient to produce 200 kg cereals annually. Due to its rich nutrient content, reuse of urine as fertilizer has been suggested.

Considering that public acceptance/willingness is a key parameter for adoption of any reuse option, this preliminary survey presents an attempt for investigation of attitudes towards using human urine as fertilizer and aims to gain insight about the willingness/acceptance of Turkish people for this practice. The survey was intended to identify and assess trends concerning the willingness/acceptance to use plants fertilized with direct and/or indirect use of human urine, and to investigate motivations/obstacles for Urine Diversion Toilets (UDT) which will provide this separation.

The survey was run on 434 Turkish citizens, who were asked about the direct and indirect use of human urine (i) for growing various types of plants as food stuff including those which are consumed raw and after cooking, (ii) in green areas and for landscape purposes, as well as their opinion on urine diversion and use of urine diverting toilets (UDT).

The results showed that 89% of the respondents had no objection to urine segregation and to the use of UDT's provided that they get funding. In general acceptance/willingness for indirect use of human urine as fertilizer received a higher preference over direct use; landscape/green area applications over food stuff; and cooked food stuff over uncooked ones. All in all, the attitude of people surveyed in this preliminary work did not discourage further attempts regarding urine segregation and its use as fertilizer. These results were interpreted as being motivating for further efforts of reusing the fertilizing potential hidden in urine.

**Keywords:** human urine/yellow water, nutrients, fertilizers, urine diversion toilets, public opinion/acceptance, segregated streams of domestic wastewater

### INTRODUCTION

Fertilizer production is an industrial activity, which exploits a number of material inputs and energy, which includes non-renewable resources like phosphorus. Currently, more than half of the world's mined phosphate rock is used for fertilizer production. Peak phosphorus production is expected in the next 40 years after which phosphorus production will decline [1].

Recently, application of human urine as fertilizer has gained attention. Using urine as fertilizer is a promising alternative for mineral/chemical fertilizer production, which will lead to a sustainable future.

Human urine constitutes only about 1% of domestic wastewater but contains majority of nutrients with 80% nitrogen(N), over 50% phosphorus(P), and potassium(K) [2]. One of its constituents, ammonium, is a direct plant-available fertilizer. Studies have shown that the potential of global urine production is equivalent to 1/3 of global total fertilizer use [3] while urine excreted by one person on an annual basis contains enough NPK to produce about 200 kg of cereals.

Source separation of urine at the point of generation is a feasible method of recycling these nutrients. Urine Diverting Toilets(UDT) are used for the separation. The German Agency for International Cooperation(GIZ) estimates that there are about 2.81 million users of UDTs worldwide [4]. Currently, urine collection with UDTs is unfamiliar in Turkey, however its adaptation will be beneficial.

Public acceptance, reaction and willingness are key factors to apply any new system. Without understanding people's concerns and attitudes, it is difficult to practice urine/urine-based fertilizer on soil and new sanitation concepts like UDTs. A survey undertaken in Switzerland had shown that farmers accepted the use of urine as fertilizer as a good/very good idea with 57% for 125 participating farmers [5]. In another Swiss survey, 72% of consumers thought they would eat vegetables fertilized with urine, and 80% of participants had a preference for vegetables fertilized with urine over synthetic fertilizers [6]. Similarly, in Indonesia, 80% of participating farmers were willing to use urine and feces-based fertilizer on crops but only 40% of them were eager to inform their customers about the type of the fertilizer used [7].

This preliminary survey presents an attempt for investigation of attitudes towards using human urine as fertilizer in Turkey and aims to gain insight about the willingness/acceptance of Turkish people for this practice.

## METHODOLOGY

The survey was intended to identify and assess trends concerning the willingness/acceptance to use crops fertilized with direct and/or indirect use of human urine as fertilizer, and to investigate motivations/obstacles for using UDT in Turkey on a preliminary basis. The survey consists of three sections; i) part one basic demographic data, ii) part two attitudes of people regarding use of urine as fertilizer and iii) part three opinions about UDTs, to unfold the willingness of people to collect urine separately to be used as fertilizer.

The survey was conducted through face-to-face and internet questionnaires. 434 people participated in the survey, and majority of participants was adults over 20 years of age living in Turkey. Most of them were living in an urban area, some of them having connection with rural areas. The participants were from different cities of Turkey, educational backgrounds and occupations. Particularly, participants were asked for their preference between usage of natural fertilizers versus synthetic fertilizers; acceptance of urine as fertilizer; direct use versus indirect use, and acceptance of application on different types of plants and landscapes/green areas, and finally about acceptance and willingness to use UDTs.

Most of the questions were in multiple-choice format, which requested respondents to choose the most appropriate answer. Besides, some questions allowed participants to write their own ideas and comments. No information about urine-based fertilizers and UDTs were given, so that participants could make decisions based on their existing knowledge on urine, environmental pollution and sustainability.

The analysis of this preliminary survey was based on results as simple head counts and their respective percentages.

## RESULTS AND DISCUSSION

### Demographic Data:

Demographic data were collected to describe the respondents. In total, there were 434 respondents who were Turkish citizens. 20%, 88 of them were surveyed face to face, while 80%, 348, were filled out through the internet. The results of the survey showed that most of the respondents were female with 58% or 250 respondents, while the rest 42% or 184 respondents were male. The largest fraction of the respondents was between 20-25 years old age with 40% or 173 respondents. The respondents have high level education, 57% undergraduate and 34% graduate degrees. The occupations of the respondents were widely spread but largest groups of the respondents were engineers with 35.7%. Particularly, 53% of the engineers were environmental engineers.

The entire demographic data is summarized in Table 1. It may be observed that the profile of the respondents demonstrate a broad spread. Specifically, the great majority of the respondents were highly educated, which is not the most typical profile of Turkish citizens in general, and young. As such, to a large extent, the survey presents acceptance of highly educated young people's attitudes over this new approach and recycling/reuse of a conventionally wasted resource, i.e. domestic wastewater/human urine.

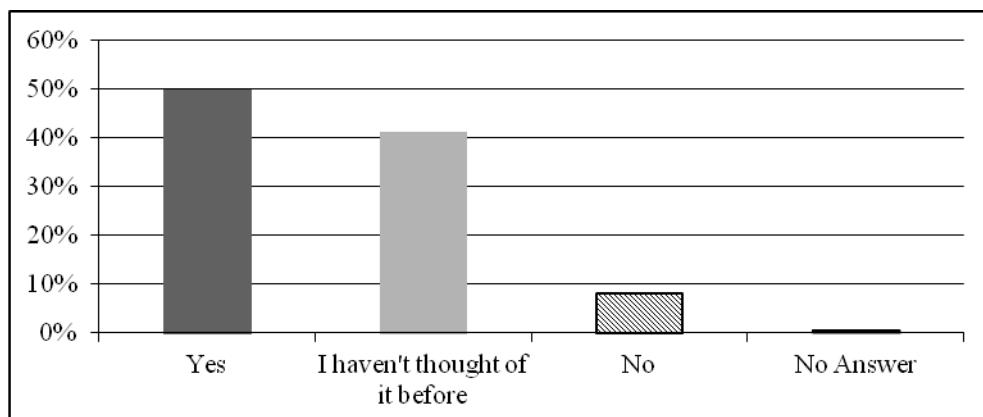
**Table 1 Demographic Data (434 respondents in total)**

		Counts	%
<b>Survey Type</b>			
	<b>Face to face</b>	86	19.8
	<b>Internet</b>	348	80.2
<b>Gender</b>			
	<b>Female</b>	250	42.4
	<b>Male</b>	184	57.6
<b>Age (years)</b>			
	<b>Less than 20</b>	12	2.8
	<b>20-25</b>	173	39.9
	<b>25-30</b>	152	35
	<b>30-40</b>	75	17.3
	<b>40-50</b>	10	2.3
	<b>More than 50</b>	11	2.5
<b>Education (degrees received)</b>			
	<b>Primary School</b>	3	0.7
	<b>Secondary School</b>	2	0.5
	<b>High School</b>	28	6.5
	<b>Undergraduate</b>	248	57.1
	<b>Graduate</b>	148	34.1
<b>Occupation</b>			
	<b>Academician</b>	10	2.3
	<b>Housewife</b>	14	3.2
	<b>Teacher</b>	17	3.9
	<b>Business &amp;Finance</b>	19	4.3
	<b>No Answer</b>	37	8.5
	<b>Environmental Engineers</b>	82	18.8
	<b>Students</b>	115	26.4
	<b>Engineers</b>	155	35.7

#### Urine as Fertilizer:

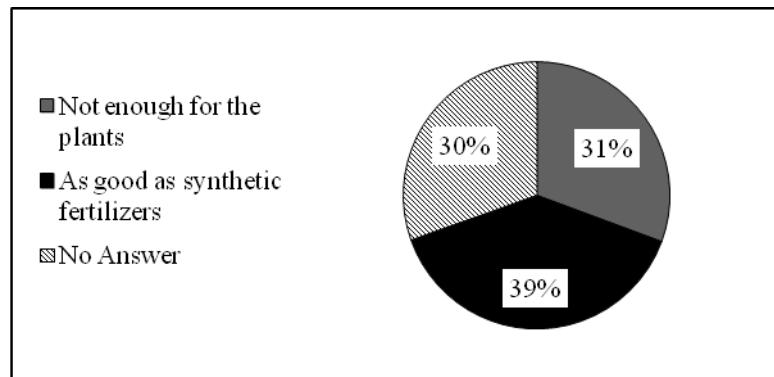
In this section, the main concern was to find out the tendency of the participants towards the use of human urine as fertilizer. The majority of the respondents supported the use of natural fertilizers instead of using synthetic ones. 96% of respondents said they would prefer using natural fertilizer over synthetic ones.

The first focus of the questionnaire was to find out whether people think human urine can be used as fertilizer. According the results shown in ts revealed that only 13% of the , 50% of the respondents thought that human urine can be used as a fertilizer. Only 8% thought the use of urine, as fertilizer should not be exercised for that purpose.



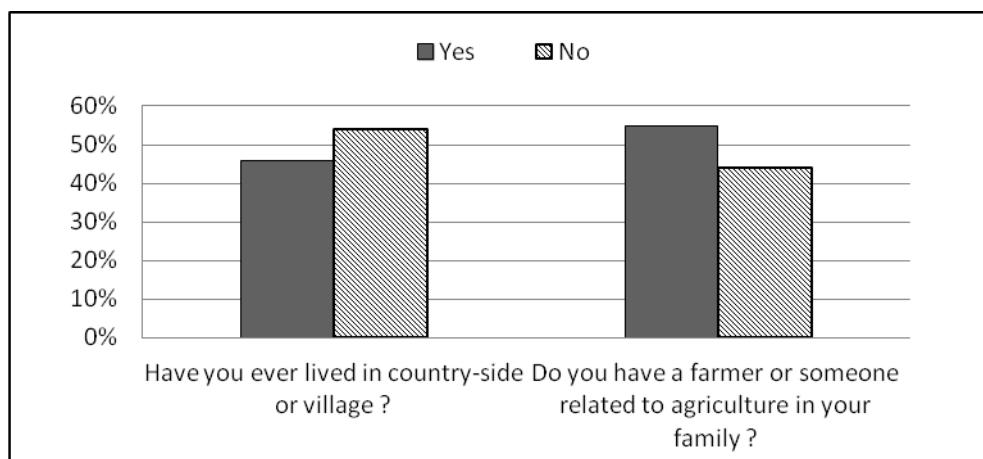
**Figure 1.** Human urine as fertilizer

espondents have relatives involve shows that 39% of the respondents think that human urine could be as good as synthetic fertilizers. However, 31% of them think it would not be sufficient for plants.



**Figure 2.** Fertilizer potential of human urine

As human urine has been used as fertilizer since ancient times, exposure to rural areas and agriculture practices was thought to impact the acceptance level. For this reason, it was thought that it was important to find out if participants have ever lived in a country-side or a village, or if they have connection to a farmer/farming. However the survey results revealed that only 13% of the people who have once lived in a country-side found direct use of human urine safe. As shown in use of processed urine, which occurs, 54% of the all respondents have never lived in a country-side or a village. Nevertheless, 55% of all respondents have relatives involved with agriculture or farming. This ratio was higher than expected considering that most of the participants were from urban area and highly educated. Only 12% of the respondents who have connection with farming/agriculture found direct use of human urine safe. This was not in line with expectations.



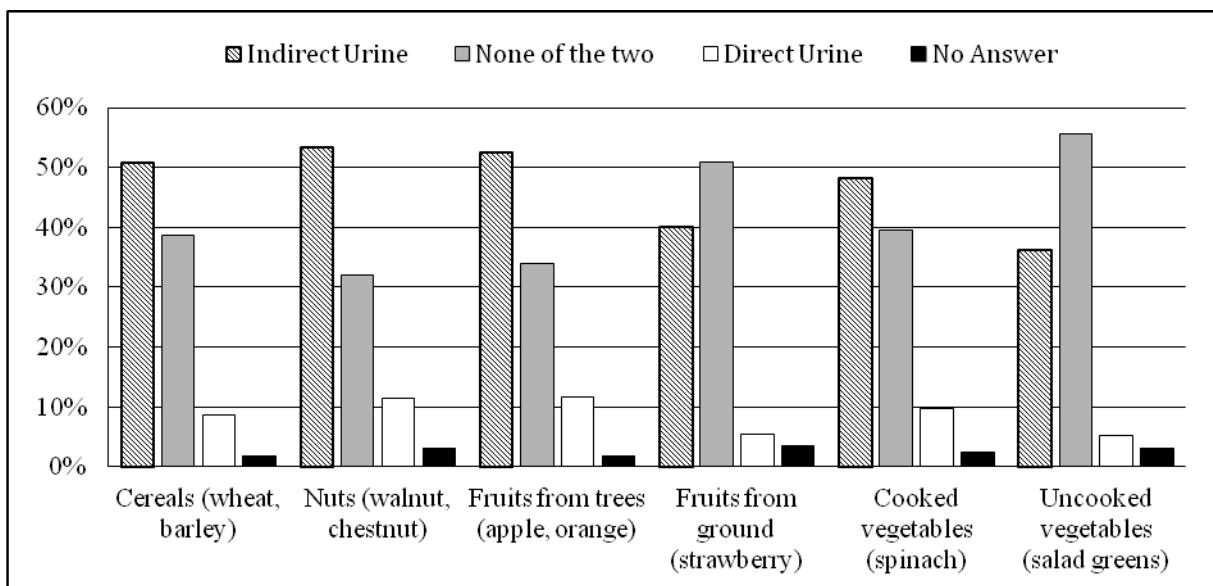
**Figure 3.** Living in country-side or village

Another issue which was investigated through the questionnaire was hygienic concerns. Respondents were asked about their idea concerning the safety of applying urine onto soil. The results are shown in 53%, 40%, 48% and 36%, respectively. 14% of the respondents found direct use of urine 'safe' while this number was 48% for indirect use. 43% of them did not find using urine directly safe at all. 'Not safe at all' opinion decreased to 10% for indirect use of urine. The greatest percentage of respondents found human urine (both direct and indirect use) safer than synthetic fertilizer with 41%. These results indicate that the use of processed urine, which occurs in the case of indirect use, makes people feel much safer than direct application which does not receive any processing.



**Figure 4.** Applying urine directly or indirectly to the soil

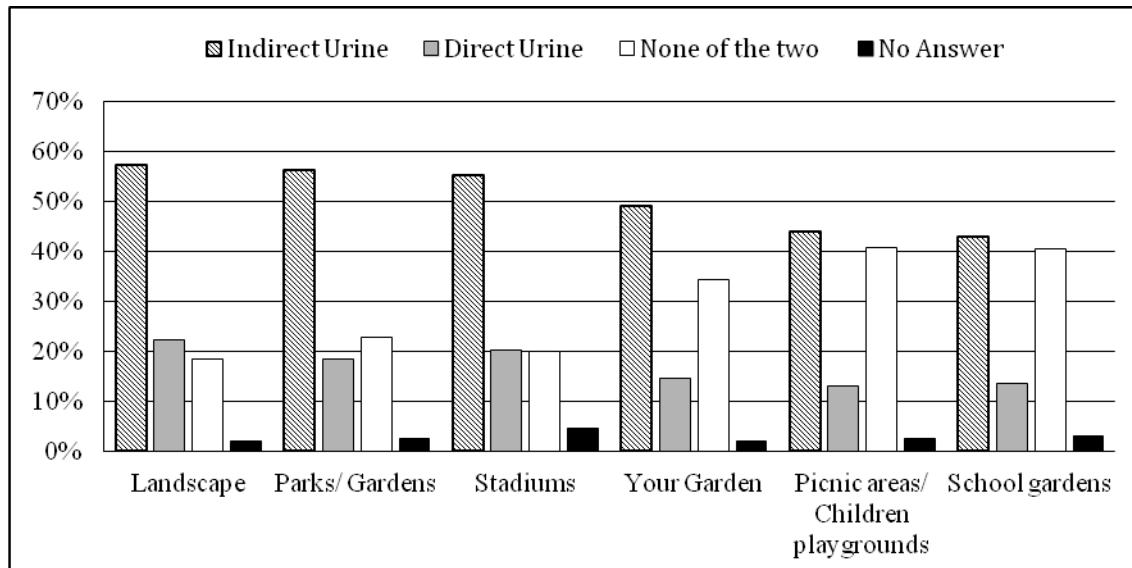
Acceptance of direct and indirect use of human urine for consuming different types of food such as cereals, nuts, fruits from trees, fruits from ground, cooked vegetables and uncooked vegetables were also investigated. Different types of foods were chosen to observe how people's attitudes will change with the changing proximity of urine-based fertilizer to the food products. Considering the entire set of products, the maximum level of acceptance of direct use of human urine was 12% whereas, indirect use for cereals, nuts, fruits from trees, fruits from ground, cooked vegetables and non-cooked vegetables was 51%, 53%, 53%, 40%, 48% and 36%, respectively. As expected, the level of acceptance decreases with the higher levels of possible urine contact with food such as fruits from ground. Likewise the level of acceptance for application on non-cooked vegetables was lower as compared to cooked ones due to higher bacteriological risks associated with the former. Of the participants, 51% did not approve any kind of urine based fertilizer use for fruits from grounds like strawberries and this ratio was 56% for uncooked vegetables as salad greens. Approval of any kind of urine shows that indirect use of urine as fertilizer received the highest level of acceptance. Under all circumstances, indirect use received considerable acceptance and was accepted by far more than direct use. The largest percent of respondents indicated that they would prefer not to use either type of urine based application for uncooked vegetables and fruits from ground.



**Figure 5.** Application of urine on different food types

Agricultural/fertilizer potential of human urine can be used not only for agricultural purposes but also for landscape/green areas. For this reason, the acceptance of respondents regarding direct/indirect use of urine for

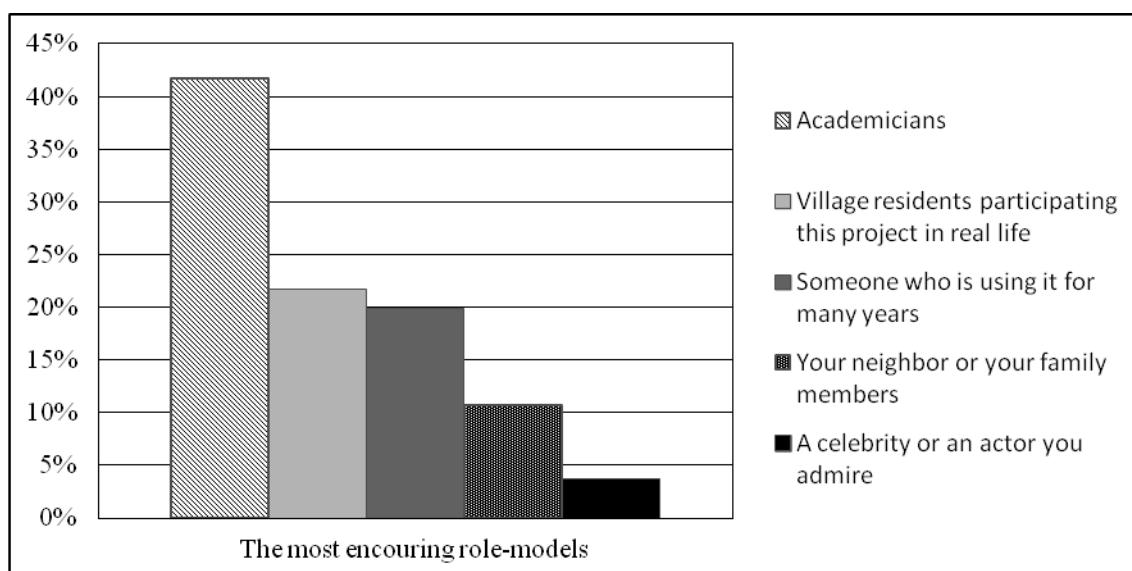
different green areas such as landscapes, parks, stadiums, home gardens, picnic areas/playgrounds and school gardens were additionally questioned. Indirect urine usage had the higher percentages than direct application as expected. For all cases, acceptance was higher than 44% for indirect use as shown in ants were asked to choose the best. However, 34%, 41% and 41% of the respondents did not approve of any kind of urine based fertilizer at picnic areas/playgrounds, school gardens and home gardens, respectively. Furthermore, that acceptance of direct use of human urine was at most 22% which belongs to landscape areas.



**Figure 6.** Application of urine on different green areas

Another question in this study was directed towards finding out how participant's attitude to wearing a cotton dress manufactured from urine fertilized farm. According to the results, 64% of the respondents answered as 'Yes' while, 34% of all did not find this idea appealing. Acceptance level of the question is much higher than all food types and landscape areas. This high ratio can be a starting point for reuse of human urine for non-edible industrial products as exemplified by cotton.

Reuse of human wastes as 'resource' including human urine is a new idea for Turkey that needs to be encouraged. Within this context participants were asked to choose the best role models/people that will influence their attitudes positively. As illustrated in ed the use of UDTs. This level of, 'Academicians' received the highest percentage with 42% and 'Celebrities' the lowest with 4%.



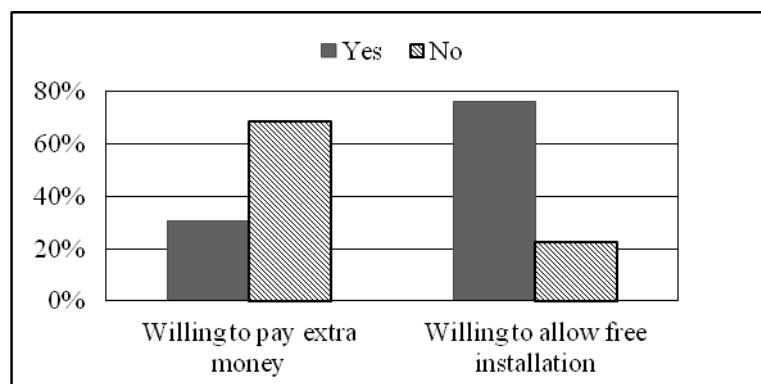
**Figure 7.** The most encouraging role-models for using human urine as fertilizer

Segregation of urine and UDT's:

Questions about urine collection are focused on understanding 'if people can imagine urine separation', 'their level of acceptance and willingness to use it', 'their borders and barriers to apply this installation in practice' and 'if there are any other specified problems for Turkey'. 80.4% of the respondents answered the question 'Do you think urine can be collected separately to make fertilizer out of it?' positively. This is considered as a high ratio that represents people think it can be done. The results have further revealed that 80.6% of the respondents accepted the use of UDTs. This level of acceptance was higher than expected.

The willingness of the use of UDTs was 57% in public areas and 42% at home. People seem to have a tendency to use it in public than in their own homes. There was one question which asked their willingness to change their toilets with UDTs. 29% of the respondents answered it as 'Yes' without any further comments while 27% as 'If I am obliged to' and only 9% of the respondents answered as 'Never'. This means over 90% of the respondents were not against using UDTs.

The most interesting point regarding UDTs was the willingness to pay money for these toilets. The idea of paying extra money for the installation of a UDT was rejected by 69% of the participants. However, when the question was asked as 'Would you allow a UDT to be installed at your home for free?' acceptance raised to 76% as demonstrated in could be a problem. Among those . These numbers illustrate how the financing/funding of this new technology is linked with the acceptance level.



**Figure 8.** Paying extra money for UDT installation

Driving forces for acceptance of UDTs were listed as: UDTs are environmental friendly with 49 % followed by eagerness for trying a new system with 21% and water saving properties with 20%. Actually, the respondents were not informed about UDTs before the survey.

31% and 20% of the respondents found unfamiliarity of these toilets and complicated mechanism/non practical use as the main discouraging factors to use UDTs, respectively. Respondents were also given a chance to write their comments/concerns, they stated that they would not be sure about hygienic conditions and cleanliness of these toilets. Some stated that anal cleansig could be a problem. Among those who made comments, the frequently stated issue was religious concerns. This was also previously indicated in other Muslim countries as was addressed in Uddin et al., (2014) [8], Drangert et al., (2011)[9] and Wilson et al., (2008) [10].

## CONCLUSION

This preliminary survey provides an idea about Turkish people's attitudes towards the use of human urine as fertilizer and urine separation. As the concept is brand new in Turkey, there are no reports on perception/acceptance regarding this subject matter. This piece of work is a preliminary and simple investigation to get a first picture about public perception.

The results showed that 89% of the respondents had no objection to urine segregation and use of UDT's provided that they get funding. In general acceptance/willingness for indirect use of human urine as fertilizer received a higher preference over direct use: landscape/green area applications over food stuff; and cooked food stuff over uncooked ones. All in all, the attitude of people surveyed in this preliminary work did not discourage further attempts regarding urine segregation and its use as fertilizer. These results were interpreted as being motivating for further efforts of reusing the fertilizing potential hidden in urine. A more comprehensive and systematic survey is surely recommended to get refined results on the subject matter.

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## AIR POLLUTION PROBLEM IN ERZURUM CITY DURING 2014-2015

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### ABSTRACT

Erzurum where is one of the highest and the coldest city of Turkey has a harsh continental climate. Climate conditions usually last as freezing cold and snowy in winters and hot and dry in summers. For this reason in Erzurum during the winter months air pollution originated from heating reaches high values by the effects of city topography with bowl-shaped, irregular urbanization and meteorological factors. In this study, during 2014-2015 winter period, air pollution level in terms of SO<sub>2</sub> and particulate matter parameters were examined in the city center of Erzurum and the results were evaluated. Data for the period of 2014 October-2015 April were taken from Ministry of Environmental and Urbanization Air Quality Monitoring Station which is located at the city center and compared with the air quality values prescribed by Air Quality Assessment and Management Regulation, the World Health Organization and Environmental Protection Agency.

**Keywords:** Erzurum, air pollution, SO<sub>2</sub>, particulate matter

### INTRODUCTION

The scale of air pollution has rapidly increased with technological developments and the use of fossil fuels especially. Air pollution basically occurs due to natural sources like volcanic eruptions and forest fires and artificial sources linked to human activity (Peker, 2011).

A broad definition of air pollution is one or more types of pollutants in open air outside buildings at amounts that harm human, plant and animal life, trade or personal possessions and environmental quality for longer than a certain period (Müezzinoğlu, 2000). Many factors play a role in air pollution. Among these factors, human effects take first place.

### AIR POLLUTANTS

Air pollutants from domestic heating, transport and a variety of industrial sources have a range of negative effects on human health and environmental quality. The classic air pollutants dispersed into the atmosphere as a result of these activities, like sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), hydrocarbons (HC) and particulate matter (PM), form a significant portion of air pollution (Müezzinoğlu, 2000; Finlayson-Pitts and Pitts, 1986; Çiçek et al., 2004; Erbaşlar and Taşdemir, 2007). Pollutants may be classified in 4 groups as;

- Gas pollutants (SO<sub>x</sub>, NO<sub>x</sub>, CO, Ozone, Volatile Organic Compounds)
- Persistant organic pollutants (Dioxin/furan, polychlorinated biphenyls)
- Heavy metals
- Particulate matter

In large cities surrounded by industry varying rates of organic and inorganic sourced air pollutants may be found. Among gas pollutants, sulfur oxide, a non-flammable, colorless gas, is among the primary known air pollutants. Its persistence in the atmosphere is 40 days. The majority occurs due to the burning of fossil fuels. It is estimated that more than 80% of anthropogenic sulfur oxides occur due to industrial sources such as chemical plants and metal processing plants and incineration of rubbish. When these emissions are examined globally, the largest portion appears to come from Europe and North America (Iversen et al., 1991; Taşdemir, 2002). Many studies have revealed the close relationship between sulfur dioxide (SO<sub>2</sub>) levels and human health. It is a pollutant that should be focused on due to respiratory tract disorders and causing mortality of people with respiratory tract disorders. As SO<sub>2</sub> is a water-soluble gas, it easily enters blood circulation. This gas irritates the upper respiratory system and lungs in people due to the acid effect and at high concentrations may show effects that are disruptive to health or even deadly. The acid rain caused by sulfur oxides disrupts the balance of the natural environment and in addition to humans, causes great damage to animals, inanimate objects, soil and plant cover, especially. Plant leaves turn yellow, marble structures are eroded; it has a corrosive effect on iron and steel and reduces

visibility and sunlight. Additionally when SO<sub>2</sub> interacts with particulate matter effects are larger and reach more severe scales (Çiçek et al., 2004; Taşdemir, 2002; Elsom, 1987; Ertürk, 1993).

Particulate matter includes the various and complex mix of particles suspended in the air. They form due to natural and anthropogenic activities (Pöschl, 2005). The main sources are factories, energy facilities, incinerators, construction activity, fires and wind. The size of particles varies widely and they may be defined in different categories. Ultra fine particles have an aerodynamic diameter of less than 0.1 μm, fine particles have aerodynamic diameter of less than 1 μm and coarse particles have diameter larger than 1 μm. These particles may accumulate in the respiratory system. To assess the health effects of particulate matter parameters playing an important role are particulate diameter, surface, composition and amount. The composition of particulate matter may be metals, organic compounds, material of biological origin, ions, reactive gases and particulate carbon. Additionally metal, polycyclic aromatic hydrocarbons and other organic compounds within particulate matter may cause toxic effects. Ultra fine and fine particles are more dangerous from the point of view of health compared to coarse particles (Varinca et al., 2008).

## AIR QUALITY MANAGEMENT

The Air Quality Assessment and Management Regulation was published and entered into force on 6 June 2008 in the Official Gazette No. 26898. The aim of the regulation is to prevent or reduce the harmful effects of air pollution on the environment and human health by defining and creating air quality targets, assessing air quality based on defined methods and criteria, preserving the current situation in places with good air quality and improving other situations, gathering sufficient information related to air quality and informing the public through warning thresholds (Anonymous, 2008). This regulation also determines limit values for pollutants that may be released from a variety of sources. The Air Quality Assessment and Management Regulation is used, in accordance with regulations prescribing long-term (LTL) and short term (STL) limit values, to evaluate the results of measurements of pollutants. In accordance with the definition in the regulation, LTL values are those that shall not be exceeded and are the arithmetic mean of all measurement results. STL values are the maximum daily mean values and are defined as the value which ninety-five percent of measurement results shall not exceed when distributed statistically according to the size of the numerical value of all measurement results. For precipitated dust, there are different maximum monthly mean values that shall not be exceeded.

## CURRENT SITUATION in ERZURUM

Erzurum city center is located at an altitude of 1800-2000 m, surrounded by 3200 m mountains. The city, on a flat plane surrounded by mountains, has a topographic formation like a bowl. The topographic structure and geographical location of Erzurum creates an intense continental climate generally. With some of the lowest mean temperatures in Turkey, in Erzurum the winters are long and snowy and the short summers are hot and dry. With winter periods lasting more than 6 months, temperatures fall in October and begin to rise in April. The mean annual temperature is 6 °C with 165 days of temperatures lower than 5 °C, 155 days with frost and 112 days with snow cover. The mean annual rainfall is 460.5 mm with snow fall beginning in October and continuing until May. With heating required during the winter months, effective wind speeds are 2.2 m/s in winter rising to 2.9 m/s in the months not requiring heating. In Erzurum fuel is used for at least 6 months to heat due to the intense winter conditions (Öz and Yılmaz, 2003; Turan and Yalçın Çelik, 2012).

The topographic structure and unplanned urbanization of the city, controlled by many meteorological factors affecting air pollution led by wind, makes dispersion of the air pollutants difficult. Additionally when the long duration of fuel use and traffic in the city are noted, assessment of the air pollution situation in Erzurum is a necessary environmental topic, especially in the winter months. This study arranged SO<sub>2</sub> and PM amounts, measured daily from 1 October 2014 to 30 April 2015 at the Ministry of the Environment and Urban Planning Erzurum Air Quality Monitoring station, according to month to determine variations in concentration. The measurement results were compared with limit values from the Air Quality Assessment and Management Regulation, the World Health Organization (WHO) and the Environmental Protection Agency (EPA) and the current situation of air pollution in Erzurum city in the winter period with high heating fuel use and traffic was evaluated.

## MATERIAL and METHODS

In Erzurum; the air quality measurements are carried out by Ministry of Environment and Urbanization. The data used in this study were taken from Ministry of Environment and Urbanization Air Quality Monitoring Station which is located at the city center. The meteorological data is taken from Erzurum Regional Directorate of Meteorology. Erzurum Air Quality Monitoring Station satellite image is shown Figure 1. Particulate Matter Measurements with BAM 1020 Fully Automatic, Sulfur Dioxide measurements are also measured using Monitor Europe Fully Automatic. Measurement results are monitored by the Ministry. It is also simultaneously published results from [www.havaizleme.gov.tr](http://www.havaizleme.gov.tr) address of Ministry of Environment and Urbanization.



**Figure 1.** Air Quality Monitoring Station Satellite Image

#### MEASUREMENT LOCATION

Erzurum Air Quality Monitoring Station illustrates air pollution caused by traffic and heating. The station is 70 meters distance from the nearest dwelling. The highway is also about 50 meters from the station. The station, from three district in the city center, (Yakutiye, Palandöken and Aziziye), illustrates air pollution in Yakutiye and Palandöken districts. Yakutiye and Palandöken districts are the districts where traffic and population are most intense in Erzurum. Erzurum Air Quality Monitoring Station is positioned between the limits of our two district and illustrates pollution rates of two districts.

#### RESULTS AND DISCUSSION

Air Quality Assessment and Management Regulation was prepared considering 2869896/62/ECC, 99/30/EC, 2000/69/EC, 2002/3/EC, 2004/107/EC directives into account EU membership process of our country and was enacted upon being published on the Official Gazette dated 06/06/2008 and numbered 28698. The air quality limit values for certain pollutants were determined for protection of air quality in regulations. THE air quality limit values of pollutants for The World Health Organization and the European Union (EU) is quite strict. In our country; it aims to reach to EU limit values by decreasing gradually the air quality limit values according to the Air Quality Assessment and Management Regulation and compliance calendar is determined to implement. For 2014 and beyond the reduced rates in these limits, is given in Table 1, No. 2013/37 of Air Quality Assessment and Management Circular published on the Official Gazette 09/09/2013 and numbered 31677. In the Table 1, sulfur dioxide parameters for daily and hourly for the protection of human health, and to protect the ecosystem for the year and winter period, the parameters for particulate matter, on a daily and annual limit values were defined in order to protect human health. Table 2 is also given national and international limit values for sulfur dioxide and particulate matter.

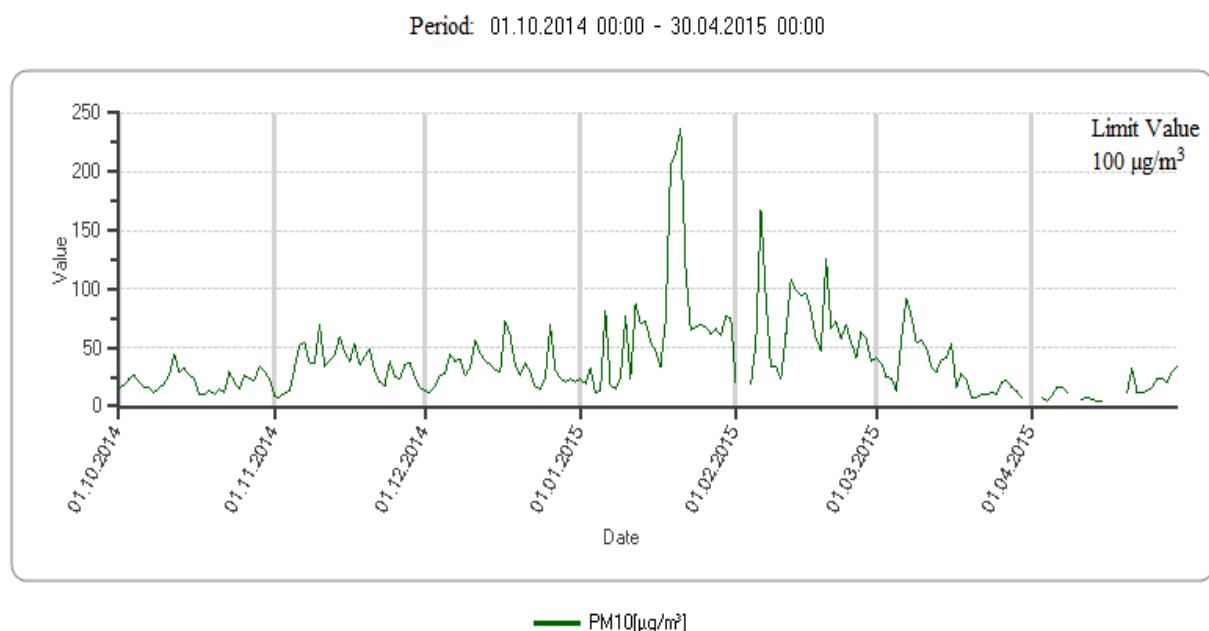
**Table 1. Air Quality Assessment and Management Regulation (AQAMR) Annex 1, gradually reduction in the limit values**

SO <sub>2</sub> μg/m <sup>3</sup>	Hourly (human health)	500	500	470	440	410	380
	Daily (human health)	250	<b>250</b>	225	200	175	150
	Yearly and winter period (ecosystem) (1 October-31 March)	20	20	20	20	20	20
PM10 μg/m <sup>3</sup>	Daily (human health)	100	<b>100</b>	90	80	70	60
	Yearly (human health)	60	60	56	52	48	44

**Table 2. National and international limit values for sulfur dioxide and particulate matter.**

Pollutants	AQAMR		WHO		EPA	
	STL	LTL	STL	LTL	STL	LTL
SO <sub>2</sub> µg/m <sup>3</sup>	400	150	125	50	365	30
PM10 µg/m <sup>3</sup>	300	150	120	-	150	50

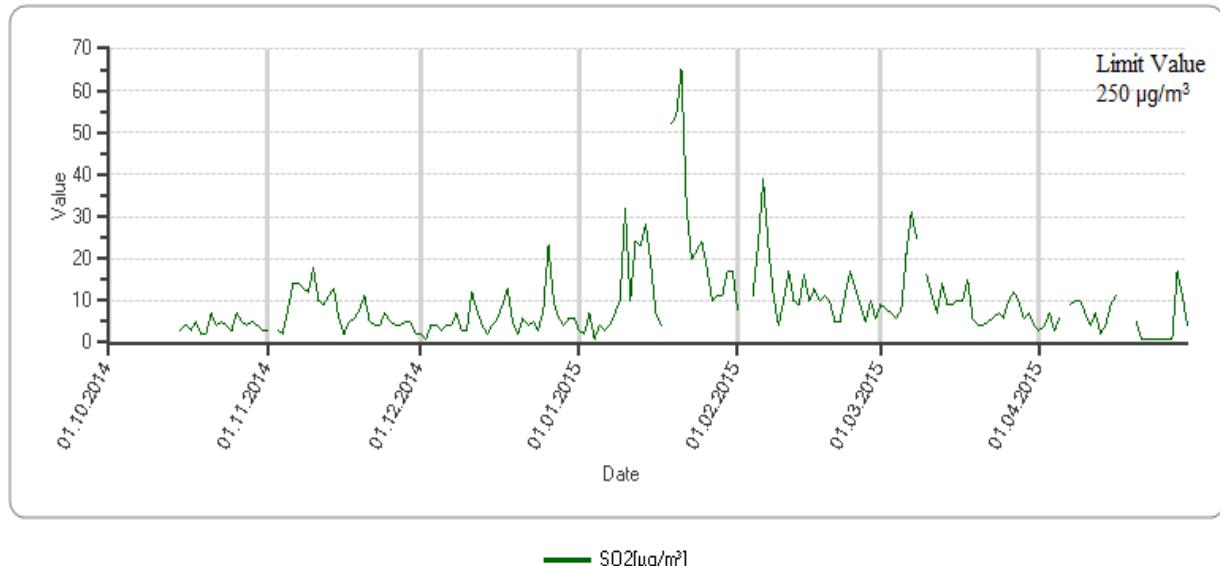
In Erzurum, during 2014–2015 winter season, daily measurement values of particulate matter and SO<sub>2</sub> are shown graphically in Figure 2 and Figure 3, respectively.



**Figure 2.** Particulate matter concentration for 2014–2015 winter season.

Erzurum is one of the cities located in the eastern part of Turkey, situated on a plateau surrounded by mountains. Winters are long and cold. This situation increases usage of fuel for heating purposes in the winter season and air pollution reaches high values. In addition, the use of more fuel in the vehicles during the winter months is one of the factors contributing to the air pollution. As can be seen from Figure 2, the coldest months of Erzurum at winter period, the limit of particulate matter concentration is reached at highest level and it is over. Figure 3 also shows that SO<sub>2</sub> concentrations aren't exceeded the limit values In the coldest days of the year, however, it increases the concentration.

Period: 01.10.2014 00:00 - 30.04.2015 00:00



**Figure 3.** SO<sub>2</sub> concentration for 2014–2015 winter season

During 2014–2015 winter season, monthly average concentration values of air quality parameters and number of day exceeded of the limit values are shown in Table 3. Table 3 shows that average monthly concentration values of SO<sub>2</sub> are not exceeding limit value. However; PM concentration has exceeded the limit level, 4 times in January and 3 times in February.

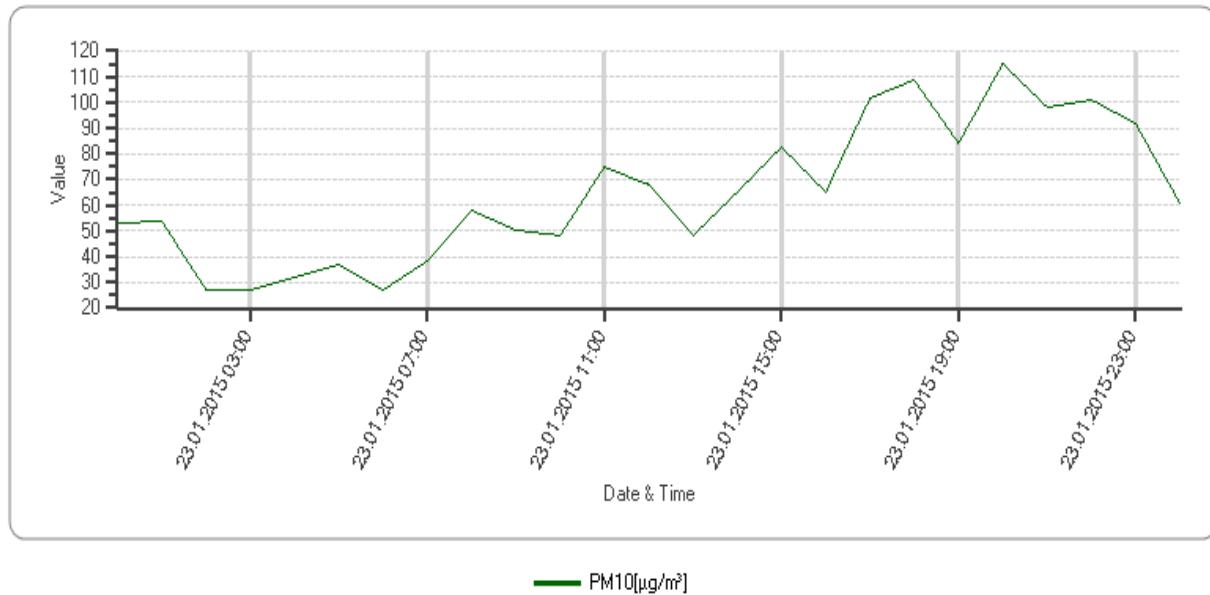
**Table 3. Monthly average concentration values of air quality parameters and the number of day exceeded of the limit values in Erzurum during 2014–2015 winter season.**

Month	PM10 µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	PM 10 number/day	SO <sub>2</sub> number/day
October	21	4	0	0
November	34	7	0	0
December	33	6	0	0
January	70	8	4	0
February	67	12	3	0
March	31	10	0	0
April	15	6	0	0

In Erzurum, in period “23.01.2015 00:00-24.01.2015 00:00”, during 2014–2015 winter season, the hourly measurement values of particulate matter and SO<sub>2</sub> are shown graphically in Figure 4 and Figure 5, respectively.

Figure 4 shows that the air pollution has reached the peak in hours when traffic flow and burning boiler are dense. As can be seen from these figures, then, the peaks drop to normal levels. Therefore, it is determined that air pollution originated from by traffic and heating in Erzurum.

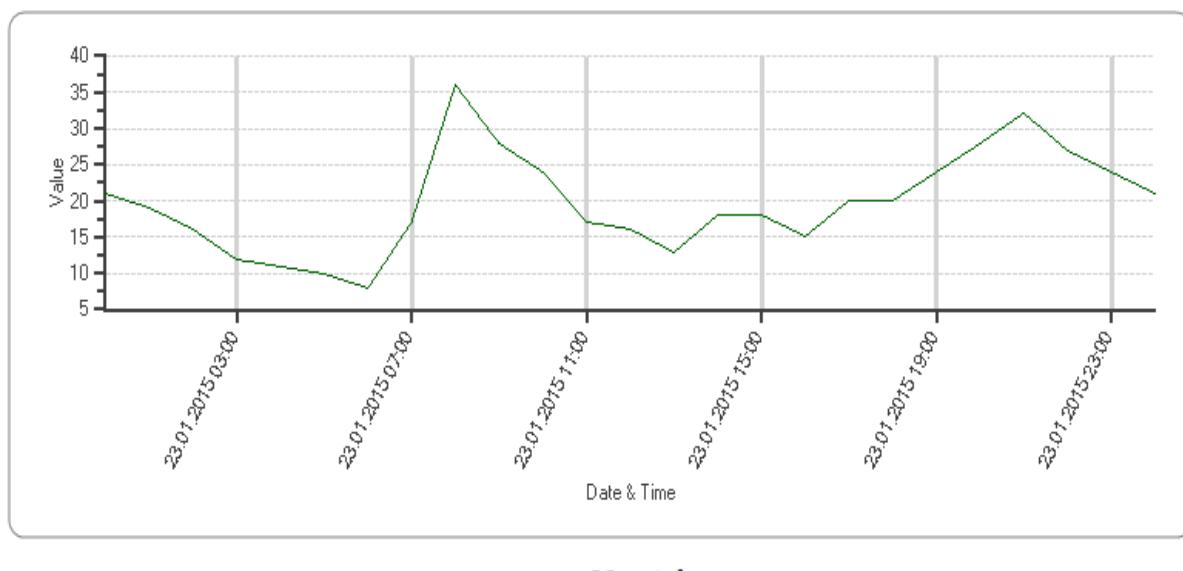
Period: 23.01.2015 00:00 - 24.01.2015 00:00



**Figure 4.** PM10 concentration for 23.01.2015 00:00-24.01.2015 00:00

The pollutants and meteorological data in February are given in Table 4. In Table 4, it is seen that high SO<sub>2</sub> and PM values were measured especially in days with low temperature.

Period: 23.01.2015 00:00 - 24.01.2015 00:00



**Figure 5.** SO<sub>2</sub> concentration for 23.01.2015 00:00-24.01.2015 00:00

**Table 4. The pollutants and meteorological data in February**

Date	PM10	SO <sub>2</sub>	T (°C)	T (°C)	Wind Speed	Pressure	Rainfall
	µg/m <sup>3</sup>	µg/m <sup>3</sup>	max	min	m/s	mb	kg/m <sup>2</sup>
01.02.2015	20	8	5.1	-4.1	2.2	813.2	
02.02.2015	-	-	5.7	-4.7	0.7	812.4	
03.02.2015	-	-	6.6	-5.7	1.7	809.2	
04.02.2015	19	11	1.7	-1.7	0.9	810.5	10.9
05.02.2015	54	23	-0.4	-9.8	0.5	816.0	1.5
06.02.2015	167	39	-5.8	-16.5	0.4	81.3	
07.02.2015	93	23	3.6	-17	0.5	806.9	
08.02.2015	34	11	2.4	-4.6	1.0	801.4	
09.02.2015	34	4	2.2	-3.1	1.0	798.2	4.1
10.02.2015	23	10	3.3	-2.4	1.1	800.5	7.1
11.02.2015	62	17	3.8	-3.6	1.0	802.5	0.2
12.02.2015	108	10	1.0	-10.0	0.5	807.4	
13.02.2015	9	0.0	-11.2	0.6	810.6		
14.02.2015	95	16	-3.1	-12.9	0.4	811.0	
15.02.2015	96	10	-5.2	-16.3	0.3	811.1	
16.02.2015	81	13	-4.8	-19.4	0.5	808.6	
17.02.2015	57	10	-1.5	-9.6	0.5	806.6	0.1
18.02.2015	47	11	3.9	-8.9	0.6	808.6	9.4
19.02.2015	125	10	4.8	-9.2	1.2	804.1	
20.02.2015	67	5	-1.0	-6.6	1.7	798.7	
21.02.2015	73	5	-1.3	-6.0	1.8	805.8	
22.02.2015	97	11	-2.7	-14.0	0.5	814.5	0.2
23.02.2015	69	17	-1.1	-13.5	0.4	816.6	
24.02.2015	95	13	-0.6	-14.1	0.7	812.6	
25.02.2015	41	9	2.4	-5.8	0.4	811.6	
26.02.2015	63	5	3.3	-5.0	0.6	818.5	0.5
27.02.2015	57	10	0.2	-5.6	0.8	817.1	
28.02.2015	39	6	1.0	-11.1	0.7	810.9	

## CONCLUSIONS

Erzurum city's extreme cold climatic conditions, topographic structure, unfavorable geomorphology, irregular urbanization and meteorological factors cause serious air pollution problems. As no major industrial establishment exists in the city centre, the important source of air pollution is domestic heating. Poor quality lignite is used for domestic heating from October to May. The air pollutant such as SO<sub>2</sub>, NO<sub>x</sub> and PM are released into the atmosphere as a result of the burning this fuels and thus heavy air pollution appears. In addition, the highway passes through the city and vehicles also contribute to air pollution. However, it is reduced air pollution with increased usage of natural gas and low-ash coal and is expected to further decrease in Erzurum city centre.

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## STUDY OF IMPACT AGRICUTURAL DRAINAGE WATER ON SPIRULINA CULTIVATION IN OUARGLA (ALGERIAN BAS SAHARA)

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### ABSTRACT

Spirulina can be cultivated in drainage water to improve water quality. This study examines the possibility of using Spirulina to produce biomass. Evaluation of growth of Spirulina sp. cultivated in flasks was undertaken under greenhouse. The results showed that the biomass concentration of Spirulina in Drainage water medium was  $1.74 \pm 0.79 \text{ g.l}^{-1}$ , but this medium can be enhanced by the addition of nutriments to reach to a biomass concentration with a range of  $2.19 \pm 0.85 \text{ g.l}^{-1}$ . This suggested that Spirulina sp. could be applied for use as organic fertilizers of dry land soils in our region.

**Keywords:** Drainage, water, spirulina, cultivation, Ouargla, Algeria.

### 1. INTRODUCTION

The enhancement of water resources and their impact on the development of the Sahara are conditioned by a rational and planned utilization, and appropriate application of methods and techniques of mobilization, operation and water management (Hamdi-Aissa et al., 2000; Sakar and Daddi Bouhoun, 2007a). Ouargla is a big producer of dates (*Phoenix dactylifera*), who is the main economic activity, and stands as the basic element of social and economic development of the region (Saker and Daddi Bouhoun., 2007b) The resources available of Saharan water barely exceed the 5.4 billion cubic meters and water losses in irrigation systems are estimated at 40%, and generally range from 30 to 60% (Sakar and Daddi Bouhoun, 2007a).

Ironically this state of scarcity, increased discharges of urban and agricultural waste water, resulting from the growth of water consumption, contributes to the rise of shallow aquifers that clogs the low areas of the oases and generate salinization process the northern Sahara (Idder, 2007; OSS-AWF, 2010). Artificial drainage is practiced in such areas in order to prevent water-logging and salinity buildup in the root zone of crops (Lee and al, 2003). Most of the time the water is collected but practically not used in Algeria, they have the advantage of having an agronomic quality often superior to those of water captured, since they contain nutrients, nitrates and phosphates, which they have charged at the time of leaching in the soil under agricultural land. Their recovery thus reduces the growing pressure on conventional resources, especially non-renewable groundwater and to better generally manage water resources (Hamdi-Aissa et al., 2000; Idder, 2007). Enhancing these effluents by cultivation of microalgae; whether spirulina, could economize the groundwater resource, only available; the biomass produced could be used as an amendment to improve soil quality and promote plant growth in degraded arid soils (Trejo et al., 2012).

Microalgae have excellent adaptability to various environments and can grow almost everywhere. The nutrient requirements for the majority of microalgae include N, Pand K, and these requirements could be catered by drainage water. (Lee et al.; Fenton and O huallacháin, 2012). Its growth and biomass productivity depends on selected parameters were light intensity and nitrogen source (Hirano et al., 1997; Bezerra et al., 2012), the presence and concentration of inorganic and organic carbon sources (Cheirsilp and Torpee, 2012; Kim et al., 2013), pH, biomass concentration and days in culture (Sharon Mano Pappu et al., 2013); salinity and nutrient availability (Colla et al., 2004; Ogbonna et al., 1995; Vonshak, 1997).

The present study investigated the effect of drainage water on the kinetic characteristics biomass production of Spirulina sp. cultivated in non-enriched Medium and enriched medium.

### 2. MATERIALS AND METHODS

#### 2.1. DRAINAGE WATER SAMPLING

One sources of agricultural drainage water was found at Ouargla area, The water samples were collected from WWTP (wastewater treatment plant) pumping in clean and well-stoppered polyethylene bottles. The samples were stored, and analyzed after arrival to the laboratory (Table 1)

**Table 1. Characteristics waters of cultivation the microalgae**

Parameter	Drainage water	Wells waters
pH	8.14	7.86
Salinity (g.l <sup>-1</sup> )	7.86	2.34
Ca <sup>2+</sup> (mg.l <sup>-1</sup> )	650	260
Mg <sup>2+</sup> (mg.l <sup>-1</sup> )	806.4	153.6
Na <sup>+</sup> (mg.l <sup>-1</sup> )	2325	645
K <sup>+</sup> ( mg.l <sup>-1</sup> )	181	39.5
Cl <sup>-</sup> ( mg.l <sup>-1</sup> )	4050	1088
SO <sub>4</sub> <sup>2-</sup> ( mg.l <sup>-1</sup> )	4175	1000
HCO <sub>3</sub> <sup>-</sup> ( mg.l <sup>-1</sup> )	176.90	152.5

## 2.2. ALGAE CULTIVATION AND GROWTH

Cyanobacteria used in this study, Spirulina sp. was isolated from guelta Atakor in Tamanrasset (Algeria).

Tow type of waters are used; Drainage water and wells waters (Table 1), and three different medium are prepared. The first medium is drainage water medium (E1) without enrichment. While the others two are drainage water enriched medium (E2) and Wells waters enriched medium (E3). Mediums enrichment is accomplished by introducing : 0.2 g. l<sup>-1</sup> of (NH<sub>4</sub>)<sup>2</sup> SO<sub>4</sub>, 0.05 g.l<sup>-1</sup> FeSO<sub>4</sub>, 0.1 g.l<sup>-1</sup> K<sub>2</sub>SO<sub>4</sub> in order to increase nutrient levels. No dilution for the drainage water. This medium is well suited for outdoor mass cultivation of Spirulina. To adjust the pH for each medium; 16g l<sup>-1</sup> natron was adding.

The Spirulina sp. was cultivated in 2 l plastic flasks with a working-volume of 1.5 l under shiter. Cultures were continuously bubbled with air. The initial biomass concentration for all cultures was 0.67 g.l<sup>-1</sup>.

## 2.3. GROWTH KINETIC PARAMETERS

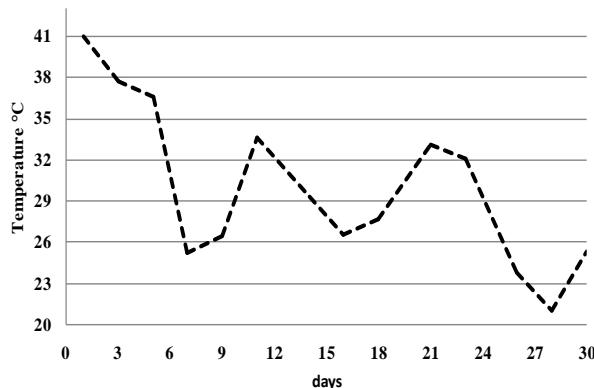
Samples were withdrawn each tow days, Biomass concentration was determined by spectrophotometer at 625 nm (Doumandji et al. (2012)). The Biomass concentration was then converted to algal productivity. The productivity (P) was calculated as maximum productivity ( $P_{max}$ , g l<sup>-1</sup> d<sup>-1</sup>), according to the equation  $P = (X_t - X_0) / (t - t_0)$ , where  $X_0$  is the initial biomass concentration (g l<sup>-1</sup>) at time  $t_0$  (d) and  $X_t$  is the biomass concentration in g l<sup>-1</sup> at any time  $t_0$  (d) subsequent to  $t_0$  (Samori et al., 2013).

The physicochemical parameters (pH, temperature and salinity) were measured using a portable pH meter (WTW 315 series) and a portable electrical conductivity meter (WTW 315 series) with a combination electrode.

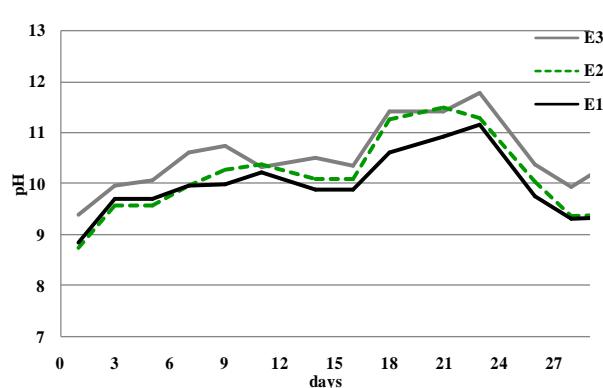
## 3. RESULTS AND DISCUSSION

The experiments were carried out under shelter. The temperature, pH and salinity variations are shown in Figure 1, Figure 2 and Figure 3.

Effects of cultivation time on the biomass concentration by spirulina sp. are given in Figs. 1–3. The short lag phase was a result of acclimated cell transferred from the inoculum to the medium (Zeng and Vonshak, 1998), as can be seen for E1 (Drainage-water medium) and E2 (Drainage-water enriched medium), which is supported by Ravelonandro et al. (2011) and was observed at salinity superior of 13 g.l<sup>-1</sup>, whereas Colla et al. (2007) reported that these microalgae had no lag phase.



**Figure 1.** Evolution of temperature in the mediums

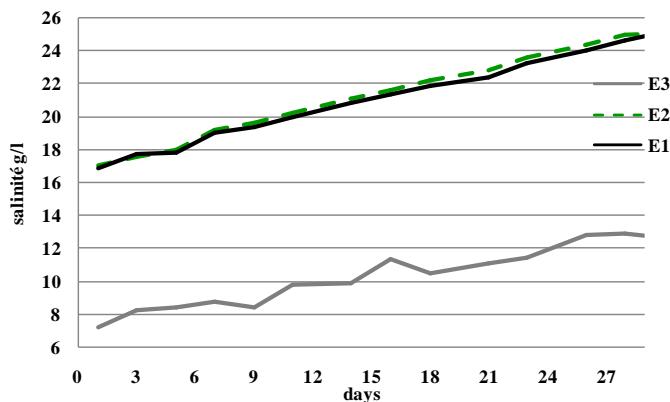


**Figure 2.** Evolution of pH in the mediums

Variation in concentration of biomass by *S. platensis* could be due to changes in the availability of nutrients (Ogbonna et al., 1995), and other environmental factors such as temperature and pH (Chaumont., 1993; Colla et al., 2007) which may have been a limiting factor. The best *S. platensis* kinetics were  $P_{max} = 0.48 \pm 0.27 \text{ g.l}^{-1} \text{ d}^{-1}$  in (E1) was produced at a temperature of 26.30 °C and at pH value of 10, whereas the  $P_{max} = 0.73 \pm 0.18$  for (E2) were at a temperature of 37.70 and 26.53°C; and  $P_{max} = 0.97 \pm 0.32$  at temperature and pH 27.67 and 10.35 respectively (Figs. 1 and 2). Rafiqul et al. (2005) reported °C and pH 9.0 as optimal temperature for biomass production by *S. platensis*. On the other hand, some authors reported that the highest productivity was obtained at 30 °C (Danesi et al., 2001; Colla et al., 2007). However, at close to 20 °C, the microorganism capable of living at lower temperature with reduced activity (Jordan, 1999; Kashyap et al., 2003)

The pH not only affects nutrient availability, or affects physiology of cell but also biomass production due to their physiological requirements (Vonshak 1997; Çelekli and Dönmez, 2006; Kim et al., 2007; Ogbonda et al., 2007). Increasing pH from 10.0 to 11.16 leads to remarkable decrease in the biomass for E1, However, for E3; increasing pH from 9.97 to 11.79 leads to increasing in biomass (Figs .2 and 4).

Another important factor in algal production is salinity which plays a significant role in biomass production. As Ravelonandro et al. (2011) reported, the influence of salinity has no significant effect on specific growth except at the range of higher salinity ( $30 \text{ g.l}^{-1}$ ), as can be seen the range of salinity in E1, E2 and E3 ( $21.03 \pm 2.66$ ,  $26 \pm 1.86$  and  $21.25 \pm 2.73 \text{ g.l}^{-1}$ ) was not high enough to stop growth; the productivity  $X = 0.14 \pm 0.01$  at the end of culture in E1 was at the range of salinity  $25.14 \text{ g.l}^{-1}$ . Also some authors like Sheehan et al. (1998) reported that Spirulina strains were maintained in both high bicarbonate and high salinity.



**Figure 3.** Growth of spirulina in various medium of drainage water and wells waters

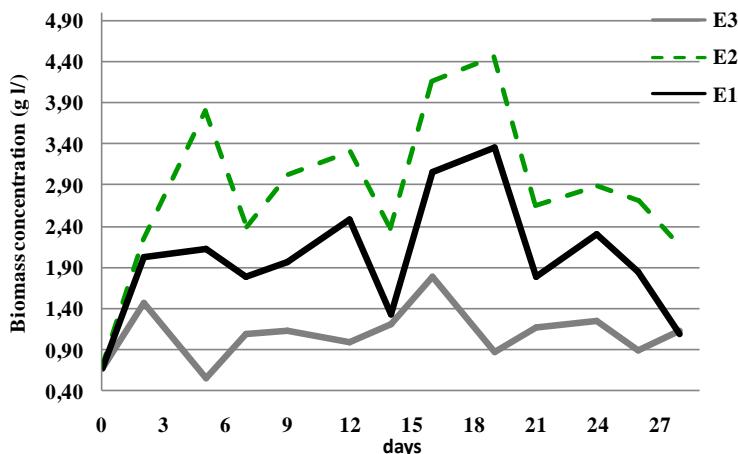
In our study, an increase in salinity due to evaporation would as result increase the accumulation of lipids as the abrupt increase in salinity, as Bartley et al. (2013) reported.

The algal biomass cultivated in drainage water was compared with wells waters medium (Fig .4). The cells grown in the E1, productivity increased up to 9 days, and decreased on the 11<sup>th</sup> day and began to starve from the 14<sup>th</sup> day with a range of  $0.05 \pm 0.09 \text{ g l}^{-1} \text{ d}^{-1}$ , probably due to the limited quantities of nutrients, whereas the cells growing in the E2 and E3 enriched medium continued to grow.

Although these results appear quite promising, the sirulina sp. growth in drainage water medium (E1) has a highest biomass concentration compared to wells waters medium (E3) with a range of  $3.36 \pm 0.24$  and  $1.24 \pm 0.70$

respectively, from these findings, the use of medium based on drainage water or effluents could be fortified the medium with minerals.

The factor of the ratio between the nutrients could be also an important factor; the availability and the concentrations of N and P is important for algal growth (Olguin, 2000; Tang et al., 2007; Markou and Georgakakis, 2011). The imbalance of N/P ratio could reduce the algal growth (Redfield., 1958;Correll, 1998; Samori, 2013), which could be explained the shift in the profile of growth (Fig .4).



**Figure 4.** Growth of spirulina in various medium of drainage water and wells waters

Our results are supported by those of Fenton and O huallacháin (2012) who studied the the growth of algal biomass in agricultural nutrient surpluses and has demonstrated that the nutrient content of drainage waters have the potential to facilitate algal biomass growth.

#### 4. CONCLUSION

The integrated microalgae production in drainage water could be one of the options to enhancing the groundwater resource, only available; and to prevent water-logging and salinity buildup in the root zone of crops. Our purpose is to adapt the technological possibilities to optimize the water use anywhere. Further research is needed before thi system of integration drainage water with spirulina sp could be implemented.

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## TÜRKİYE'DE SÜRDÜRÜLEBİLİR KALKINMANIN MEVCUT DURUMU

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### ÖZET

Çevreye uygun ekonominin temel koşulu sürdürülebilir kalkınmadır. Sürdürülebilir kalkınmanın sağlanması ise ekolojiyi genel ekonomik çerçeveye içinde bir bileşen olarak görmek yerine, ekonomiyi ekolojik çerçeveler içine yerleştirmekle mümkün olacaktır. Sürdürülebilir kalkınma, çevre yönetimini uluslararası boyutta ele alan, kalkınma ve çevre arasındaki ilişkiye yeni bir boyut getiren bir yaklaşımdır. Sürdürülebilir kalkınma, insan boyutunun yanında doğal yaşamın korunmasını da hedef alır. Ar-Ge Harcamasının Gayri Safi Yurtiçi Hasıla (GSYH) içindeki payı 2011 yılında %8,6 iken, bu oran 2012 yılında %9,2 olarak hesaplanmıştır. İstihdam oranı 2012 yılında %52,8 iken, 2013 yılında %53,4'e ulaşmıştır. 2013 yılında istihdam oranı kadınlarda %31,8, erkeklerde ise %75,3 olmuştur. Bu çalışmada mevcut literatürlerden yararlanılarak Türkiye'de sürdürülebilir kalkınmanın mevcut durumunun belirlenmesi ve sürdürülebilir kalkınmanın gerçekleştirilmesi için somut ilerlemelerin sağlanması gereken konuların incelenmesi için bir durum değerlendirmesi yapılması amaçlanmıştır. Bu bağlamda, sürdürülebilir bir kalkınmanın hem küresel, hem de bölgesel temelde yaşanması bölgesel kalkınma açısından bir fırsat yarattığı gibi, geleceğe güvenle bakmayı da beraberinde getirecektir.

**Anahtar Kelimeler:** Çevre, istihdam oranı, Sürdürülebilir kalkınma, Türkiye.

## CURRENT SITUATION OF SUSTAINABLE DEVELOPMENT IN TURKEY

### ABSTRACT

Basic condition for environmentally friendly economy; is sustainable development. Ensuring sustainable development is instead seen as a component within the overall economic framework of the ecology, the economy will be able to place the ecological frameworks. Sustainable development, is an approach addressing the international dimension of environmental management that brings a new dimension to the relationship between development and the environment. Sustainable development is aimed at the protection of natural habitats as well as human dimensions. R&D expenditure in 2011, the gross domestic product (GDP) and the share of 8.6%, while in 2012 to 9.2% was calculated. While the employment rate of 52.8% in 2012, reached 53.4% in 2013. In 2013, the employment rate has been 31.8% for women and 75.3 of the men. In this study, to determine the sustainable development of the current situation in Turkey and the issues that need to provide tangible progress for the realization of sustainable development making use of existing resources for the study is intended to conduct a situation assessment. In this context, global and regional basis for a sustainable development to occur, as it creates an opportunity for regional development, will bring to look confidently to the future.

**Keywords:** Environmental, Employment rate, Sustainable development, Turkey.

### 1. GIRİŞ

Sürdürülebilirlik kavramı oldukça popüler olmasına ve çoğu kişi tarafından belirli bir kavramı pazarlamak için sık sık kullanılmasına rağmen yine de çoğu insan tarafından yanlış bir şekilde tanımlanmakta ve kullanılmaktadır. Bu kavram tanımlanırken gelecekte de sürdürülebilirliğin düşünülmlesi gerekmektedir. Sürdürülebilir kalkınmanın en yaygın tanımı 1987 yılında Dünya Çevre ve Kalkınma Komisyonu tarafından yapılan tanımdır. Bu tanıma göre kalkınma; “gelecek nesillerin kendi ihtiyaçlarını karşılayabilme yeteneğini ortadan kaldırımsızın şimdiki neslin ihtiyaçlarının karşılanmasıdır”. Bu tanım genel hatlarıyla oldukça açık olmasına rağmen, tanım içinde geçen ihtiyaç teriminin netlige kavuşturulması gereklidir. ‘İnsan ihtiyacı’ algısı büyük ölçüde içinde yaşadığımız topluma göre şekillenmektedir. Bazıları ihtiyaç teriminden sadece yiyecek, içecek ve barınma gibi çok temel ihtiyaçları anlarken, bazıları sağlık hizmetleri sunumu ve sosyal güvenlik gibi durumları ve bazen araba, bulaşık makinası ve televizyon gibi malları da ihtiyaç olarak algılamaktadırlar. Bu açıdan gelişmiş ülkeler ve Çin veya Hindistan gibi gelişmekte olan ülkeler veya İran gibi nükleer enerji konusunda çalışmalar yapmakta olan ülkelerin durumları göz önünde bulundurulduğunda, sürdürülebilirlik konusunda devam eden tartışmaların sonu yok gözükmektedir (Jeffery, 2006; Çelik, 2006).

Konuya ilgili daha önce yurt içinde ve yurt dışında yapılmış bazı çalışmalar derlenerek aşağıda sunulmuştur;

Smutko (1996a;b), Collados and Duane (1999), Naradoslawsky (2001), Lindley (2001), Mc Evoy and Ravetz (2001), Ravetz (2003) ve Medhurst (2003), yaptıkları çalışmalarla bölgesel olarak sürdürülebilir kalkınma olusunu farklı açılardan inceleyerek çeşitli modeller geliştirmiştir.

Gibbs ve Jonas (1999) yaptıkları çalışmada bölgesel kalkınma ajansları, bölgesel idare ve çevre arasındaki ilişkiler üzerinde yoğunlaşmışlardır.

Uysal (2003) tarafından hazırlanan raporda, sürdürülebilir kalkınma konusunda Birleşmiş Milletler (BM), Dünya Bankası, OECD gibi belli başlı uluslararası kuruluşlar ile Avrupa Birliği (AB) ve Türkiye'de yapılmış son çalışmalar ışığında sürdürülebilir kalkınma konusunda oluşturulan vizyonlar ve yapılan teknoloji öngörülerini özetlenmiştir.

Yapıcı (2003) tarafından yapılan çalışmada sürdürülebilir kalkınma olusu ile eğitim olusu arasındaki ilişki tartışılmış, sürdürülebilir kalkınmada eğitim kurumlarına düşen rolün çok önemli olduğu gerçeğinden hareketle neler yapılabileceği ele alınmıştır.

Çelik (2006) tarafından yapılan çalışmada, sürdürülebilir kalkınma kavramının tanımından hareketle, bütün ülkelerin nihai hedefi olan kalkınmış bir toplumun oluşturulmasında sağlık hizmetlerinin oynadığı önemli rol tartışılmıştır.

Çetin (2006) tarafından yapılan diğer bir çalışmada, teori ve uygulama düzeyinde bölgesel sürdürülebilir kalkınma olusu değerlendirilmiştir. Öncelikle geleneksel yaklaşımın çerçevesinde sürdürülebilir kalkınma olusu ele alınmış, daha sonra son yıllarda bölgesel değerlendirmelere imkan sağlayan yeni yaklaşım ve modeller incelenmiştir. Son olarak, hem Avrupa Birliği düzeyinde hem de ulusal düzeyde farklı bölgesel sürdürülebilir kalkınma uygulamalarından örnekler yer verilmiştir.

Öztürk ve Mengüoğlu (2008) yaptıkları çalışmada, sürdürülebilir kalkınmada fiziksel kırsal alan planlanmasına yönelik olarak; proje destekli fiziksel planlamalar, örnek koy oluşturmaya yönelik planlamalar ile turizm köyleri oluşturmaya yönelik planlamaları ele almışlardır.

Akgül (2010)'un yaptığı çalışmaya göre; sürdürülebilir kalkınmanın temel ilkesi, ekonomik, çevresel ve sosyal olmak üzere üç farklı alanda sürdürülebilirliği sağlamaktır. Kaynak temelli ve kurumsal olmak üzere, yenilenebilir kaynakların yönetilmesini etkileyen iki değişik faktör bulunmaktadır. Karakteristik özelliklerinin korunabilmesi için ekonomik, çevresel ve sosyal bileşenlerin yenilenme kapasiteleri, sistemin doğal sermayeleri olarak algılanmak zorundadır. Bilhassa sosyal bileşene ilişkin kurumsal faktörler, sürdürülebilir kalkınmanın gereksinim duyduğu kapasitelerin korunabilmesi ve desteklenebilmesi açısından geniş bir eylem alanı sunmaktadır.

Aksu (2011) yaptığı çalışmada sürdürülebilir kalkınma kavramı üzerinde durmuş, küresel çevre sorunları ve kalkınma-çevre etkileşim sürecinden bahsetmiş, Türkiye'deki çevre politikaları ve sürdürülebilir kalkınma bağlantısını değerlendirmiş son olarak da bölgesel kalkınma ve çevre konusu üzerinde durmuştur. Çalışmada sürdürülebilir kalkınmanın ekonomik kalkınma, sosyal kalkınma ve çevresel kalkınma olmak üzere üç temel ayagından biri olan "çevre" üzerinde odaklanılmış, mevcut durumu ve geçmişten günümüze değişim kaydedilen gelişmeler ortaya konulmuş, yeni yaklaşımlar değerlendirilmiştir.

Kayıp (2011) tarafından yapılan çalışma küreselleşme sürecinde sürdürülebilir kalkınmayı temel olarak, çevre olusuna odaklanan betimsel bir inceleme çalışmasıdır. Çalışma, sürdürülebilir kalkınmanın bugün geldiği noktayı belirleyerek, sürdürülebilir bir çevrenin oluşturulması sürecinde dönüşen çevresel paradigmaları sorgulamak amacıyla yapılmıştır. Çalışmada küreselleşme ve sürdürülebilir kalkınma sürecinde gerçekleştirilen uluslararası çabaların incelenmesi ve geleceğe yönelik konunun terminolojik çatısının kurulması hedeflenmiştir. Son olarak, sürdürülebilir bir çevre için çözüm arayışları ortaya konmuştur.

Özmete (2011) tarafından yapılan çalışmada çevresel ve doğal kaynaklar, insan refahı, kalkınma konularında çalışan Tufts Üniversitesi'nde profesör olan Jonathan M. Harris sürdürülebilir kalkınmanın temel prensiplerini ortaya koymustur. Çalışma, kalkınma ve sürdürülebilir kalkınma kavramlarını ekonomik, ekolojik ve sosyal perspektif ile açıklamıştır. Harris (2000)'e göre, sürdürülebilir kalkınmanın ekonomik, çevresel ve sosyal boyutları olduğu belirtilmiştir. Sürdürülebilir kalkınmanın başarılması için de bu perspektiflerin sentezinin yapılması gerektiği odaklanmıştır.

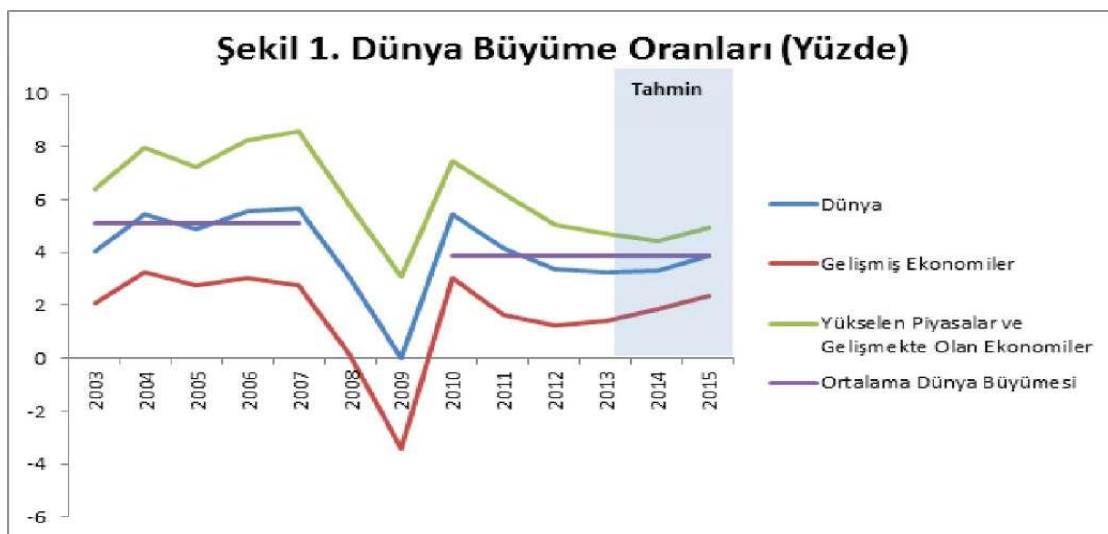
Tutar (2011) tarafından yapılan çalışmada sürdürülebilir bir kalkınma etrafında çözüm bulan çevre-kalkınma ve ticaret etkileşiminin önemini ortaya koymak amaçlanmıştır. Çalışmada, çevre ve kalkınma ilişkisi kapsamında; çevre, ekonomik kalkınma, çevre ve ekonomik kalkınma bağları hakkında bilgi verilmiştir. Çevre ve ticaret ilişkisi yanı sıra Dünya ve AB'de çevre- kalkınma ve ticaret ayrıca son olarak Türkiye'de çevre-kalkınma ve ticaretin sürdürülebilirliği konusu anlatılmıştır.

Özmehtem (2012) yaptığı çalışmada çevre ve kalkınma sorunlarına değinmiş ve sürdürülebilirlik kavramının kökenini ve içeriğini incelemiştir. Sürdürülebilir kalkınma kavramının ve sürdürülebilir kalkınma anlayışının tarihsel süreç içinde, fikir tabanından toplumsal eylem planına dönüşme aşamalarını ele almıştır. Bunlar ek olarak, çalışmada sürdürülebilir kalkınma modeli açıklanmış, Birleşmiş Milletler Sürdürülebilir Kalkınma Komisyonu tarafından oluşturulan sürdürülebilirlik göstergeleri (sosyal göstergeler, çevresel göstergeler, ekonomik göstergeler ve kurumsal göstergeler) ile sürdürülebilir toplumun ilkelerine açıklık getirilmiştir. Ayrıca, Türkiye'de sürdürülebilir kalkınmaya ulaşma çabaları, tarihsel süreç içinde tartışılmıştır.

Tiraş (2012) yaptığı çalışmada, sürdürülebilir kalkınma ve çevre kavramı arasındaki ilişkiyi teorik olarak incelemiştir.

Karaca (2013) tarafından yapılan çalışma, fosil yakıtların doğrudan veya dolaylı kullanımıyla ortaya çıkan çevresel sorunların önlenmesi ve sürdürülebilir kalkınmanın sağlanması için, tarım sektöründe yenilenebilir enerji kaynaklarının gerekliliğini vurgulamak amacıyla yapılmıştır. Bu bağlamda çalışmada tarım sektöründe kullanılabilecek yenilenebilir enerji kaynakları ile çevre kalitesinin sağlanması, kırsal alanda istihdamın artırılması ve yerli nüfusun refahını artırması yoluyla kırsal kalkınmanın sağlanmasına yönelik çözüm önerileri getirilmiştir.

Osborn et al (2015) tarafından yapılan çalışma gelişmiş ülkelerin dönüşümel zorluklarında, ekonomik paradigmaların iyileştirilmesinde, yeni politika ve kaynakların taahhüdü konularında hedef ve amaçların belirlenmesi için yeni bir analiz yöntemi belirlemek amacıyla yapılmıştır.



Şekil 1. Dünya büyümeye oranları

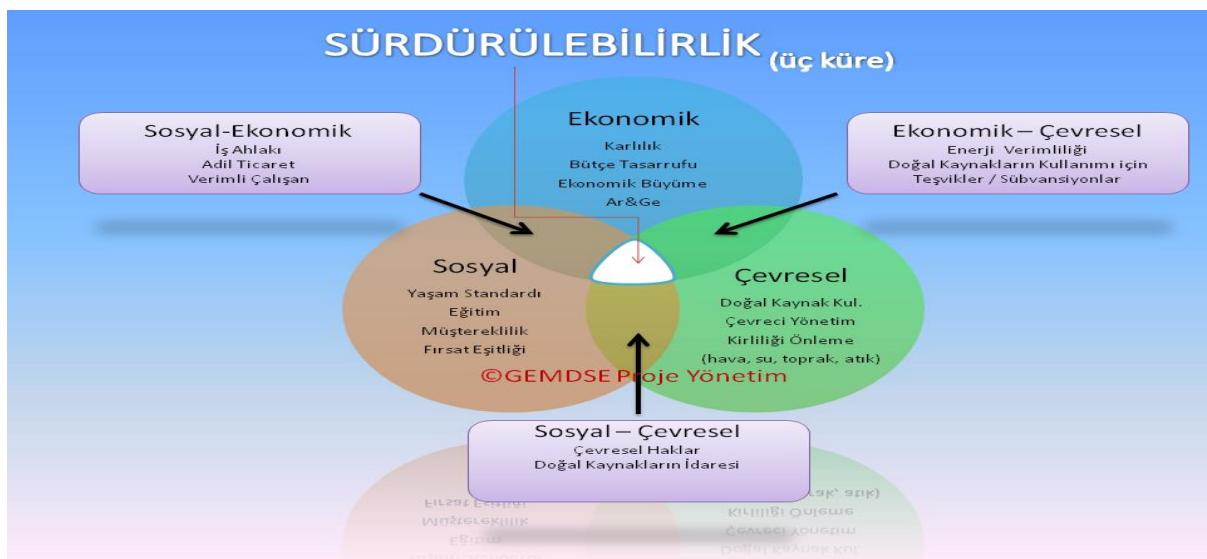
Kaynak: IMF, Dünya Ekonomik Görünüm Raporu veri tabanı, Ekim, 2014; T.C Kalkınma Bakanlığı Uluslararası Ekonomik Göstergeler, Ocak, 2015

Günümüzde küreselleşmeyle beraber ekonomilerde rekabetçilikte artmış, ülke ekonomileri için günü kurtaran tedbirler almak yerine mevcut ekonomileri koruyarak, geliştirmek amacıyla kalkınma temelli politikalar benimsenmiştir. Bu çalışmada sürdürülebilir kalkınma kavramı üzerinde durulmuş, Türkiye'deki sürdürülebilir kalkınma bağlantısı değerlendirilmiş, mevcut durumu ve geçmişten günümüze degen kaydedilen gelişmeler ortaya konulmuş, yeni yaklaşımalar değerlendirilmiştir. Girit (2014)'e göre, Avrupa Birliği kurucu ülkeleri olan Almanya, İtalya, Fransa, Hollanda, İtalya ve Lüksemburg arasından nispeten Türkiye ile benzer özelliklere sahip olan Almanya, Fransa ve İtalya ile "Çok yüksek insani gelişme endeksine" sahip ülkeler sıralamasında 1. Sırada olan Norveç ile 47. Sırada olan Barbados ülkeleri ile Türkiye'nin sürdürülebilir kalkınma göstergeleri bakımından karşılaştırma yapılması hedeflenmiştir.

### 1.1. Sürdürülebilir Kalkınma ve Tarihsel Gelişimi

Kalkınma, bir ekonomide halkın değer yargıları, dünya görüşü ile tüketim ve davranış kalıplarındaki değişimleri içeren toplumsal ve kuramsal yapıda dönüşüm yol açan büyümeye olarak tanımlanır ([www.tdk.gov.tr](http://www.tdk.gov.tr); Kaypak, 2011). Sürdürülebilir kalkınma (sustainable development), adı üstünde kalkınmanın bir anlık değil sürdürülebilir olmasını, süreklilik taşımاسını ifade etmektedir. İnsan ile doğa arasında denge kurarak doğal kaynakları tüketmeden, gelecek nesillerin ihtiyaçlarının karşılanması ve kalkınmasına olanak verecek şekilde bugününe ve

geleceğin yaşamını ve kalkınmasını programlama anlamını taşımaktadır (Türkiye Çevre Vakfı, 1991, Kaypak, 2011). Sürdürülebilir kalkınmanın; ekonomik, sosyal, mekânsal, kültürel ve çevre boyutu bulunmakta ve her biri karşılıklı olarak birbirini etkilemektedir. 1929 Büyük Buhranı sonrası ve II. Dünya Savaşı'nı (1939-1945) takip eden yıllarda dünyanın birçok yerinde yaşanan olaylar ekonomik sorunları ön plana çıkmasına neden olmuş ve kalkınma kavramının oluşturulmaya başlamasını sağlamıştır. II. Dünya Savaşından sonraki yıllarda hızlı kapitalist büyümeyen ekolojik denge üzerinde yarattığı sorunların farkına varılması ve kalkınma ile çevre arasındaki bağların ortaya çıkması 1960'lı yılların sonuna rastlamaktadır. Sürdürülebilir kalkınmanın temel ilkelerinin tartışılması ise 1970'lerin ikinci yarısında başlamıştır (Anonim, 2015). Özellikle ikinci dünya savaşından sonra başlayan kalkınma çabaları, birçok ülkeyi ekonomik olarak gelişmiş ülke statüsüne sokarken aynı zamanda insanlığı tehdit eder boyutta çevre sorunlarıyla baş başa bırakmıştır. Başlangıçta kalkınma adına mazur görülen çevre sorunları giderek bögesellikten çıkararak, küresel boyuta ulaşmıştır. 1970'lerden itibaren kalkınma ve doğal çevre arasında denge kurulması için arayışlar hız kazanmıştır. Böylece, insanların ve diğer canlıların yaşamları üzerinde etkili olan tüm faktörleri içinde barındıran çevreyi ve beseri sermayeyi dikkate alan, kaynakların optimum kullanımını amaçlayan uzun dönemli tek kalkınma modeli olan "Sürdürülebilir Kalkınma" modeli gündeme gelmiştir. Farklı tanımları yapılsa da 1987 yılında yayınlanan Burtland raporunda; bu günün ihtiyaçlarını gelecek nesillerin ihtiyaçlarını karşılamalarından ödün vermeden karşılaşma süreci, olarak yapılan tanım ortak kabul görmüştür. Tanım kalkınma ve doğal kaynak dengesini dikkate alan, kalkınmanın yararlarından bu günün olduğu kadar gelecek kuşaklarında faydalananlığını sağlayan, çevreyle kalkınmanın birbirini tamamladığı kalkınma anlayışını ifade etmektedir (Tiraş, 2012).



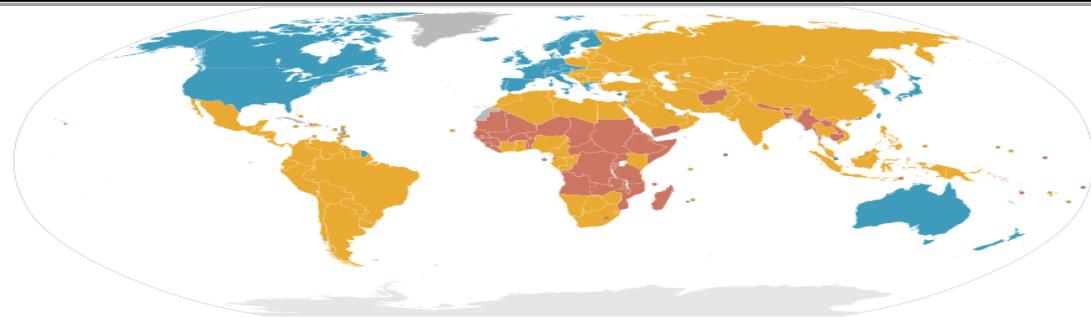
Şekil 2. Sürdürülebilir kalkınmanın temel unsurları

Kaynak: Anonim, 2015a

## 1.2. Gelişmiş Ülkeler, AB ve Türkiye' de Sürdürülebilir Kalkınma

İnsani Gelişme Endeksi (İGE) ülkeleri gelişme seviyelerine göre "çok yüksek"ten "düşük"e sıralamak için kullanılan bir kompozit istatistikidir. Ülkeler; ortalama ömrü süresi, eğitim, hayat standartı, çocuk bakımı, sağlık hizmetleri, ekonomik refah ve toplum huzuruna bağlı olarak sıralanır (Anonim, 2015).

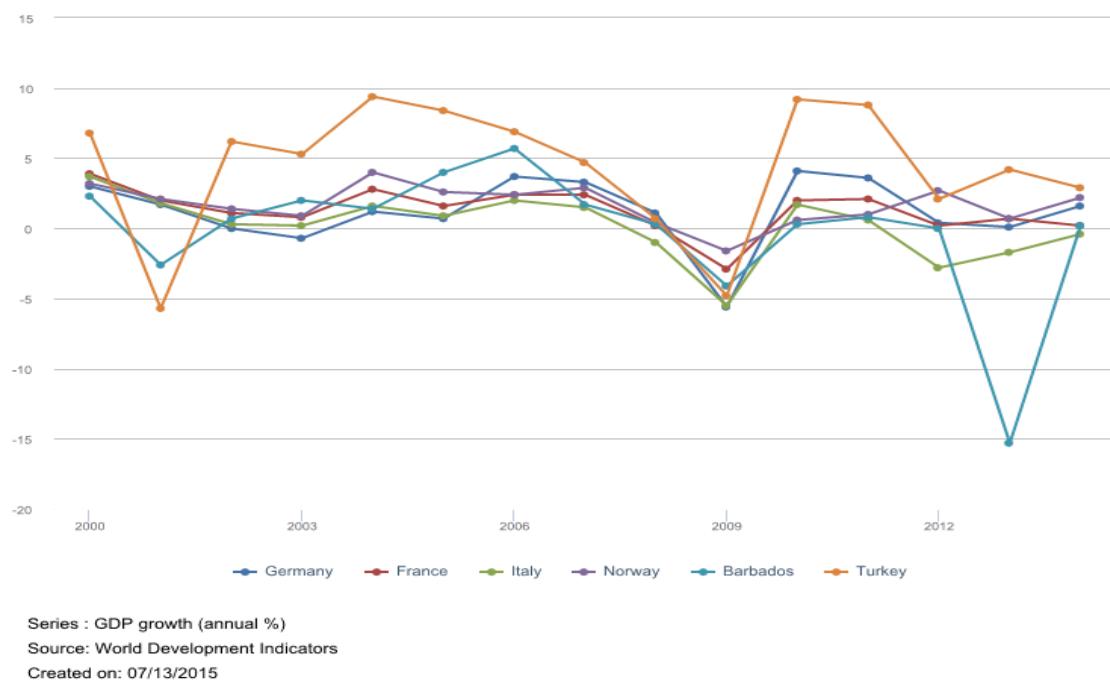
Şekil 3'e göre Mavi renkte olanlar çok gelişmiş ülkeler, Sarı renkte olanlar gelişmiş ve halen gelişmekte olanlar, Kırmızı renkte olanlar ise gelişmemiş ülkeler olarak belirtilmiştir. Türkiye, 2011 İnsani Gelişim Raporu'na göre Orta İnsani Gelişim sınırının hemen üzerinde Yüksek İnsani Gelişim kategorisindedir. 187 ülke arasında 92. sırada bulunmaktadır (Anonim, 2015b).



Şekil 3. İGE'ye göre (İnsanı Gelişme Endeksi) gelişmiş ülkeler, gelişmekte olan ülkeler ve gelişmemiş ülkeler

Kaynak: Anonim, 2015

“Sürdürülebilir Kalkınma” kavramı ilk kez 1987 yılında Birleşmiş Milletler Dünya Çevre ve Kalkınma Komisyonu tarafından yayınlanan Brundtland Raporu olarak da bilinen ‘Ortak Geleceğimiz Raporu’nda öne çıkmıştır (Mawhinney, 2002; Altun Ada, 2011). Sürdürülebilir kalkınma Avrupa Topluluğu’nun bir hedefi olarak ilk defa Avrupa Tek Senet (1987)’inde tanıtılmıştır. Tek Senet ile Roma Antlaşması’na “çevre” ile ilgili bölümler eklenmiştir. Sürdürülebilir kalkınma düşüncesinin tüm topluluk politikalarına eklenmesi gerekliliği 1992 Avrupa Birliği Antlaşması (Maastricht Antlaşması) nda belirtilmiş ve 1997 Amsterdam Antlaşması’nda desteklenmiştir (European Commission, 2004; Karluk, 2007; Altun Ada, 2011). AB Sürdürülebilir Kalkınma Stratejisi, gelecek nesillerin ihtiyaçlarını karşılama kapasitesini tehlkiye atmaksızın bugünkü neslin ihtiyaçlarının nasıl karşılanabileceğini gösteren tüm AB politikaları için kapsayıcı bir stratejidir. Türkiye’de çevre sorunları ilk kez Üçüncü Beş Yıllık Kalkınma Planı (1973-1977) döneminde ele alınmıştır. Beşinci Beş Yıllık Kalkınma Planı’ndan sonra, doğal kaynakların etkin kullanımının ve gelecek kuşaklara aktarımının sağlanması için yeni politikaların oluşturulması yönünde değerlendirmeler yapılmıştır. Çevre konusunun diğer sektör politikalarında dikkate alınması ve ağırlıklı biçimde sürdürülebilir kalkınmayı hedefleyen yaklaşım, Altıncı Beş Yıllık Kalkınma Planı (1990-1994) ile söz konusu olmuştur. Yedinci (1996-2000) ve Sekizinci (2001-2005) Beş Yıllık Kalkınma Planları dönemlerinde ise, çevre sorunlarının sosyal, ekonomik politikalara ve sektörlerle entegrasyonu yönünde çalışmalar söz konusu olmuştur. Türkiye, Dokuzuncu Kalkınma Planı (2007-2013) ile birlikte, AB’nin sürdürülebilir kalkınma stratejisini uygulamaya entegre etmektedir. Türkiye’de sürdürülebilir kalkınma konusunda; Ulusal Çevre Stratejisi ve Eylem Planı ile Sürdürülebilir Kalkınmanın Sektörel Politikalara Entegrasyonu Projesi gibi önemli somut çalışmalar mevcuttur (Altun Ada, 2011). AB’de sürdürülebilir kalkınma göstergeleri; ekonomik, çevresel ve sosyal konuların hepsini kapsayan, aşağıda belirtilen ana konularda sınıflandırılmıştır: Sosyo-Ekonomik Kalkınma, Sürdürülebilir Üretim ve Tüketim, Sosyal İçerme, Demografik Değişiklikler, Halk Sağlığı, İklim Değişikliği ve Enerji, Sürdürülebilir Ticaret, Doğal Kaynaklar, Küresel Ortaklık, İyi Yönetim (<http://ec.europa.eu>, 2011; Altun Ada, 2011).

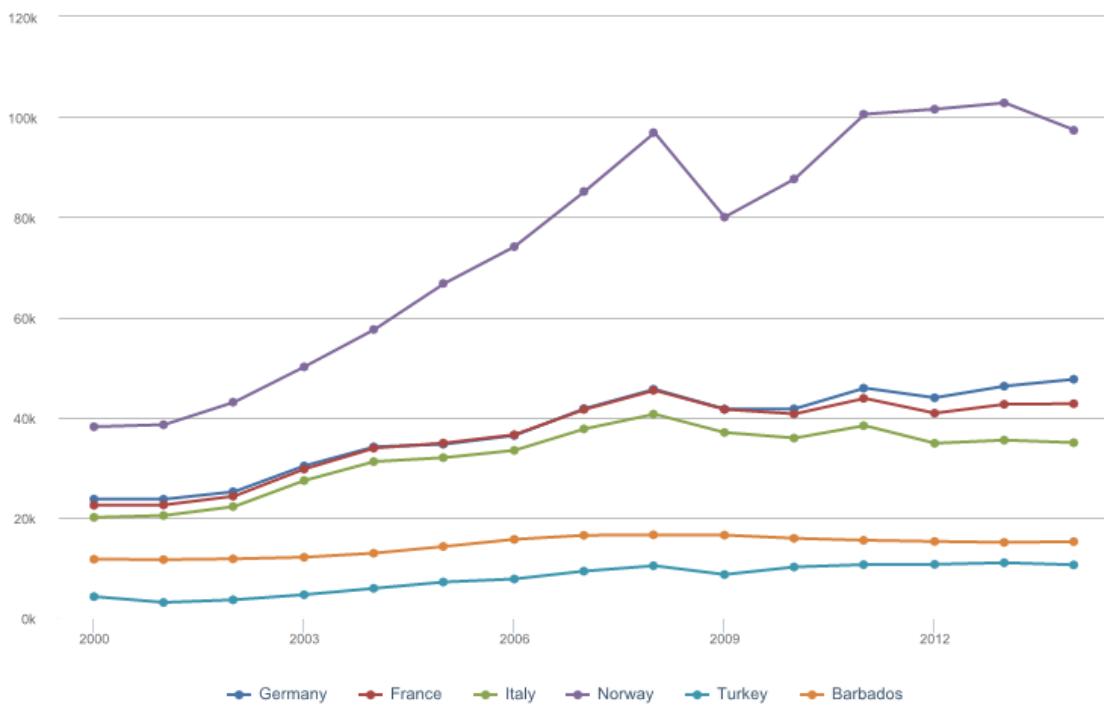


Şekil 4. Gayrisafi yurtiçi hasılada yıllık büyümeye (%)

Şekil 4' e göre 2000 yılında gayrisafi yurtiçi hasılasındaki yıllık büyümeye oranı %6.8 olan Türkiye 2001 yılında “2001 Türkiye ekonomik krizi” nedeniyle %-5.7 olarak gerçekleşmiştir. 2009 yılında ABD başlayan ve tüm dünyayı etkileyen finansal kriz tüm ülkeleri etkilemiş İtalya ve Almanya'dan sonra gayrisafi yurtiçi hasılasındaki yıllık büyümeleri en az olan ülke Türkiye olmuştur. Türkiye dış kaynaklı bu krizden, uyguladığı mali disiplin, para politikaları ve yapısal reformlarla en hızlı çikan ve son dönemlerdeki küresel ekonomik belirsizlikten görelî olarak az etkilenen ülkelerdendir (Acar, 2013).

2009 yılından itibaren Türkiye'nin gayrisafi yurtii hasılasındaki yıllık büyümeye oranı sürekli artan oranda artmış ve 2010 yılında en yüksek yıllık büyümeye oranı olan %9.2'ye ulaşmıştır. Türkiye'nin Gayrisafi yurtiçi hasılasındaki büyümeye oranı 2011 yılında %8.8 iken bu oran 2012 yılında %2.1, 2013 yılında %4.2 ve 2014 yılında %2.9 olarak gerçekleşmiştir. 2013 ve 2014 yıllarında Türkiye diğer ülkelere göre gayrisafi yurtiçi hasılada daha büyük oranda büyümeye sağlamıştır. Çalışmamızdaki bu veriler IMF Dünya Ekonomik Görünüm Raporu, 2014 ve T.C Kalkınma Bakanlığı Uluslararası Ekonomik Göstergeler Raporu, 2015' deki verileri destekler niteliktir.

Şekil 5'e göre gayrisafi yurtiçi hasılanın kişi başına düşen miktarı yıllar itibariyle diğer ülkelere göre Norveç'te en fazla, Türkiye'de ise en azdır. 2014 yılında Norveç'te kişi başına düşen gayrisafi yurtiçi hasıla 97.363.1 US\$, iken Almanya'da 42.627.4 US\$, Fransa'da 42.736.2 US\$, İtalya'da 34.960.3 US\$, Barbados'da 15.199.3 ve Türkiye'de ise 10.542.8 olarak belirlenmiştir. Çalışmamızdaki bu veriler IMF Dünya Ekonomik Görünüm Raporu, 2014 ve T.C Kalkınma Bakanlığı Uluslararası Ekonomik Göstergeler Raporu, 2015' deki verileri destekler niteliktir.



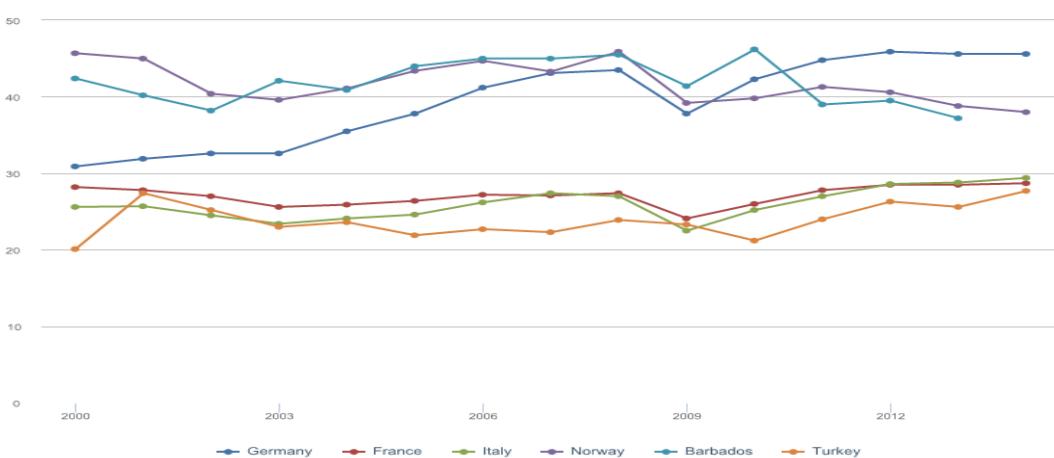
Series : GDP per capita (current US\$)

Source: World Development Indicators

Created on: 07/13/2015

Şekil 5. Gayrisafi yurtiçi hasılanın kişi başına düşen miktarı (US\$)

2014 yılı itibarıyle gayrisafi yurtiçi hasıla içinde mal ve hizmetlerin ihracat oranının en yüksek olduğu ülke Almanya (%45.6) en düşük olduğu ülke ise Türkiye (%27.7) olmuştur. Türkiye %27.7'lik ihracat orANIYLA 2000 YILINDAN İTİBAREN EN YÜKSEK İHRACAT ORANI YAKALAMIŞTIR. IMF DÜNYA EKONOMİK GÖRÜNÜM RAPORU, 2014 VE T.C KALKINMA BAKANLIĞI ULUSLARARASI EKONOMİK GÖSTERGELER RAPORU, 2015 VERİLERİNE GÖRE 2013 YILINDA ALMANYA'NIN MAL İHRACATI 1452.58 MİLYAR ABD DOLARI, TÜRKİYE'NİN MAL İHRACATI İSE 151.81 MİLYAR ABD DOLARI OLARAK HESAPLANMIŞTIR (ŞEKİL 6). 2014 YILI İTİBARIYLE BARBADOS ÜLKESİNİN MAL VE HİZMET İTHALAT DEĞERLERİ BİLNİMEMEKLE ERABER, ALMANYA %39.2 ORANLA 1. ÜLKE OLURKEN ALMANYA'YI SIRAŞILA %32.1 ORANLA TÜRKİYE, %30.5 ORANLA FRansa, %29.6 ORANLA NORVEÇ VE %26.2 ORANLA İTALYA İZLEMİKTEDİR (ŞEKİL 7).

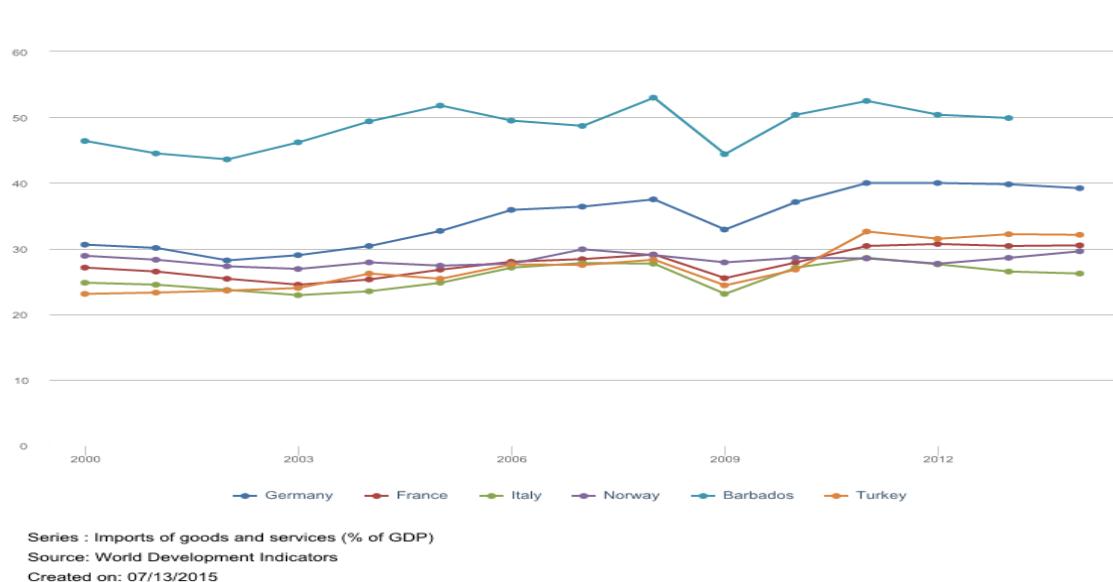


Series : Exports of goods and services (% of GDP)

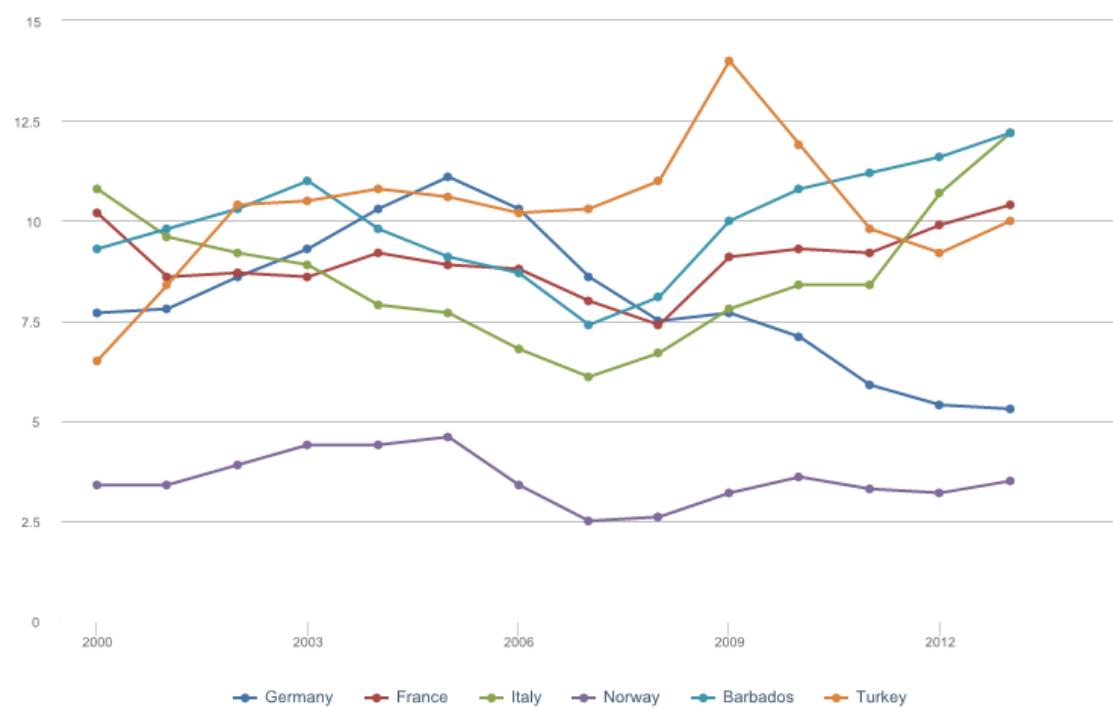
Source: World Development Indicators

Created on: 07/13/2015

Şekil 6. Gayrisafi yurtiçi hasıla içinde mal ve hizmetlerin ihracat oranı (%)



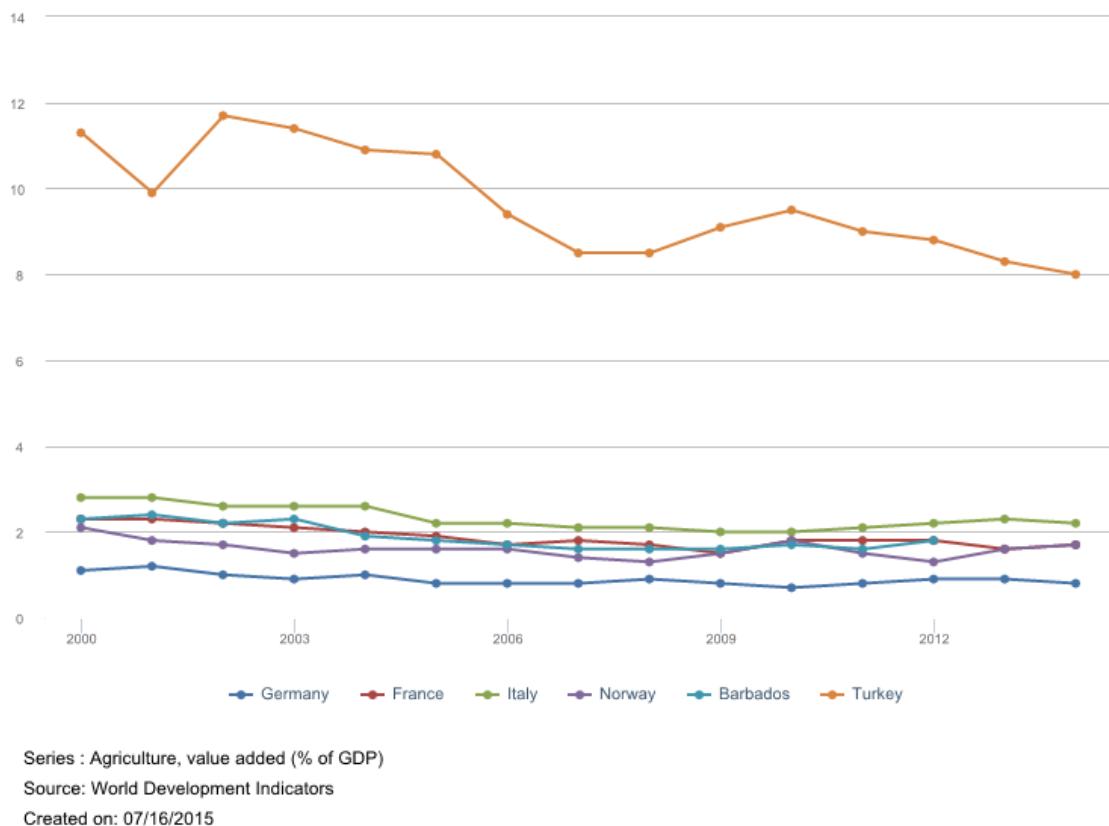
Şekil 7. Gayrisafi yurtiçi hasıla içinde mal ve hizmetlerin ithalat oranı (%)



Şekil 8. İşsizlik oranları

Eser ve Terzi (2008)'e göre; işsizlik hem gelişmiş hem de gelişmekte olan ülkelerde karşılaşılan önemli problemlerden birisi olmaya devam etmektedir. İşsizlik ülkelerin sosyo-ekonomik durumlarına göre farklılık gösterse de çoğu ülkenin en büyük sorunlarından bir tanesini oluşturmaktadır. İşsizlik oranı, Uluslararası Çalışma Örgütü (UÇÖ)'ne göre istihdam edilmeyen faal olarak iş arayan herkesi kapsamaktadır. İşsizlik oranları seçili ülkeler için Şekil 8'de verilmiştir. 2013 yılı itibarıyle işsizlik oranının en düşük olduğu ülkenin %3,5 ile Norveç olduğu Barbados ve İtalya'da aynı yıl işsizlik oranın %12,2 olduğu saptanmıştır. 2013 yılında Türkiye'de işsizlik oranı %0 olarak belirlenmiştir. TÜİK (2015) verilerine göre, İşsizlik oranı %11,2

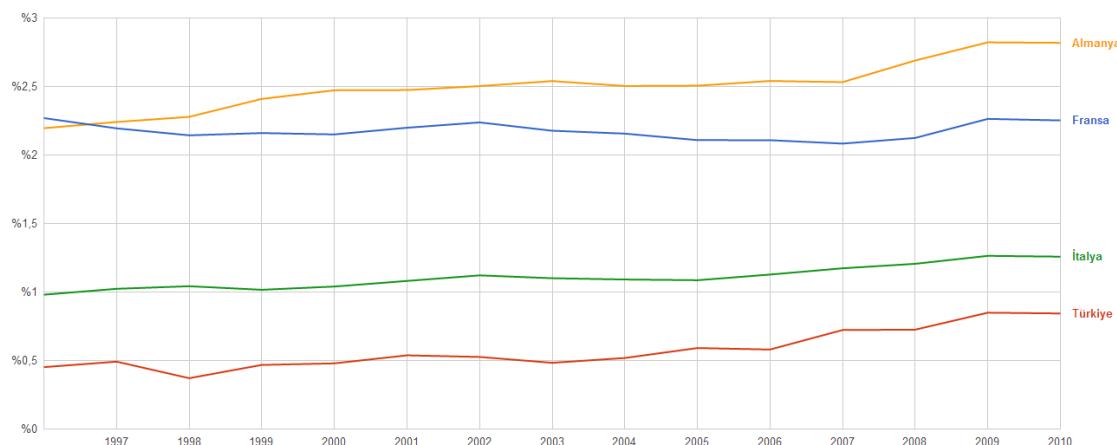
seviyesinde gerçekleşmiştir. Aynı dönemde; tarım dışı işsizlik oranı %13,2 olarak tahmin edilmiştir. İstihdam oranı 2012 yılında %52,8 iken, 2013 yılında %53,4'e ulaşmıştır. 2013 yılında istihdam oranı kadınlarda %31,8, erkeklerde ise %75,3 olmuştur. Türkiye'de işsizlik oranı gelişmiş ülkelerin tersine, eğitimli kişiler arasında daha yüksektir. Türkiye'deki işsizliğin asıl nedeni ise, ilk kez iş arıyor olma ve işlerin doyurucu olmaktan uzak bulunmasıdır. İşsizlik daha çok hane halkı reisi olmayan kişiler arasında yaygındır (Aktürk, 1999; Kanca, 2012). Acar (2013) tarafından yapılan bir çalışmada %9,9 olan Türkiye'nin işsizlik oranı, %11 olan 8 AB üyesi ülke ortalamasının altında; ancak AB üyesi olan Almanya, İngiltere, Danimarka, Hollanda gibi ülkelerin üzerinde olduğu saptanmış, bunun için işsizlik alanında yeni çözüm önerileri geliştirmek ve sorunun temeline yönelik önemli çalışmalar yapma zorunluluğu olduğu öngörülülmüştür.



Şekil 9. Tarımın gayrisafi yurtiçi hasılaya katkısı (%)

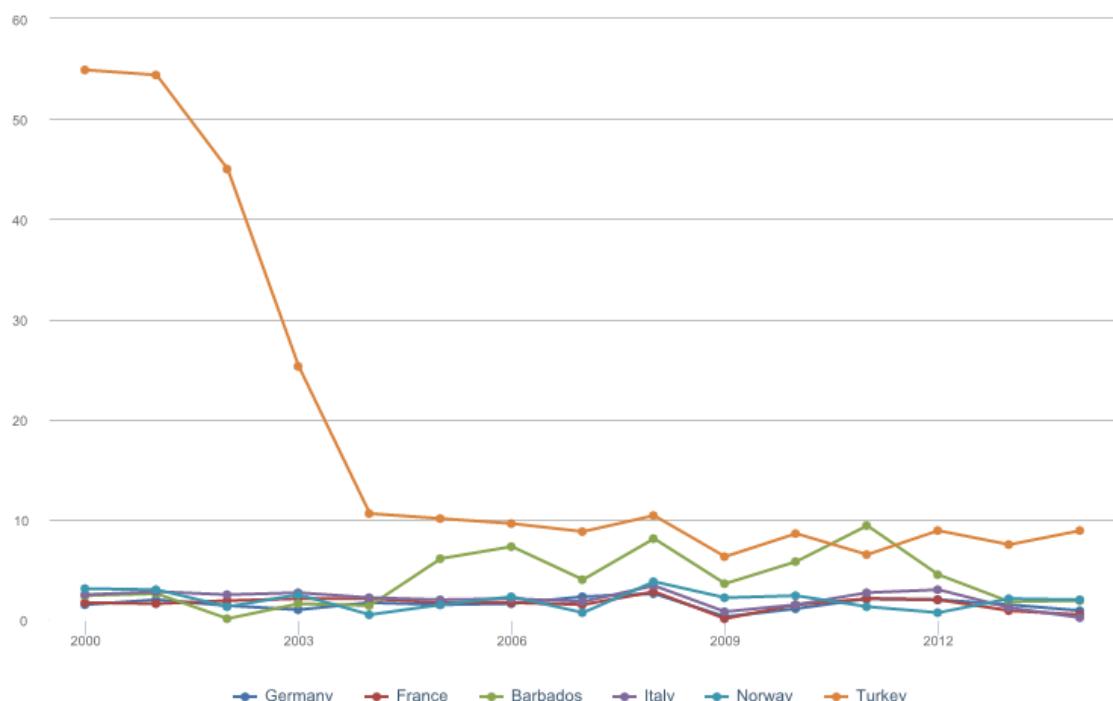
Tarımın yıllar itibarıyle gayrisafi yurtiçi hasılaya olan katkısı diğer ülkelere nazaran Türkiye'de daha fazla dalgalanma göstermektedir. 2002 yılında gayrisafi yurtiçi hasılaya %11.7 oranla en yüksek katkı değerini sağlayan tarım sektörü 2008 yılına kadar sürekli olarak azalma eğilimi göstermiş ve %8.5 oranda katkı sağlamıştır. 2014 yılında ise tarımın gayrisafi yurtiçi hasılaya olan katkısı %8 olarak hesaplanmıştır. Diğer ülkelerin 2014 yılı itibarıyle tarımın gayrisafi yurtiçi hasılaya olan katkısı Türkiye'ye nazaran daha düşük seviyelerdedir (Şekil 9).

Araştırma ve geliştirme harcamaları (GSYİH'nin yüzdesi)



Şekil 10. Gayrisafi yurtıcı hasılda araştırma geliştirmeye yapılan harcamanın oranı

Ülkelerin Gayrisafi Yurtıcı Hâsılası (GSYİH) içerisinde, araştırma ve geliştirmeye yapılan kamu harcamalarının oranına baktığımızda 2010 yılı verilerine göre Türkiye %0.84 ile en düşük seviyede harcama yapan ülkedir (Şekil 10). En fazla kamu harcaması yapan ülke %2.82 ile Almanya'dır, ardından %2.25 ile Fransa ve %1.26 ile İtalya gelmektedir (Girit, 2014). Ar-Ge Harcamasının Gayri Safi Yurtıcı Hasıla (GSYH) içindeki payı 2011 yılında %0.86 iken, bu oran 2012 yılında %0.92 olarak hesaplanmıştır (TÜİK, 2013).



Series : Inflation, consumer prices (annual %)

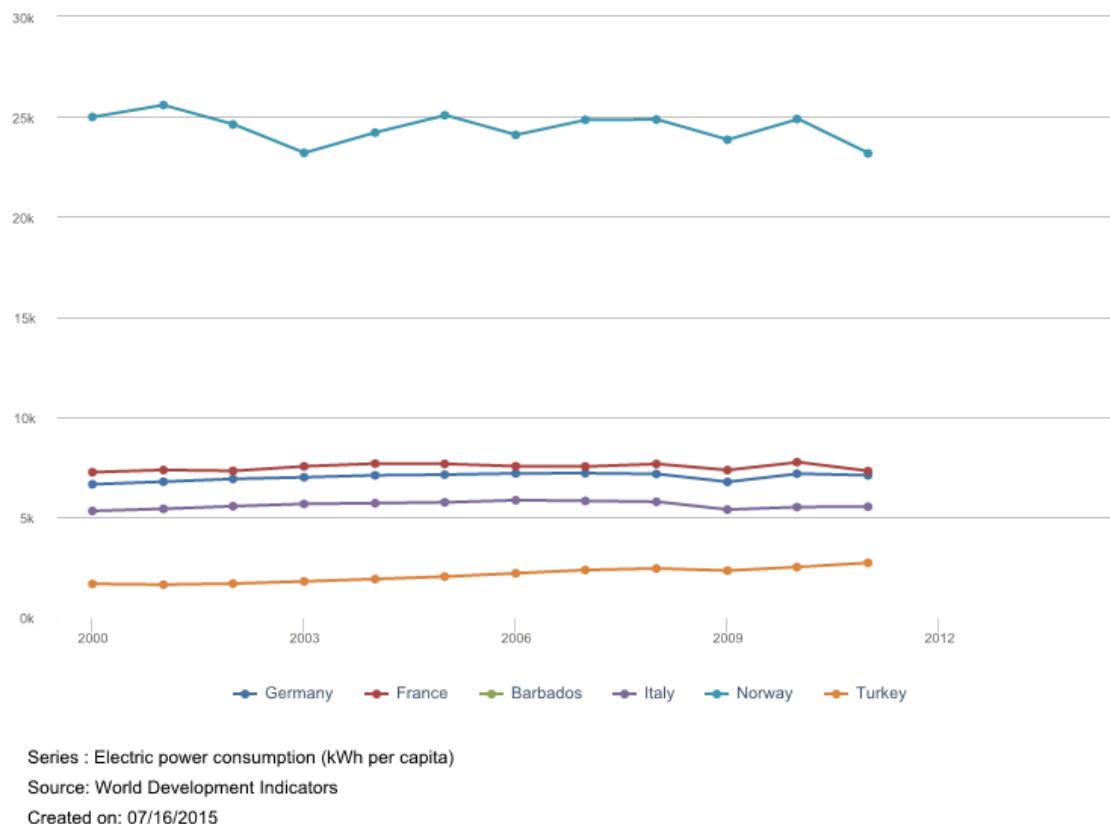
Source: World Development Indicators

Created on: 07/16/2015

Şekil 11. Yıllık enflasyon, tüketici fiyatları

Ülkelerde, tüketici endeksi türünden enflasyon oranlarına aktığımızda, Türkiye ile Avrupa Birliği Kurucu Ülkeleri arasında ciddi bir uçurum gözlemlenmektedir. Türkiye 2000'den 2004 yılına kadar yüksek enflasyon oranlarına sahipken; diğer ülkelerde enflasyon oranları daha düşüktür (Şekil 11). Girit (2014) tarafından yapılan bir çalışmada enflasyon oranları 2012 yılı verilerine göre, Türkiye'de %8.89, İtalya'da %3.04, Almanya'da %2.01 ve Fransa'da %1.96'dır. 2014 yılı verilerine göre, bu oranlar Türkiye'de %8.9 iken diğer ülkelerde %0.2 olarak gerçekleşmiştir (The World Bank, 2015). Acar (2013)'e göre, ülkemizde uzun yıllar

kayıt dışılığın en önemli nednlerinden biri olarak kabul edilen ve ekonomik istikrarı bozan, uzun bir dönem % 50'lerin üzerinde seyreden yüksek enflasyon, 2002 yılından itibaren alınan tedbirler sonucu önemli ölçüde düşürülmüş, bugün geldiğimiz noktada özellikle 2008 yılı sonrası % 10'ların altında seyretmiştir. Bu durum ekonomik istikrar açısından oldukça önemlidir.

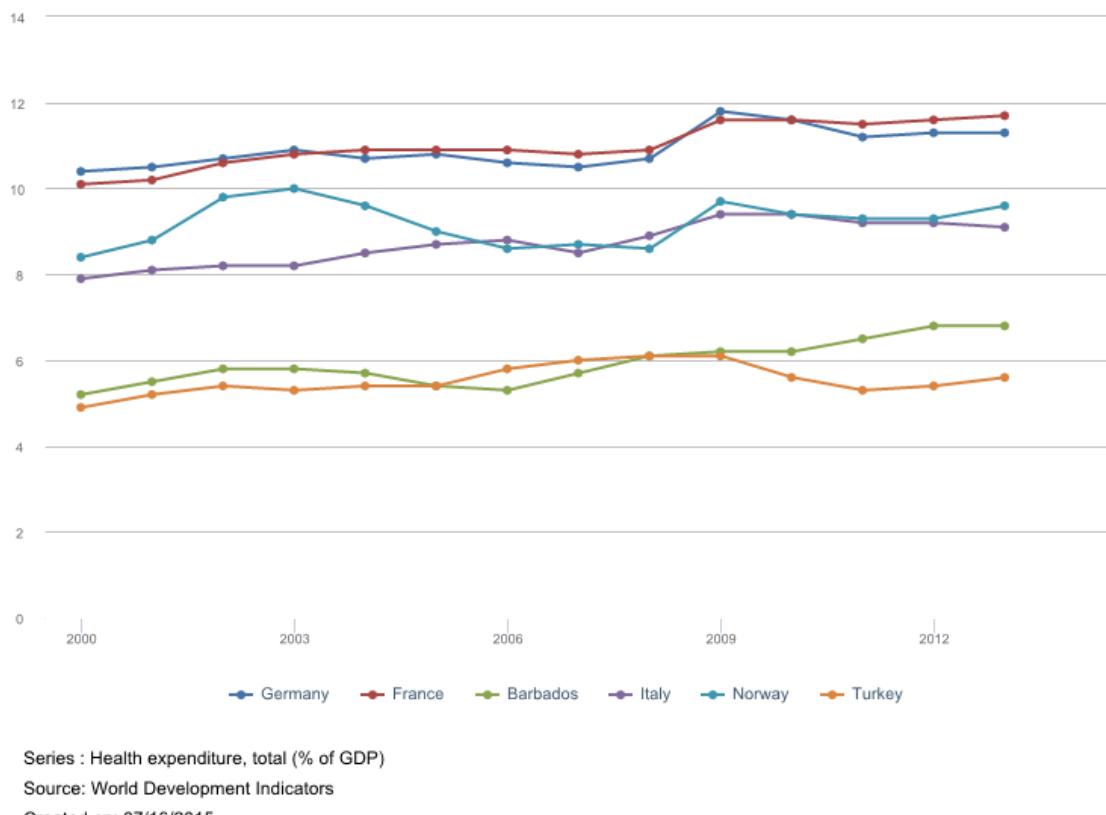


Şekil 12. Kişi başına düşen elektrik tüketimi (Kilovatsaat)

Ülkelerin yıllık kişi başı elektrik tüketim miktarında 2011 verilerine baktığımızda, Norveç 23.173.6 milyar kW ile ilk sırada bulunmaktadır. Sonrasında 7.292.8 milyar kW ile Fransa ve Almanya 5.514.8 milyar kW ile İtalya gelirken; Türkiye 2.709.3 milyar kW saat ile son sırada yer almaktadır (Şekil 12). Barbados ülkesine ait kişi başı elektrik tüketimi verileri bulunamamıştır.

Toplam sağlık harcamaları, kamu ve özel sağlık harcamalarının toplamıdır. Sağlık hizmetlerini (önleyici ve tedavi edici), aile planlaması etkinliklerini, beslenme etkinliklerini ve acil sağlık yardımını kapsar, ancak su ve hıfzıssıhha teminini kapsamaz (Girit, 201).

Şekil 13'de sağlık harcamalarının toplam gayrisafi yurtıcı hasıla içindeki oranları verilmiştir, 2013 yılı itibarıyle Fransa %11.7 oranla ilk sırada yer alırken Fransa'yı sırasıyla %11.3 ile Almanya, %9.6 ile Norveç, %9.1 ile İtalya, %6.8 ile Barbados ve %5.6 ile Türkiye izlemektedir.

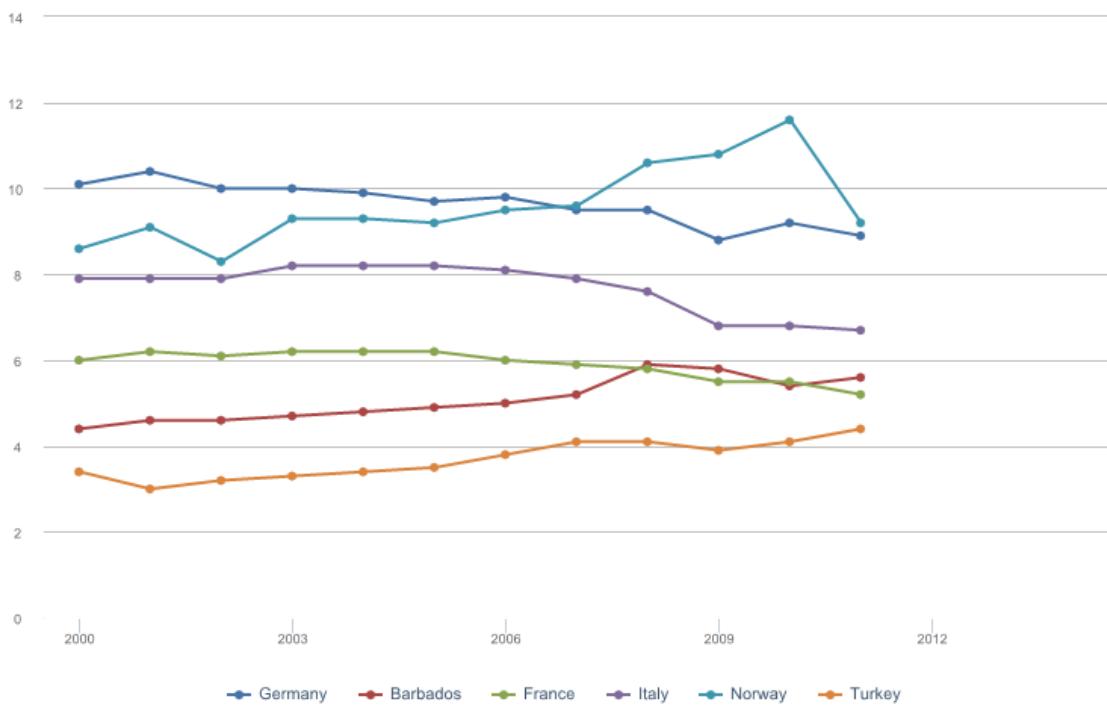


Şekil 13. Sağlık harcamalarının toplam gayrisafi yurtiçi hasıladaki oranı (%)

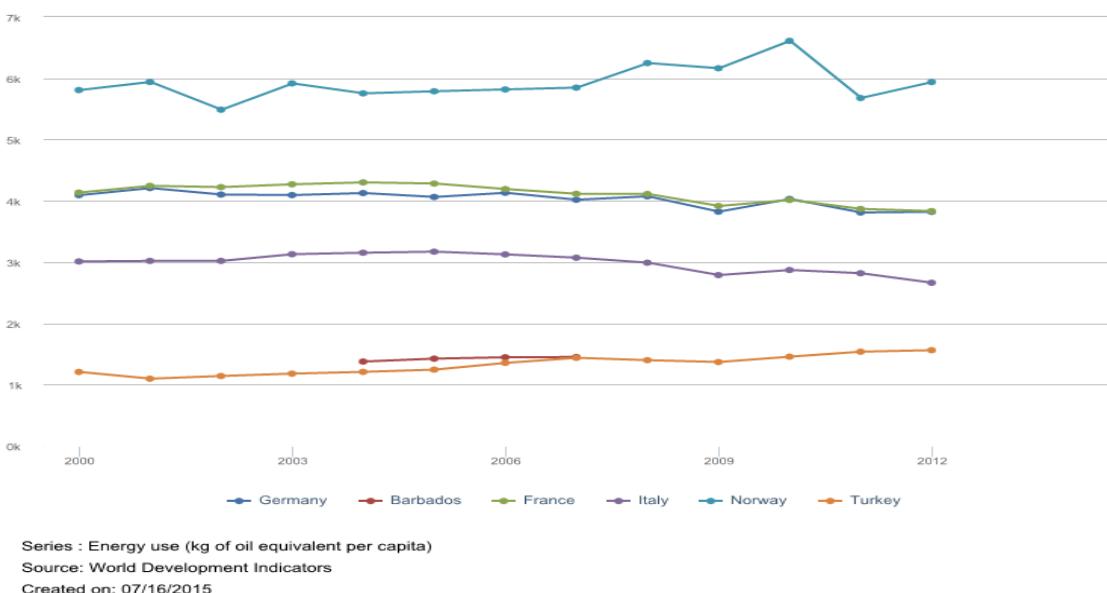
Karbondioksit emisyonları, fosil yakıtların yakılması ve çimento üretiminden kaynaklanan emisyonlardır. Bunlar, katı, sıvı ve gaz yakıtların tüketimi ve gaz yakımı sırasında üretilen karbondioksiti içerir (Girit, 2014).

Ülkelerin Karbondioksit ( $\text{CO}_2$ ) Emisyonu salınımları düzeylerine baklığımızda, doğaya en yüksek seviyede karbondioksit bırakılan ülkenin, 2011 yılı verilerine göre 9.2 metrik ton ile Norveç olduğu belirlenmiştir. En düşük seviyede karbondioksit salınımlı yapan ülkenin ise 4.4 metrik ton ile Türkiye olduğu saptanmıştır (Şekil 14).

Kişi başına düşen enerji kullanımının (petrol eşdeğeri kg) verilerine bakıldığına 012 yılı itibariyle Norveç 5.941.6 kg petrol ile ilk sıradaki ülke olurken, Türkiye 1.563.6 kg petrol ile son sırada yer almıştır (Şekil 15).



Şekil 14. Karbondioksit (CO<sub>2</sub>) Emisyonu (kişi başına metrik ton)



Şekil 15. Kişi başına düşen enerji kullanımı (petrol eşdeğeri kg)

## DEĞERLENDİRME VE SONUÇ

Avrupa Birliği kurucu ülkeleri olan Almanya, Belçika, Fransa, Hollanda, İtalya ve Lüksemburg arasından nispeten Türkiye ile benzer özelliklere sahip olan Almanya, Fransa ve İtalya ile "Çok yüksek insani gelişme endeksine" sahip ülkeler sıralamasında 1. Sırada olan Norveç ile 47. Sırada olan Barbados ülkeleri ile Türkiye'nin sürdürülebilir kalkınma göstergeleri bakımından karşılaştırılması amacıyla yapılan bu çalışmaya göre;

2013 ve 2014 yıllarında Türkiye diğer ülkelere göre gayrisafi yurtıcı hasılada daha büyük oranda büyümeye sağlamıştır. Gayrisafi yurtıcı hasılanın kişi başına düşen miktarı yıllar itibarıyle diğer ülkelere göre Norveç'te en fazla, Türkiye'de ise en azdır. 2014 yılı itibarıyle gayrisafi yurtıcı hasıla içinde mal ve hizmetlerin ihracat oranının en yüksek olduğu ülke Almanya (%45.6) en düşük olduğu ülke ise Türkiye (%27.7) olmuştur. 2014 yılı itibarıyle ülkelerin mal ve hizmet ithalat değerlerinde Almanya %39.2 oranla 1. Ülke olurken Almanya'yı sırasıyla %32.1 oranla Türkiye, %30.5 oranla Fransa, %29.6 oranla Norveç ve %26.2 oranla İtalya izlemektedir. 2013 yılı itibarıyle işsizlik oranının en düşük olduğu ülkenin %3.5 ile Norveç olduğu Barbados ve İtalya'da aynı yıl işsizlik oranın %12.2 olduğu saptanmıştır. 2013 yılında Türkiye'de işsizlik oranı %10 olarak belirlenmiştir. 2014 yılında ise tarımın gayrisafi yurtıcı hasılaya olan katkısı %8 olarak hesaplanmıştır. Diğer ülkelerin 2014 yılı itibarıyle tarımın gayrisafi yurtıcı hasılaya olan katkısı Türkiye'ye nazaran daha düşük seviyelerdedir.

Ülkelerin Gayrisafi Yurtıcı Hâsilası (GSYİH) içerisinde, araştırma ve geliştirmeye yapılan kamu harcamalarının oranına baktığımızda 2010 yılı verilerine göre Türkiye %0.84 ile en düşük seviyede harcama yapan ülkedir. 2014 yılı yıllık enflasyon, tüketici fiyatları verileri Türkiye'de %8.9 iken diğer ülkelerde %0.2 olarak gerçekleşmiştir. Yıllık enflasyon oranları 2002 yılından itibaren alınan tedbirler sonucu önemli ölçüde düşürülmüş, bugün geldiğimiz noktada özellikle 2008 yılı sonrası % 10'ların altında seyretmiştir. Bu durum ekonomik istikrar açısından oldukça önemlidir. Ülkelerin yıllık kişi başı elektrik tüketim miktarında Türkiye 2.709.3 milyar kW saat ile son sırada yer almaktadır. Sağlık harcamalarının toplam gayrisafi yurtıcı hasıla içindeki oranlarında 2013 yılı itibarıyle Fransa %11.7 oranla ilk sırada yer alırken Fransa'yı sırasıyla %11.3 ile Almanya, %9.6 ile Norveç, %9.1 ile İtalya, %6.8 ile Barbados ve %5.6 ile Türkiye izlemektedir.

Bu veriler ışığında; Türkiye'de önemli yapısal reformlar ve alınan idari karar ve uygulamalar sonucu temel parametrelerde çok önemli iyileşme ve gelişmeler kaydedilmiş, Türkiye'nin AB ortalamasında bir sürdürülebilir kalkınma düzeyine sahip olduğu ve AB ülkelерinden büyük farklılıklar göstermediği söyleyebilir. Sürdürülebilir kalkınma uygulamaları; bölgesel kaynaklar, bölgesel aktörler ve dinamiklerin bunu kollektif olarak benimsemesi, desteklemesi ve aktif katılımı durumunda sonuç verebilecektir. Türkiye için entegre edilmiş sürdürülebilir kalkınma ilkeleri ve yöntemlerinin oluşturulması, sürdürülebilir kalkınma önceliklerinin belirlenmesi ve yönetiminde geniş bir yelpazede paydaşları dahil etme amacını güden çok fonksiyonlu ve katılımcı bir planlama yapılmalıdır. Türkiye'de, Sürdürülebilir Kalkınma yaklaşımı doğrultusunda, insan sağlığını ve doğal dengeyi koruyarak ekonomik kalkınmaya imkan verecek, doğal kaynakların optimum kullanımını sağlayacak, gelecek kuşaklara daha sağlıklı, doğal, fiziki ve sosyal çevre bırakacak yönde çevre politikaları ile ekonomik ve sosyal politikaların entegrasyonunun sağlanması ve bu konuda ekonomik araçlardan yeterince faydalanan çabaları benimsenmelidir.

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## THE INVESTIGATION OF SOME OF THE OPERATION PARAMETERS FOR REMOVAL OF COLOR FROM OLIVE MILL WASTEWATER BY ELECTROOXIDAION PROCESS

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### ABSTRACT

In this study results obtained from electro-oxidation process with Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anode was investigated for color removal from olive mill wastewater. Mixed metal oxide covered Ti/IrO<sub>2</sub>/RuO<sub>2</sub> sieve-plates were used as anode material and titanium sieve-plates as cathode material. Stirring rates (0-600 rpm), dilution rate (1/5-5/5) and support electrolyte concentration (0.25-1.25 M) parameters were tested in subsequent reactor to investigate their effects on removal of color. According to results obtained, in electro-oxidation process without stirring which NaCl was used as support electrolyte provided 99% removal of color from olive mill wastewater.

**Keywords:** Color removal; electro-oxidation; olive mill wastewater; Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anode

### 1. INTRODUCTION

Olive oil is mechanically obtained from ripe fruit of olive tree which is widely grown in Mediterranean region, is liquid in room temperature, has changing colors between green to yellow, has a unique taste and odor, is a vegetable oil that can be consumed naturally (Gümüşkesen and Yemişcioğlu, 1999; Tokuşoğlu, 2010). Production process of olive oil creates environmental problems in production area as a result of high organic loads and volatile fatty acids (Stasinakis et al., 2008). Amount of wastewater discharged and its properties changes depending on production process (Vitolo et al., 1999).

In this study removal of color from olive mill wastewater were investigated by using Ti/IrO<sub>2</sub>/RuO<sub>2</sub> sieve-plates as anode material and Ti plates as cathode material with changing pH, support electrolyte type and current density parameters.

### 2. MATERIAL AND METHODS

Effects of different pH, support electrolyte type and current density in removal of color from olive mill wastewater through electro-oxidation process were investigated. Wastewater used for experiments was taken from olive oil process mill Balıkesir/Turkey. Properties of wastewater listed in Table 1. Reactor with 10 cm inner diameter, 16 cm depth and 800 ml of total volume, which had Ti/IrO<sub>2</sub>/RuO<sub>2</sub> as anode material and Ti plates as cathode, was used in this study. 5 anode and 5 cathode plates were used for total surface area of 2600 cm<sup>2</sup>. DC power supply (Quassar 150 Switch Mode) was used to provide electricity and Pt/Co method was used for color analysis (Oktav et al., 2003). Equation 1 was used for color removal fraction and graphs for time-color removal fraction were plotted.

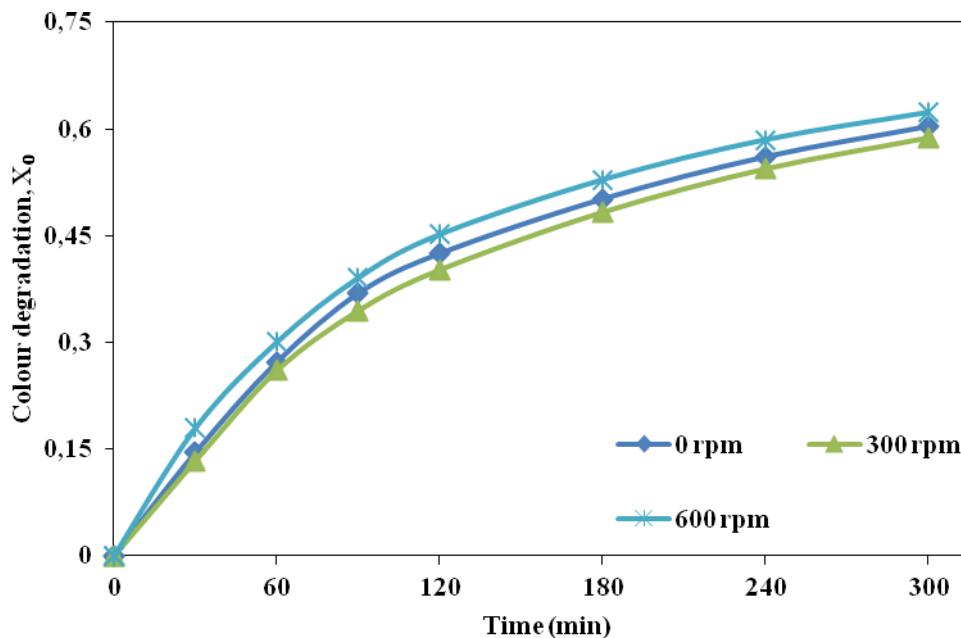
$$\text{Removal Fraction (X}_0\text{)} = (\text{C}_0\text{-C}_t)/\text{C}_0 \quad (1)$$

**Table 1. Properties of olive mill wastewater used in the study**

Parameter	Value
COD(Chemical Oxygen Demand) (mg L <sup>-1</sup> )	46 000 – 54 000
Color (Pt/Co)	13 000 – 14 000
Conductivity (ms cm <sup>-1</sup> )	9.24 – 9.47
pH	4.56 – 4.69

### 3. RESULTS AND DISCUSSION

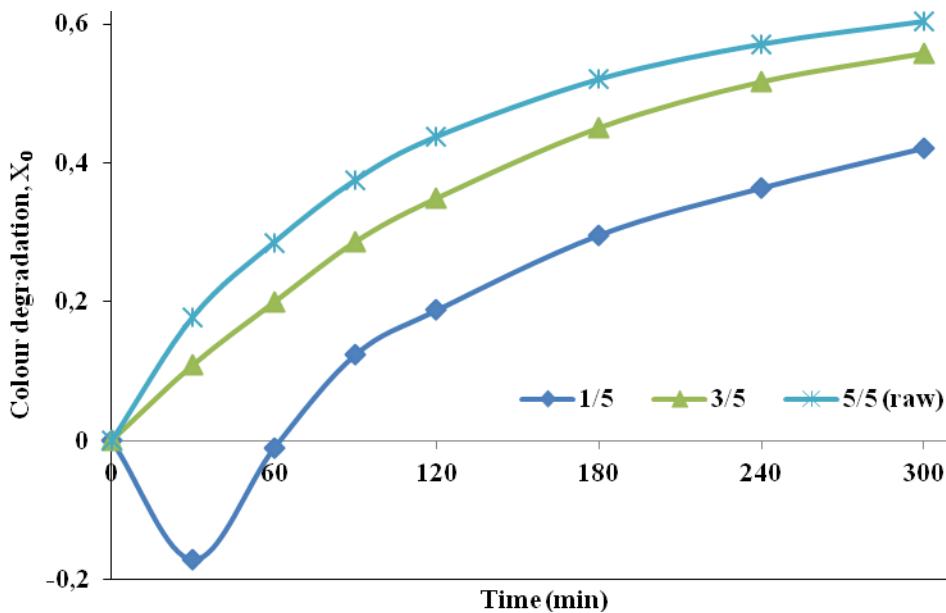
**3.1. Stirring Rate:** Wastewater was continuously stirred by magnetic stirrer to investigate effect of stirring rate. To investigate effect of stirring rate on color removal fractions for Ti/IrO<sub>2</sub>/RuO<sub>2</sub> 0, 300 and 600 rpm stirring rates were tested at constant temperature of 20°C controlled by liquid circulator, at current density of 7.69 mA cm<sup>-2</sup> and natural pH of wastewater (4.5-4.7). Samples taken against time were diluted and color analyses were performed. Results are given at Figure 1.



**Figure 1.** Effect of Stirring rate on color removal fraction

As seen in Figure 1, in tests with Ti/IrO<sub>2</sub>/RuO<sub>2</sub> color removal fractions weren't effected much from increase in stirring rate. It even led to a slight increase in removal fractions. When stirring rate was increased from 0 to 300 color removal fraction was decreased from 0.60 to 0.59. When stirring rate was increased from 300 to 600, color removal fraction was increased by 0.03 and resulted as 0.62. Increase of stirring rate to certain value increases diffusion of organic pollutants onto anode surface which causes increase on removal fractions for each parameter. But excessive increase in stirring rate decreases removal fraction by weakening effect of diffusion on anode surface. However, it was decided to use 0 rpm stirring rate in further tests for olive oil mill wastewater removal with Ti/IrO<sub>2</sub>/RuO<sub>2</sub> mixed metal oxide covered anode, because of the small changes on removal fractions and the idea to reduce system cost.

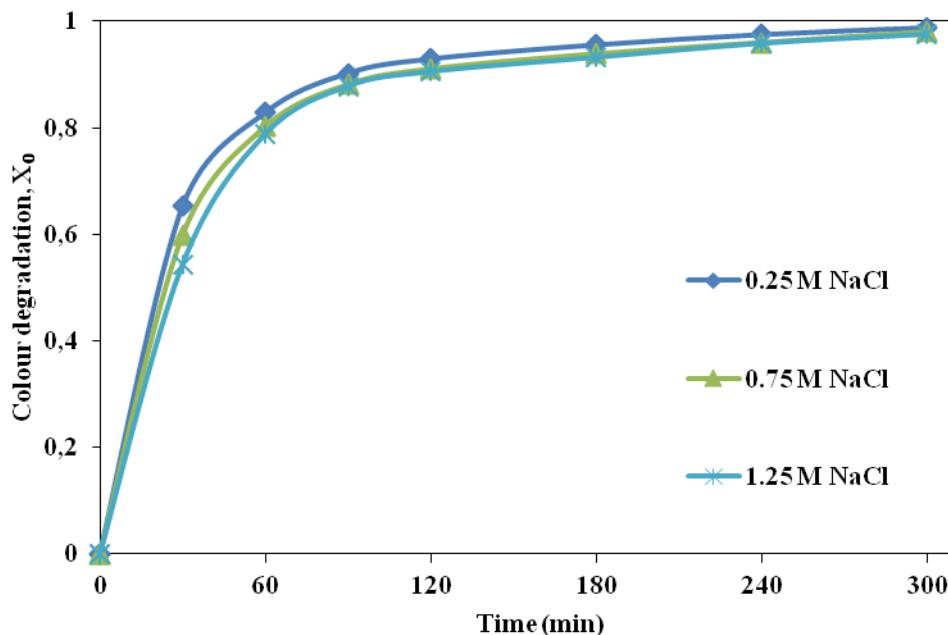
**3.2. Dilution Rate:** Experiments to investigate effect of dilution rate were performed at constant temperature of 20°C controlled by liquid circulator, current density of 7.69 mA cm<sup>-2</sup>, natural pH of wastewater (4.5-4.7) and with no stirring. Distilled water were used for dilutions and 1/5, 3/5, and 5/5 dilution rates were selected. Effect of dilution rates of 1/5, 3/5, 5/5 (raw) on color removal fractions when using Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anodes were investigated. Samples taken against time were diluted and color analysis were performed. Results obtained after 5 hour experiment period are given at Figure 2.



**Figure 2.** Effect of dilution rate on color removal fraction.

As seen in Figure 2, Increase in dilution rate showed increase on removal fractions when Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anodes were used. When dilution rate was changed from 1/5 to 3/5, color removal fractions were increased by 0.14 and resulted as 0.56. When dilution rate was increase from 3/5 to 5/5(raw), color removal fractions were increased from 0.56 to 0.60. Increasing dilution rate decreases organic pollutant load and increases color removal fractions. Therefore, use of 1/5 dilution rate was decided in further experiments with Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anode.

**3.3. Support electrolyte concentration:** In studies to investigate support electrolyte type, use of 0.25, 075 and 1.25 M NaCl concentrations was decided. For experiments, current density was set to 7.69 mA cm<sup>-2</sup>. Stirring wasn't applied and wastewater was diluted 5 times at natural pH of wastewater and constant temperature of 20°C controlled by liquid circulator. Support electrolyte type effect on color removal fractions for Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anode was investigated. Samples were taken against time and color analysis was performed. Results for 5 hour experiment period are given in Figure 3.



**Figure 3.** Effect of support electrolyte concentration on color removal fraction.

As seen in Figure 3, Ti/IrO<sub>2</sub>/RuO<sub>2</sub> anode used experiments showed small or no effects on removal fractions with changing support electrolyte concentrations. When 1.25 M support electrolyte was used color removal fractions were 0.98. When support electrolyte concentration was decreased to 0.25 M color removal fractions were 0.99. When support electrolyte concentration was selected as 0.75 M color removal fractions were 0.99. Removal fractions increases with increasing support electrolyte concentrations but also increases wastewater conductivity. Therefore support electrolyte concentration was decided as 0.25 M NaCl for Ti/Ir<sub>2</sub>/RuO<sub>2</sub> anodes to keep conductivity at minimum and to decrease system cost.

## CONCLUSION

In study to investigate color removal by using electro-oxidation with Ti/IrO<sub>2</sub>/RuO<sub>2</sub> sieve-plated anodes under different conditions, It was found that color removal from olive oil mill wastewater by electro-oxidation process method in presence of Ti/IrO<sub>2</sub>/RuO<sub>2</sub> sieve-plates was highly effective. 99% color removal fraction was obtained at current density of 7.69 mA/cm<sup>2</sup>, at 0.25 M NaCl support electrolyte concentration, at 1/5 dilution rate and at natural pH of olive oil mill wastewater.

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## THE EFFECT OF STIRRING RATE, SUPPORT ELECTROLYTE TYPE AND TEMPERATURE ON COLOR REMOVAL FROM OLIVE MILL WASTEWATER

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### ABSTRACT

In this study removal of color from olive mill wastewater by electro-oxidation results, which is one of the most commonly used advanced oxidation process for many industrial wastewater, were investigated. In electro-oxidation process Ti/Pt sieve-plates as anode material and titanium sieve-plates were used as cathode material. In subsequent reactor effects of some parameters such as pH (2-8), support electrolyte type ( $\text{Na}_2\text{SO}_4$ ,  $\text{NaNO}_3$ ,  $\text{KCl}$  and  $\text{NaCl}$ ) and temperature (10-50°C) on color removal were studied. As a result of electro-oxidation processes, in optimum conditions when pH (4.6) was unchanged and at current density of 7.69  $\text{mA cm}^{-2}$ , 100% color removal from olive mill wastewater was reached.

**Keywords:** Color removal; electro-oxidation; olive mill wastewater; Ti/Pt anode

### 1. INTRODUCTION

Production of olive oil, due to its high and toxic organic load, low pH value and color creates environmental problems for Mediterranean region (Stasinakis et al., 2008). In addition, according to literature conventional (batch) and continuous production results in 50 kg water/100 kg olive and 110 kg water/ 100 kg olive wastewater, respectively (Vitolo et al., 1999). Amount of wastewater discharged varies with production process.

In this study, color removal from olive mill wastewater by electro-oxidation were investigated to measure the effect of dilution rate, support electrolyte concentration and current density parameters with Ti/Pt sieve plates as anode material and Ti plates as cathode material.

### 2. MATERIAL AND METHODS

Effects of dilution factor, support electrolyte type and current density in removal of color from olive mill wastewater which was taken from olive oil process mill Balıkesir/Turkey, through electro-oxidation process were investigated. Characteristic of wastewater are listed in Table 1. Reactor used in study has 10 cm inner diameter, 16 cm depth. Also Ti/Pt as anode and Ti sieve-plates were used as cathode material in Reactor. 5 anode and 5 cathode plates were used for total surface area of 2 600  $\text{cm}^2$ . And wastewater volume used for experiments was 800ml. Electricity provided for system by DC power supply (Quassar 150 switch Mode) and color analysis were obtained with Pt/Co method (Oktav et al., 2003). Samples taken against time and using desired dilution rates color removal fractions were calculated with Equation 1 and graphs were plotted.

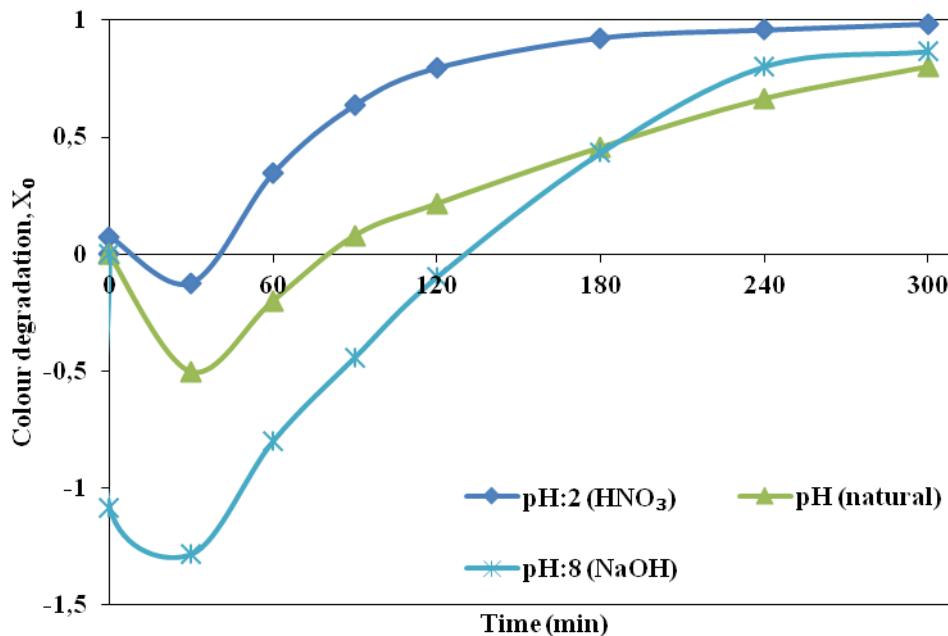
$$\text{Removal Fraction } (X_0) = (C_0 - C_t)/C_0 \quad (1)$$

**Table 1. Properties of olive mill wastewater used in the study**

Parameter	Value
COD(Chemical Oxygen Demand) ( $\text{mg L}^{-1}$ )	46 000 – 54 000
Color (Pt/Co)	13 000 – 14 000
Conductivity ( $\mu\text{s cm}^{-1}$ )	9.24 – 9.47
pH	4.56 – 4.69

### 3. RESULTS AND DISCUSSION

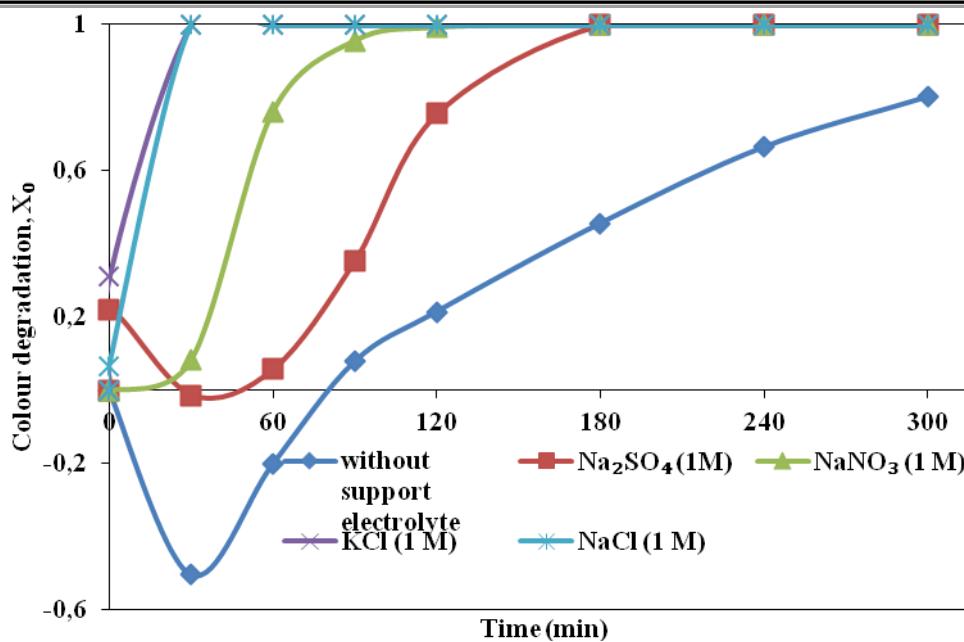
**3.1. Effect of pH change:** Experiments to investigate effect of pH change were performed at constant temperature of 20°C controlled by liquid circulator, current density of 7.69 mA cm<sup>-2</sup>. During experiments no stirring was applied and wastewater was diluted 5 times. pH values 2, 4.6 (natural) and 8 were selected to investigate their effects on removal efficiency for Ti/Pt anodes. Samples were taken against time and color analyses were performed for proper dilution rates. Results obtained after 5 hour period are given at Figure 1.



**Figure 1.** Effect of pH change on color removal fraction.

Figure 1 shows that changes in pH value causes small changes in removal fractions. For pH 2 at end of 5 hour period color removal fraction was 0.98. For natural pH color removal fraction was 0.80. When pH value was increased to 8, color removal fraction was found as 0.87. Even though decreasing pH value increases removal efficiency, there was not too much difference between removal fractions. PH value was decided to remain unchanged due to slight changes in removal efficiency in electro-oxidation with Ti/Pt anodes.

**3.2. Effect of support electrolyte type:** Different types of support electrolytes such as Na<sub>2</sub>SO<sub>4</sub>, NaNO<sub>3</sub>, KCl and NaCl were used for investigation of support electrolyte type effect. Current density was set to 7.69 mA/cm<sup>2</sup>. PH wasn't adjusted to work under natural conditions and temperature of wastewater was kept at 20°C with liquid circulator. No stirring was applied during study and 5 times diluted wastewater was used for experiments. Effect of different types of support electrolyte for Ti/Pt anodes were studied. Diluted samples were taken and color analyses were performed for 5 hour period. Results are given at Figure 2.

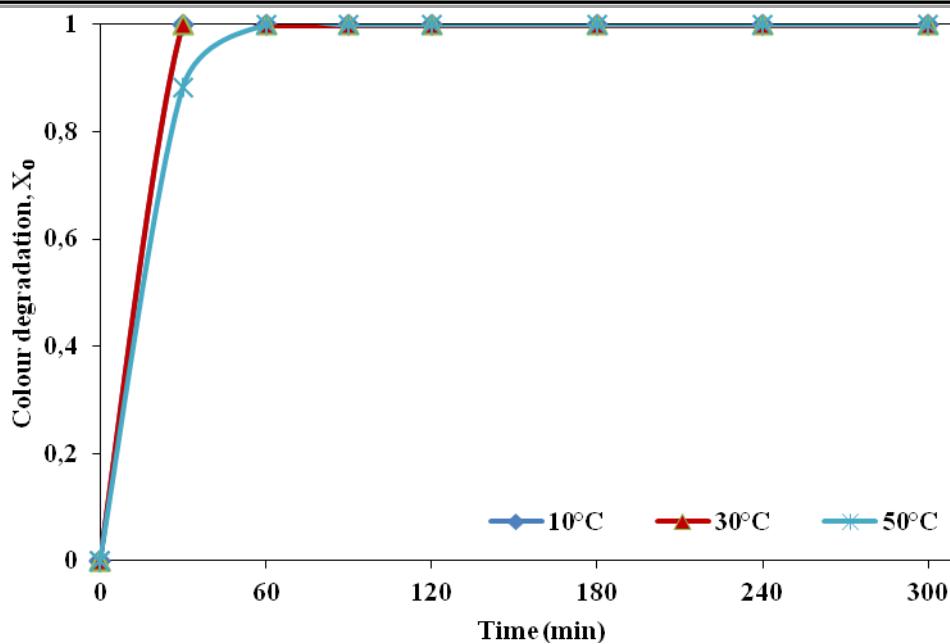


**Figure 2.** Effect of support electrolyte type in color removal fraction.

Figure 2 shows that changing electrolyte type in electro-oxidation process changes color removal fraction substantially. When no support electrolyte was used, color removal fraction was found as 0.80 at the end of 5 hour experiment period. When  $\text{Na}_2\text{SO}_4$  was used, color removal fraction was 1.00. In other experiments with  $\text{NaNO}_3$ ,  $\text{KCl}$  and  $\text{NaCl}$ , removal fractions also increased. When  $\text{NaNO}_3$  was used as support electrolyte type, color removal fraction was found as 0.99. For both  $\text{KCl}$  and  $\text{NaCl}$  color removal fractions was 1.00. As a result when  $\text{Na}_2\text{SO}_4$  was used as support electrolyte, removal fractions did not change significantly. But other electrolyte types such as  $\text{NaNO}_3$ ,  $\text{KCl}$  and  $\text{NaCl}$  changed fractions to some extent. Comparison of electrolyte types for their additional cost showed that  $\text{NaCl}$  was cheaper and more attainable. So using  $\text{NaCl}$  as support electrolyte in electro-oxidation processes with Ti/Pt anodes was decided for further studies.

### 3.3. Effect of temperature change:

$\text{NaCl}$  was selected as support electrolyte type for initial temperature experiments. 10°C, 30°C and 50°C temperatures were tried to measure the effect of temperature changes. PH value of wastewater was kept in natural form and desired temperature was provided through liquid water circulator for 5 hour period. No stirring was applied during experiments and wastewater was diluted 5 times. Removal fractions of Ti/Pt anodes for each temperature was investigated. Samples were taken against time at desired dilution rates and after 5 hour period graphs for removal fractions were plotted at Figure 3.



**Figure 3.** Effect of temperature change in removal fractions.

According to figure 3, removal fractions of Ti/Pt anodes were not affected much by temperature changes. When temperature was 10°C, color removal fractions was calculated as 1.00 which was same for both 30°C and 50°C.

## CONCLUSION

Aim of this study was to investigate electro-oxidation performance of Ti/Pt anodes under different experimental conditions. As a result, Ti/Pt was found to be very effective for color removal fractions. When natural pH value of wastewater was unchanged at current density of 7.69 mA cm<sup>-2</sup> with 0.25 M support electrolyte concentration for 1/5 dilution rate color removal fraction of Ti/Pt anodes was found as 100%.

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## DEVELOPMENT OF A PLUG-FLOW BIODIGESTER WITH A SEMI-AUTOMATED MIXING DEVICE FOR HOUSEHOLD USE

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### ABSTRACT

Mixing/stirring of substrates in a biodigester has been a major factor affecting the performance of household biodigesters. A 2.0 m<sup>3</sup> plug-flow biodigester was fabricated using locally sourced materials (water storage plastic drum, PVC pipes, etc) to produce biogas for household cooking. A semi-automated mixing device fabricated as a framework of PVC pipes was installed in the biodigester and used to stir the substrates. An airbag was improvised using a tarpaulin material to store the biogas produced and was connected to a double-burner table top biogas stove at the kitchen for family cooking. The biodigester was fed every three days with household wastes (dog and rabbit urine and faeces and left over food) and operated differently under two regimes: with no mixing and with mixing five times daily. The results showed that the mixing device aided biogas production and improved the performance of the biodigester. Significant increase (73%) in biogas production was observed when the substrates were stirred. The bubbling sound emanating from the biodigester each time it was stirred suggested that trapped gas was being released from the scum stratum. The mixing device was easy to develop, install and operate and can be easily adapted to different sizes of plug-flow biodigesters. In conclusion, the developed biodigester is suitable for household biogas production and can perform better than the floating drum biodigester.

**Keywords:** Anaerobic digestion, biodigester, mixing device, biogas, air bag

### 1. INTRODUCTION

Biogas is a clean and renewable form of energy that is produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition provided by a biodigester (or bio-reactor). Biogas could very well substitute (especially in the rural sector) for conventional sources of energy (fossil fuels, oil, etc) which are causing ecological-environmental problems and at the same time depleting at a faster rate. Biodigesters can be made of different construction materials and in different shape and size. The performance of biodigesters can be influenced by parameters like temperature, pH, particle size, nutrient, loading rate, agitation, etc. While most of the parameters are feedstock or process related, agitation (or mixing) of the substrates in the biodigester is related to the biodigester design. Mixing is very important to prevent settling and to maintain contact between the bacteria and the substrates. Mixing action also prevents the formation of scum and facilitates release of biogas produced. Mixing has been reported to enhance biogas production (Baier and Schmidheiny, 1997).

There are several types of biodigester designs (floating-drum, fixed-dome, covered lagoon, plug-flow, etc.) developed particularly for household use. Plug flow biodigester is typically a cylindrical tank (with its length greater than the width and depth) in which the gas and other by-products are pushed out one end by new feedstock being fed into the other end. It has no means of agitation. In fact, the situation can be more complicated when some parts of the manure travel faster than others on their way through the vessel, or even settle or float and remain in the digester. Apparently, a means of mixing is needed to overcome this challenge. This study focused on the development of a semi-automated mixing device for a plug-flow biodigester and the development of a plug-flow biodigester equipped with the mixing device for household use.

### 2. MATERIALS AND METHODS

The experiment was conducted in a private residence in Ile-Ife town, South-West of Nigeria, between the months of January and March, 2015, with the ambient temperature ranging between 22 and 39 °C. A black plastic drum commonly used for water storage was adapted and fabricated as a plug-flow biodigester. Black colour was adopted because a black object (with emissivity ≈1) absorbs all wavelengths of light and converts them into heat, so the drum gets warm and aids digestion. The 2.0 m<sup>3</sup> capacity drum (1.24 m diameter and 1.65 m height) was positioned on its side and fitted with 0.10 m and 0.76 m diameter PVC pipes as inlet and outlet pipes, respectively using 45° elbow joint. The inlet was positioned at upper part (0.91 m from the base) for easy feeding while the outlet was at the lower part (0.15 m from the base) to facilitate the outflow of sludge. A

semi-automated mixing device (Figure 1) was fabricated using 0.025 m diameter PVC pipes, elbows, tee joints. The components were coupled inside the biodigester to form a rigid frame that cuts through all the strata before the biodigester was hermetically sealed. A rope was tied to the opposite sides of the device and extended outside the biodigester through the inlet and outlet pipes. At any time, the device flushes with either the inlet or outlet end inside the biodigester. The biodigester was installed in a pit of about 0.5 m deep to give it a firm support against lateral movements and also, to give a solid support to the outlet pipe (Figure 2). A 2.0 m<sup>3</sup>, 3.9 kg capacity pillow-shaped airbag was fabricated using a tarpaulin material to provide storage for the biogas produced (Figure 3). An air valve was fitted to the airbag at the base for in and out flow of biogas. A double burner table top biogas stove also fabricated locally was used for flame testing and cooking. The airbag was located under a shed, 18 m from the biodigester and 5 m from the burner in the kitchen. The biodigester to airbag and airbag to burner connections were done using rubber hoses, PVC pipes and air valves of 0.0127 m diameter.

Each time the rope was pulled to draw the mixing device to either side in the biodigester, the substrates were stirred by the disruption of the strata by the movements of the horizontally and vertically connected pipes. With this method, there was no introduction of air and or leakage of the biodigester and the anaerobic environment inside was fully maintained. The loading capacity of the biodigester was about 70% of the total volume and it was initially loaded with cow dung for culturing of the anaerobic microorganisms. Subsequent feeding commenced after the biogas had started burning efficiently and was done every three days with about 12 kg (wet weight) of household wastes (dog and rabbit urine and faeces and left over food) which were further mixed with water to form a slurry mixture prior to feeding. After three weeks of every three days feeding and mixing five times a day, the biogas production was monitored for four weeks. Afterwards, a lag period of two weeks was allowed during which the biogas production was not monitored and mixing was stopped but feeding was continued. At the end of the lag period, biogas production was monitored for another four weeks. Assessment of biogas production was carried out by placing the airbag on a weighing scale every two days. The difference between the present and previous weight was the weight of the biogas produced. The volume of biogas produced was estimated by dividing the weight by biogas density, 1.15 kg/m<sup>3</sup> (Jorgensen, 2009). Student's t-test was used to compare the biogas production under the two regimes.

### 3. RESULTS AND DISCUSSION

Biogas production started within three days but started burning efficiently at eight days (Figure 4). The early production showed that the heterogeneous feedstock used had a high degree of biodegradability, co-digested effectively and improved the efficiency of the anaerobic digestion process. Results of the t-test showed that there was a significant ( $p \leq 0.05$ ) difference between the average daily biogas production, with higher production recorded when the substrates in the biodigester were stirred. The average daily productions were  $\approx 0.71$  and  $0.41$  m<sup>3</sup> in mixed and not mixed regime, respectively indicating that the mixing device aided biogas production and increased it by up to 73%. The profile of biogas production in each regime (Figure 5) showed fluctuating patterns with the difference increasing as feeding and digestion progressed. The not mixed regime recorded gradual decline in biogas production. This suggested the hardening of the scum stratum and subsequent trapping of biogas below the stratum as feeding and biodegradation progressed. This was confirmed when the biodigester was opened up at the end of the experiment and hardened fibre materials was found floating on top of the slurry. Turbulent bubbling sound emanated from the biodigester each time the substrates was mixed, indicating that trapped gas was being released from the scum stratum. This was observed by carefully placing an ear on the biodigester wall. However, during the not mixed regime, mild bubbling sound was always observed from the biodigester. The quality of the digestate coming out of the effluent pipe each time feeding was done showed that the not mixed regime had thicker and blacker digestate. This may have been due to the settlement of some fractions of the wastes during digestion.

### 4. CONCLUSIONS

The results from the experiment showed that a semi-automated mixer in a plug-flow biodigester aided biogas production and enhanced the performance of the biodigester. Biogas production increased by 73% when the substrates were mixed. The mixing device was easy to develop, install and operate and can be easily adapted to different sizes of plug-flow biodigesters. In addition, the developed biodigester is suitable for household biogas production and can perform better than the floating drum biodigester.

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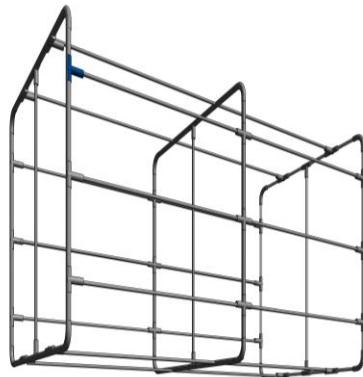


Figure 1. Orthographic view of the semi-automated mixing device.



Figure 2. The installed plug-flow biodigester equipped with the mixing device.



Figure 3. The airbag filled with biogas.



Figure 4. Biogas flame from a table top burner.

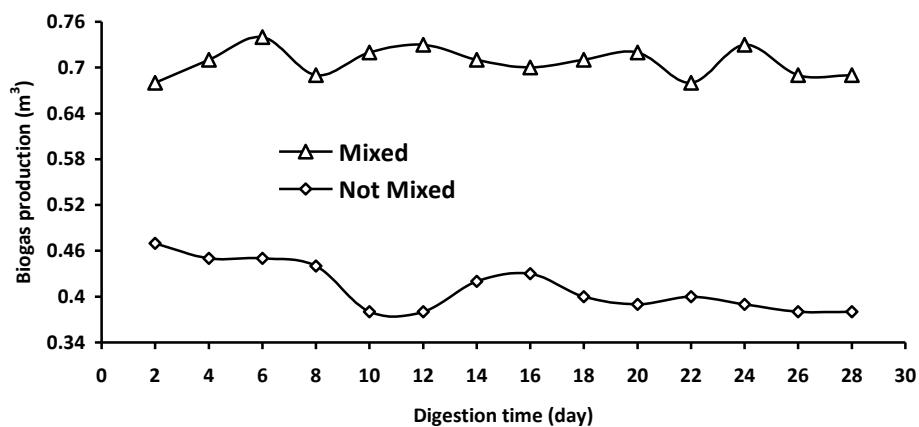


Figure 5. Profile of biogas production during the experiment.

## ACUTE TOXICITY DETERMINATION OF ANTIBIOTICS BY LEPIDIUM SATIVUM, DAPHNIA MAGNA AND VIBRIO FISCHERI TOXICITY TEST METHODS

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### ABSTRACT

Antibiotics are among the extensively used medications by humans and animals. Drugs are the chemicals used for the protection of humans/animals health, and treatment and prevention of diseases. Most of the antibiotics used by humans and animals are introduced into sewer system without undergoing any change through feces and urine, and discharged to aquatic environment directly or together with outlet waters of waste water treatment system.

All three toxicity test when the test results are analyzed, different sensitivities for antibiotics with different characteristics. It was observed that the most sensitive values were obtained from Vibrio fischeri toxicity test method among others.

In Lepidium sativum test, among human antibiotics, Azro had toxic effect on the root but had a very toxic effect on the stem. Unlike other two antibiotics, Tetra had very toxic effect on the root (TU: 21,05) and stem (TU: 16,95) and Klindan had toxic effect on the root (TU: 1,97) and stem (TU: 1,58).

In Vibrio fischeri test, in toxic units of human origin antibiotics; 40.4%, 60% and 100% of increase were observed for Klindan, Tetra and Azro, respectively.

In Daphnia magna test, when comparison was made in terms of times elapsed for reading the results, it was observed that toxic values of antibiotics were increased at 24th hour when compared to the values read at 12th hour. In toxic units of human origin antibiotics; 776,7%, 115% and 300% of increase were observed for Klindan, Tetra and Azro, respectively.

In the study, Lepidium sativum, Daphnia magna and Vibrio fischeri toxicity tests were used as a method to determine potential harms to be caused to microbial ecology in recipient environment by 3 antibiotics of that are easily commercially provided. Toxicity of antibiotics for plants and aquatic life was determined and different test methods used were compared in terms of sensitivity. This study is very important with regards to the evaluation of the applicability of the toxicity test methods used for such waste waters and shedding light on future studies on toxicity.

**Keywords:** Antibiotic, Vibrio fischeri, Daphnia magna, Lepidium sativum, toxicity

### INTRODUCTION

Antibiotics are among the extensively used medications by humans [1]. These medications are also used in agricultural work facilities and farms as anti-infective, growth-promoting and/or therapeutic medication [2,3,4]. Most of the antibiotics used by humans and animals are introduced into sewer system without undergoing any change through feces and urine, and discharged to aquatic environment directly or together with outlet waters of waste water treatment system. Presence of antibiotics in aquatic environment is expressed by numerous studies worldwide [5,6,7].

It is known that in some countries the consumption of pharmaceuticals (including veterinary and illegal use) and cosmetics, food additives and other personal care products is more than 100 tons [8,9]. In most countries, over-the-counter non-steroidal anti-inflammatory drugs (NSAIDs) reach to hundreds of tons. Drugs are the chemicals used for the protection of humans/ animals health, and treatment and prevention of diseases. Active agents in drugs can reach to urban waste water from human excretion and hospital waste waters and leak into underground waters [10].

Antibiotic content in waste water has been increased recently [11]. Studies show that classic waste water treatment facilities are not sufficient to remove the non-biodegradable antibiotic types [10,12]. Low anti-biotic content in treated waste waters has toxic effects on aquatic species and also causes resistance increase among indigenous bacteria population [13, 14]. Some studies revealed that active agents in drugs join in water resources and food chain, and their metabolites pose a real threat for the ecosystem and human health [10]. Antibiotic resistance was detected in waste waters, underground waters, drinking waters, mud, soil and sediment [3, 15, 16, 17, 18, 19, 20].

Antibiotics are among the drugs of which the use has been increasing day by day in Turkey and the rest of the world. "When the Prescription Information System (RBS) data are examined, it was determined that in 2011, 34.9% of 129,953,746 prescriptions of primal care family physicians contain antibiotics. As a result of the evaluation of these prescriptions; it was found that 439,539,673 boxes of drugs were prescribed and 55,865,492 boxes that constitute 12.71% of them were antibiotics (URL-1)".

In the light of the information given above, the use of 55,865,492 boxes of antibiotics by patients in 2011, partial metabolism (approximately 30%) of antibiotics after being taken by humans and animals [3,21], insufficiency of classic waste water treatment facilities to remove the non-biodegradable antibiotic types [12], presence of low antibiotic content in treated water outlets, the possibility of increasing resistance among indigenous bacteria population as well as having toxic effects on aqueous species [13,14] makes this study to be conducted important.

In the study, *Lepidium sativum*, *Daphnia magna* and *Vibrio fischeri* toxicity tests were used as a method to determine potential harms to be caused to microbial ecology in recipient environment by 3 human origin antibiotics that are easily commercially provided. Toxicity of antibiotics for plants and aquatic life was determined and different test methods used were compared in terms of sensitivity. This study is very important with regards to the evaluation of the applicability of the toxicity test methods used for such waste waters and shedding light on future studies on toxicity.

## MATERIALS AND METHOD

### ***Lepidium Sativum* Toxicity Test**

*Lepidium sativum* toxicity test was conducted for 6 control samples and 3 samples with 6.25%, 12.5%, 25%, 50%, 100% concentrations and  $K_2Cr_2O_7$  solution prepared in concentrations of 0.1 mg/L, 1.8 mg/l, 3.2 mg/L, 5 mg/L, 10 mg/L. 2 Watman 1 filter papers with a diameter of 90 mm were placed into 9 cm glass petri dishes, and 5 mL of distilled water was put in control petri dishes and samples prepared in different dilutions were put into sample petri dishes and filter papers were placed so as to have no air bubbles under them. 25 undamaged *Lepidium sativum* seeds of equal size were equally placed into each petri dish; they are closed and incubated at a temperature of approximately 25 °C for 72 hours in dark environment. At the end of the test, root lengths and root heights of 20 of *Lepidium sativum* seeds in each petri dish that showed the best growth were measured. At the end of the test, average root heights and lengths of *Lepidium sativum* seeds in samples were compared with control samples and % of incubation, EC<sub>50</sub> and toxic unit value were determined.

### ***Vibrio Fischeri* Toxicity Test**

Ecotoxicological trials were performed by using Microtox toxicity measurement device. The test was conducted by using standard methods specified by manufacturer. Trials were performed at a luminescence of 490 nm at 15 °C based on operating principle of the device in 2% NaCl revitalization solution. Marine bacterium was determined with the decrease of light emission in the presence of toxic substances by using *Vibrio fischeri* culture. 1 mL of diluted solution that was put into a bath was stored at 5.5 °C ±1 °C in order to prevent the reaction and then it was only added into the sample Microtox reactive flask taken from freezer. It was shaken for 30 minutes until fully mixed solution was obtained. Bath with solution that was kept at 5.5 °C ±1 °C for 30 minutes was mixed immediately before the test. 5 dilution series were prepared for each drug (2 g/L, 1 g/L, 0.5 g/L, 0,25 g/L, 0,125 g/L). Each sample was diluted to 50%, 25%, 12.5% and 6.25% (Sample A) with initial concentration by means of a diluter and blank solution was only used for the sixth sample. All operations were carried out at 15 °C ±0.5 °C.

Bioluminescence evaluation was recorded in computer memory by initially 0.1 mL of bacteria suspension was put into 6 baths at time 0 ( $I_0$ ) (Sample B). 0.90 mL of Sample A was added into Sample B and bioluminescence value was measured at 5 min ( $I_5$ ) and 15 min ( $I_{15}$ ).

Following the basic test, studied drugs were recorded by the computer in order to calculate the percentage of the effect for Sample A and % value was automatically calculated by using  $I_0$ ,  $I_5$  and  $I_{15}$ .

Results are expressed as the concentration (EC<sub>50</sub>) at which 50% of the light emission at 5 and 15 minutes [22].

## RESULTS AND INTERPRETATION

In this test, 3 human origin and totally 3 antibiotics were used and sensitivities of *Lepidium sativum*, *Vibrio fischeri* and *Daphnia magna* toxicity tests for samples with different characteristics were investigated.

In order to categorize the results, test results were expressed as toxic unit (TU). TU results were evaluated according to the classification of Persoonee et.al (1993) which is TU=0 not toxic; 0< TU<1 slightly toxic; 1< TU<10 toxic; 11< TU<100 highly toxic.

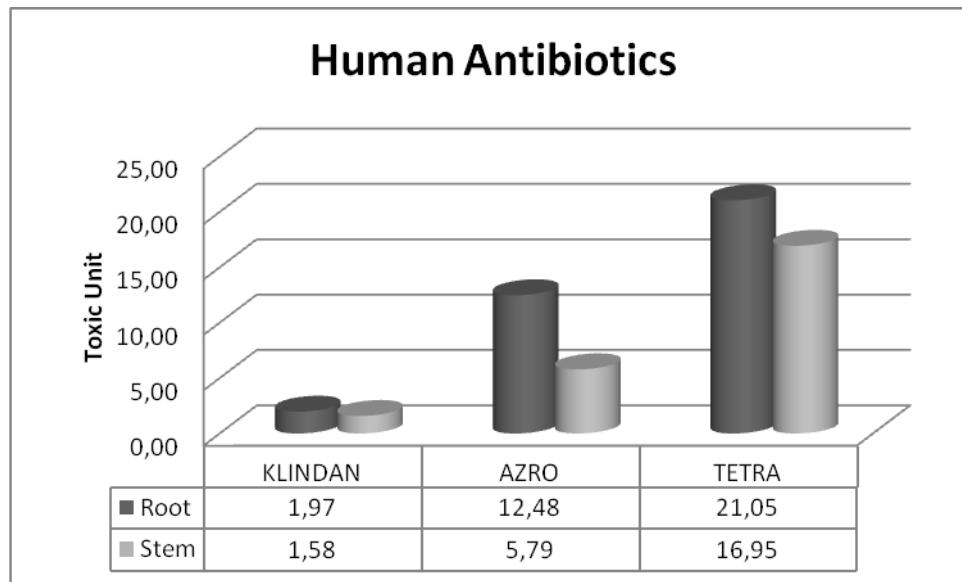
$$TB = \left[ \frac{1}{L(E)C_{50}} \right] \times 100 \quad \text{Equation (1)}$$

### Lepidium sativum Toxicity Test

EC<sub>50</sub> values and toxic units calculated at the end of Lepidium sativum toxicity test for 3 antibiotics of which Azro, Tetra and Klindan are human origin antibiotics, and given below.

**Table 1. EC<sub>50</sub> values (mg/L)**

Antibiotic Name	Azro	Klindan	Tetra
Root	8,01	50,81	4,75
Hypokotyl	17,26	63,20	5,9



**Graph 1.** Toxic Units of Human Antibiotics

At the end of Lepidium sativum tests, when toxic units were examined, among human antibiotics, Klindan was found to be toxic for the roots (TU<sub>KLINDAN</sub>:1,97) and stems(TU<sub>KLINDAN</sub>:1,58); and Azro was found to be very toxic for the roots (TU<sub>AZRO</sub>:12,48) and toxic for the stems (TU<sub>AZRO</sub>:5,79) and Tetra was found to be highly toxic for the roots (TU<sub>TETRA</sub>:21,05) and stems (TU<sub>TETRA</sub>:16,95).

### Vibrio fischeri Toxicity Test

For the 3 antibiotics that are human and animal origin, at the end of Vibrio fisheri toxicity test, EC<sub>50</sub> values and toxic units read at 5th and 15th minutes were given below.

**Table 2. Vibrio fischeri EC<sub>50</sub> values (mg/L)**

EC50	KLINDAN	AZRO	TETRA
5 Minute Later Readings (mg/L)	1,06	0,24	0,16
15 Minutes Later Readings (mg/L)	0,76	0,12	0,1

**Graph 2.** Toxic Units of Human Antibiotics

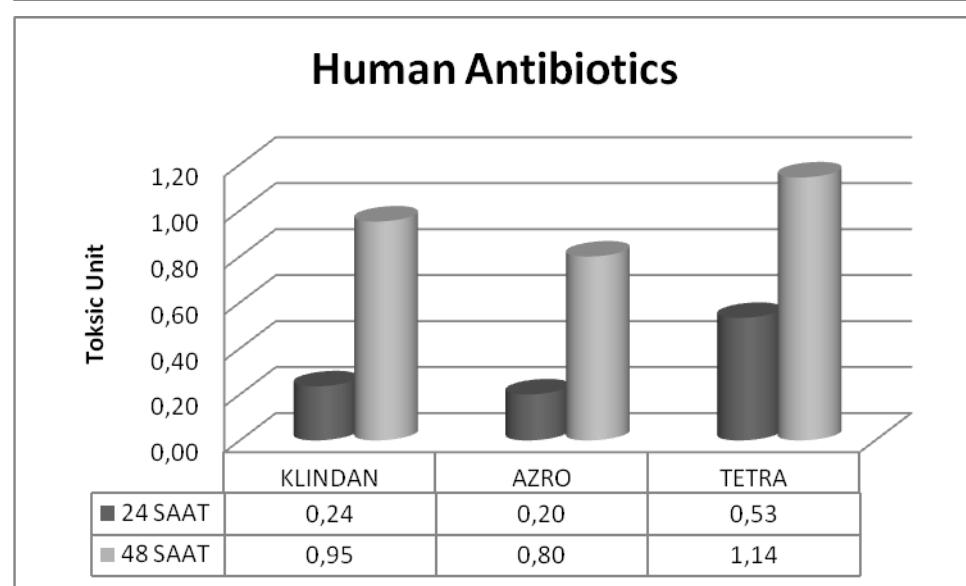
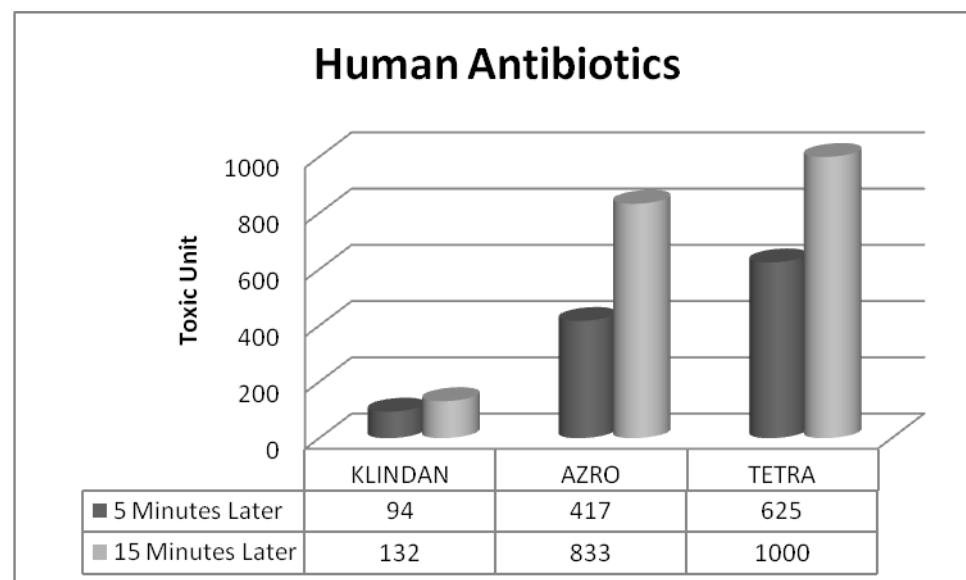
As a result of Vibrio fischeri tests, when toxic units read at 5th and 15th minutes were calculated separately, it was found that among human antibiotics only Klindan was found to be within the scale of Persoonee et.al (1993) and highly toxic (TU<sub>KLINDAN</sub>(5 min): 94). Other two antibiotics have a toxic unit above the limit values (TU<sub>AZRO</sub>(5 min): 417, TU<sub>AZRO</sub>(15 min):833 and TU<sub>TETRA</sub>(5 min):625, TU<sub>TETRA</sub>(15 min):1000).

### Daphnia magna Toxicity Test

For the 3 antibiotics that are human origin, at the end of Daphnia magna toxicity test, EC<sub>50</sub> values and toxic units read at 24th and 48th hours were given below.

**Table 3.** Daphnia magna (EC<sub>50</sub> values (mg/L)

EC50	KLINDA	AZRO	TETRA
24 Hours Later Readings (mg/L)	425	500	187,6
48 Hours Later Readings (mg/L)	105	125	87,4



**Graph 3.** Toxic Units of Human Antibiotics

As a result of Daphnia magna tests, when toxic units read at 5th and 15th minutes were calculated separately, it was found that among human antibiotics, Tetra (TU<sub>TETRA(48hours)</sub>:1,14) were found the most toxic effect on Daphnia magna.

## CONCLUSIONS

As a result of the tests, it was found that 3 antibiotics used in the test have toxic effects. When test results were examined, both toxicity tests showed different sensitivities for antibiotics with different characteristics. It was observed that the most sensitive values were obtained from Vibrio fischeri toxicity test method among others.

Although different Toxic Units were obtained from Lepidium sativum and Vibrio fischeri tests, toxicity orders of antibiotics are same. In both tests, it was found that the most toxic human antibiotics are Tetra and Azro.

In Lepidium sativum test, among human antibiotics, Azro had very toxic effect on the root but had a toxic effect on the stem.

In *Vibrio fischeri* test, in toxic units of human origin antibiotics; 40.4%, 60% and 100% of increase were observed for Klindan, Tetra and Azro, respectively.

In *Daphnia magna* test, when comparison was made in terms of times elapsed for reading the results, it was observed that toxic values of antibiotics were increased at 24th hour when compared to the values read at 12th hour. In toxic units of human origin antibiotics; 295,8%, 115% and 300% of increase were observed for Klindan, Tetra and Azro, respectively.

As a result of this study, it was concluded that both biotests (*Vibrio fischeri* and *Lepidium sativum*) can be used in the determination of antibiotic toxicities and can show different sensitivities for different antibiotics.

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## AN APPLICATION OF GIS TECHNOLOGY AND CLUSTER ANALYSIS TO EVALUATE THE SURFACE SEDIMENT QUALITY: A CASE STUDY OF A LARGE BORATE RESERVE AREA IN CENTRAL ANATOLIA (TURKEY)

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### ABSTRACT

Turkey has 70% of the total boron reserve of the world. Kırka county of Eskişehir Province that is located in the border of Seydisuyu Stream Basin is one of the most important borate deposits containing area of Turkey. It is known that boron content of geological structure is significantly effective on arsenic levels in general and arsenic may accumulate in the environment through use of arsenical pesticides and application of fertilizers in agricultural activities. In addition to the geologic structure of the Seydisuyu Stream Basin, mining activities, agricultural and domestic discharges are the major pollution sources for the system. The aim of the present study was to evaluate the sediment quality of Seydisuyu Stream Basin by a statistical perspective using Cluster Analysis (CA) and GIS technology by investigating arsenic and boron concentrations in sediment samples. For this purpose sediment samples were collected from 15 stations (3 of them from the Çatören Dam Lake and 2 of them from the Kunduzlar Dam Lake) in summer season of 2012. Arsenic and boron accumulations were measured by using ICP-OES device and Cluster Analysis (CA) was applied to detected data in order to classify the investigated stations according to similar contamination characteristics and Geographic Information System (GIS) technology was also applied to detected data in order to make a visual explanation by presenting distribution maps of investigated parameters.

**Keywords:** Seydisuyu Stream Basin, Arsenic, Boron, Cluster Analysis; GIS

### INTRODUCTION

The quality of freshwater resources is decreasing day by day in all over the world due to especially rapid growth of world population and significant developments of industry. And also contamination of freshwater ecosystems by inorganic toxic pollutants has become one of the most important problems of the world and mankind due to significant health problems they cause (Bai et al., 2011).

Multistatistical techniques, which help the interpretation of complex data matrices to better understand the ecological status of the investigated aquatic ecosystems, are being widely used in large numbers of countries in water and sediment quality assessment studies. Cluster Analysis is one of the most convenient multivariate statistical technique that is used commonly all over the world in order to classify the investigated sections in studies according to similar characteristics (Shrestha and Kazama, 2007; Tokatlı et al., 2014a).

Geographic Information System (GIS) is a computer system in order to provide capturing, storing, checking, and displaying data related to positions on Earth's surface. Also GIS can show many different kinds of datasets on one map, which enables people to more easily see, analyse, and understand patterns and relationships (Fu and Sun, 2010).

Turkey has 70% of the total boron reserve of the globe and most important borate deposits of Turkey is located in the Kırka district of Eskişehir Province where constitutes of our study area (Helvacı, 2003). Seydisuyu Stream that is one of the most important branches of Sakarya River is located in the Eskişehir Province of Turkey. Seydisuyu Stream Basin contains significant agricultural lands and most significant boron deposits of Turkey. Therefore, in addition to the geological structure of the basin, Eti Boron Works and agricultural applications are the main sources of boron and arsenic in sediments (Tokatlı et al., 2014b).

The aim of this study was to determine the arsenic and boron accumulations in sediment of Seydisuyu Stream Basin and evaluate the sediment quality of the basin in a statistical and GIS perspective using Cluster Analysis (CA) and ArcGIS technology.

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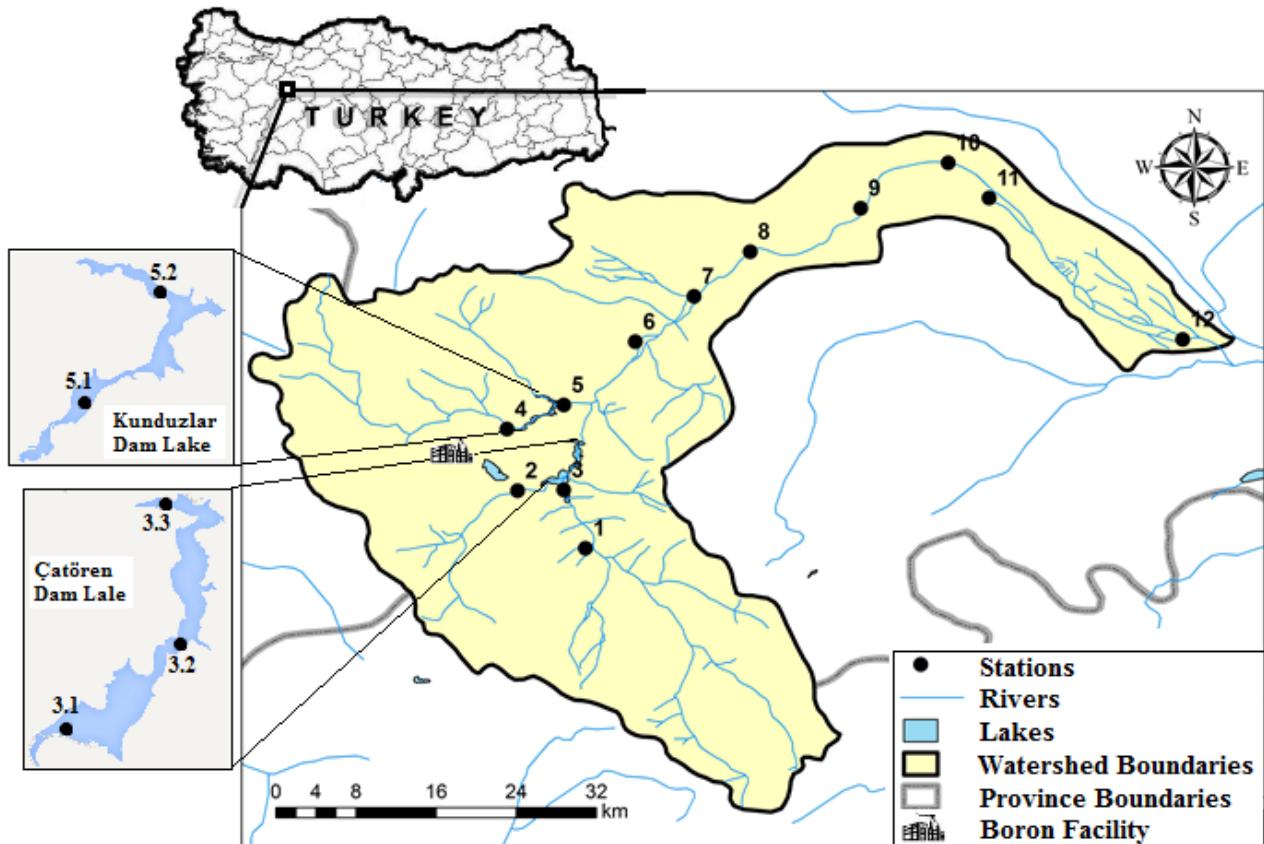
## MATERIAL AND METHODS

### Study Area

Seydisuyu Stream Basin is located in the border of Eskişehir Province in the Central Anatolia Region of Turkey between the locality of 38.0851 – 39.0361 north latitude and 30.0161 – 31.0071 east longitudes (Çiçek et al., 2013). Sediment samples were collected in summer season of 2012 from 15 stations (3 of them on the Çatören Dam Lake and 2 of them on the Kunduzlar Dam Lake). Coordinates and localities of the selected stations are given in Table 1. Map of the Seydisuyu Stream Basin and study area are given in Figure 1.

**Table 1.** Locality properties of selected stations

Stations	Location	Coordinates	
		x	y
St. 1	Karaören Village	291678	4344723
St. 2	Kırka District	286648	4350639
St. 3.1	Çatören Dam Lake	289800	4351019
St. 3.2	Çatören Dam Lake	288880	4351531
St. 3.3	Çatören Dam Lake	290654	4355433
St. 4	Akin Village	285940	4356774
St. 5.1	Kunduzlar Dam Lake	287229	4357142
St. 5.2	Kunduzlar Dam Lake	288269	4358041
St. 6	Kesenler Village	296117	4365244
St. 7	Seyitgazi District	300751	4369651
St. 8	Yazidere Village	320690	4382501
St. 9	Doğançayır	320686	4382502
St. 10	Hamidiye Village	324123	4378834
St. 11	Mesudiye District	329283	4369106
St. 12	Saithalimpasa Village	338431	4364451



**Figure 1.** Seydisuyu Stream Basin and selected stations

#### Chemical and Statistical Analysis

Sediment samples were dried for 3 h at 105°C for element analyses. Then, all sediment samples were placed (0.25 g of each sample) in Pyrex reactors of a CEM Mars Xpress 5 microwave digestion unit.  $\text{HClO}_4:\text{HNO}_3$  acids of 1:3 proportions were inserted in the reactors respectively. Samples were mineralized at 200 °C for thirty minutes. Afterwards, the samples were filtered in such a way as to make their volumes to 100 ml with ultra-pure distilled water.

Element levels were determined by Inductively Coupled Plasma-Optic Emission Spectrophotometric (Varian 720 ES) method. The element analyses were recorded as means triplicate measurements, and the wavelengths used for element analysis were given in Table 3 (EPA, 1998; EPA, 2001).

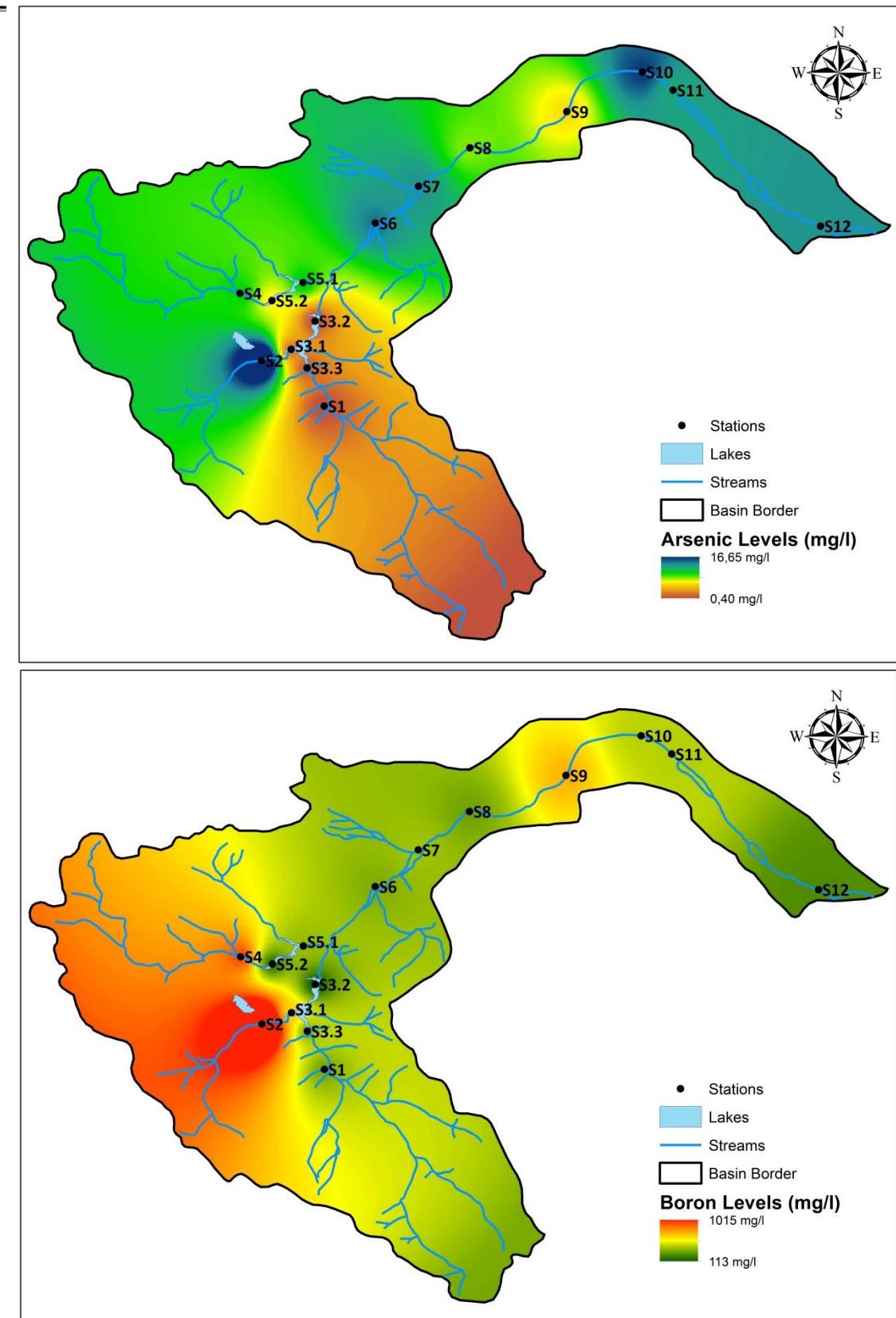
Cluster Analysis (CA) were applied to the results by using the “Past” package program and GIS based distribution maps of parameters were made by using the “ArcGIS” package program.

#### RESULTS AND DISCUSSION

GIS based distribution maps of arsenic and boron accumulations in sediments of the Seydisuyu Stream Basin are given in Figure 2.

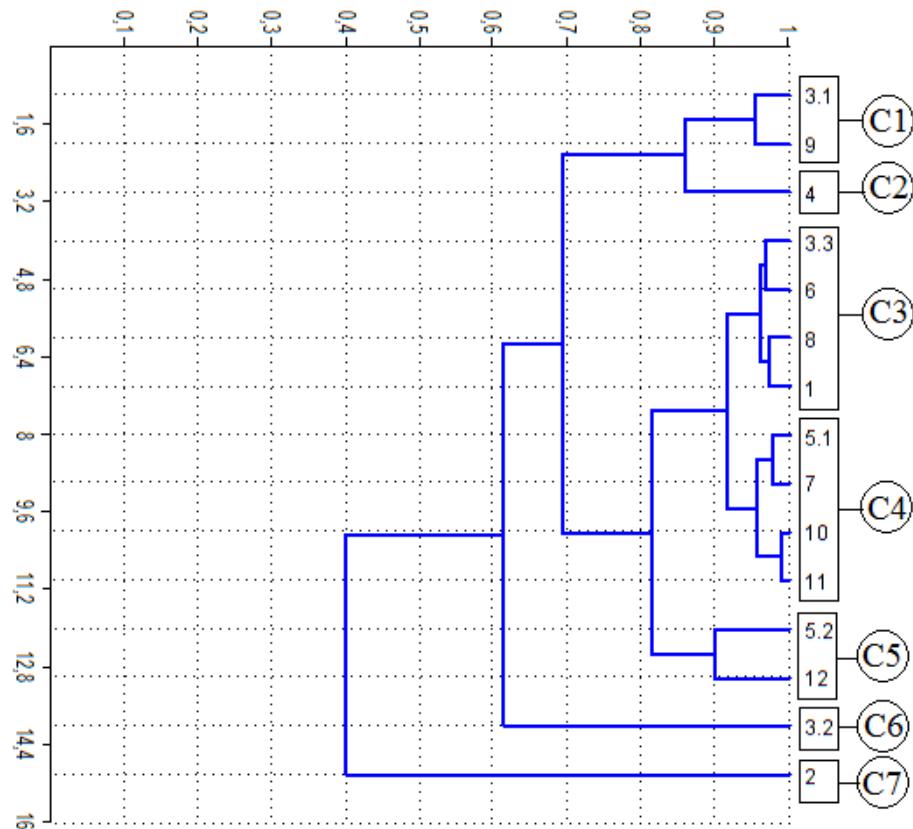
Cluster Analysis (CA) is an unsupervised multivariate statistical technique used to classify the objects into clusters based on their similarity. Hierarchical agglomerative clustering is the most common approach, which provides intuitive similarity relationships between any one sample and the entire data set and in order to provide visual summaries of the clustering process and it is typically illustrated by a dendrogram (Tabachnick and Fidell, 1996; Vega et al., 1998; Tokathlı, 2014).

In this study CA was used to classify the stations selected on the Seydisuyu Stream Basin base on their sediment quality characteristics. The diagram of CA calculated by using arsenic and boron contents of sediments is given in Figure 3 and the similarity coefficients of all the investigated stations are given in Table 2.



**Figure 2.** Arsenic and boron distributions on the basin

According to the results of CA, seven statistically significant clusters were formed. Cluster 1 (C1) corresponded to the stations of S3.1 and S9; Cluster 2 (C2) corresponded to the station S4; Cluster 3 (C3) corresponded to the stations S3.3, S6, S8 and S1; Cluster 4 (C4) corresponded to the stations of S5.1, S7, S10 and S11; Cluster 5 (C5) corresponded to the station of S5.2 and S12; Cluster 6 (C6) corresponded to the station of S3.2; Cluster 7 (C7) corresponded to the station of S2.



**Figure 3.** CA diagram

The highest arsenic and boron concentrations were determined in S2 station (As: 16.67 mg/kg; B: 1016 mg/kg), where was the closest station othe Boron Mine and located in the Kırka District and known to be exposed to point discharge by means of mining activities. Also according to the results of CA, this location of the Seydisuyu Stream Basin formed a separate cluster (C7) as the highest contaminated location for the basin. In a macroscopic point of view, arsenic and boron concentrations in sediment of almost all the investigated locations in the basin were detected in quite high levels. It was also determined that arsenic and boron concentrations of sediment have significantly decreased in the Çatören and Kunduzlar Dam Lakes in general, due to most likely resting of water in the reservoirs. These results may point that reservoirs of the basin have a significant cleaning capacity for the system in terms of arsenic and boron contents of sediment.

**Table 2. Similarity coefficients of CA**

	S1	S2	S3.1	S3.2	S3.3	S4	S5.1	S5.2	S6	S7	S8	S9	S10	S11	S12
<b>S1</b>	1														
<b>S2</b>	0.34849	1													
<b>S3.1</b>	0.74355	0.5257	1												
<b>S3.2</b>	0.68594	0.19897	0.47307	1											
<b>S3.3</b>	0.96692	0.36795	0.77472	0.65773	1										
<b>S4</b>	0.59614	0.66392	0.83557	0.36377	0.62421	1									
<b>S5.1</b>	0.93285	0.38891	0.79003	0.62793	0.96586	0.65323	1								
<b>S5.2</b>	0.80721	0.25968	0.57971	0.85082	0.77894	0.46187	0.76402	1							
<b>S6</b>	0.96466	0.36931	0.75151	0.65573	0.96652	0.61936	0.95869	0.79435	1						
<b>S7</b>	0.90869	0.40437	0.80831	0.60718	0.9416	0.67028	0.97569	0.74119	0.94175	1					
<b>S8</b>	0.97252	0.34629	0.7267	0.69073	0.94267	0.59294	0.92903	0.83217	0.96083	0.90489	1				
<b>S9</b>	0.70087	0.56233	0.95378	0.44048	0.7313	0.88088	0.75411	0.55111	0.71687	0.77208	0.69251	1			
<b>S10</b>	0.872	0.42887	0.84022	0.57623	0.90468	0.69988	0.93862	0.70688	0.90692	0.96287	0.86823	0.80339	1		
<b>S11</b>	0.88323	0.42123	0.8362	0.58563	0.91599	0.69547	0.94999	0.71734	0.9133	0.97152	0.87945	0.79923	0.9886	1	
<b>S12</b>	0.88723	0.30886	0.65223	0.75382	0.85844	0.53206	0.85386	0.89931	0.89282	0.83765	0.91623	0.62092	0.80172	0.80997	1

## CONCUSSIONS

In this study, Cluster Analysis (CA) and Geographic Information System (GIS) were used to evaluate the sediment quality and the inorganic pressures of a contaminated aquatic ecosystem. According to data observed, arsenic and boron concentrations in sediment of the basin were detected at significantly high levels, and arsenic and boron accumulations were rising extremely after from the discharge of the boron facility. According to results of CA, seven clusters of similar sediment quality characteristic were identified for the basin and the most contaminated station (the input of Çatören Dam Lake) formed a separate cluster. The present study also indicates the necessity and usefulness of the multivariate statistical techniques and GIS technology in order to evaluate the environmental conditions.

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## ASSESSMENT OF PESTICIDE POLLUTION IN SOIL AND PLANTS FROM CROPLAND IN KONYA

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### ABSTRACT

One of the most important routes of exposure to synthetic organic contaminants is the consumption of contaminated foods. Organochlorine pesticides (OCPs) and organophosphorus pesticides (OPPs) are persistent organic compounds that have adverse health effects on human. These contaminants accumulate in various environmental media and finally reach the human biosystem. In this study, pesticide contamination of both crops cultivated in Konya region and soils of this region were determined. 27 soil samples were taken along the main drainage channel, 3 soil samples were taken from soil without agricultural activity and 3 soil samples were taken from an agricultural field far away from main drainage channel. 33 soil samples and 13 wheat samples were analyzed for OCPs ( $\alpha$ -HCH,  $\beta$ -HCH,  $\gamma$ -HCH,  $\delta$ -HCH, aldrin, dieldrin, heptachlor, heptachlor epoxide, endosulfan I, endosulfan II, endosulfan sulfate, p,p'-DDE, p,p'-DDD, p,p'-DDT, endrin, endrin aldehyde, endrin ketone, methoxychlor) and OPPs (malathion, parathion, methyl-parathion, chlorpyrifos, diazinon). The determinations of OCPs and OPPs were carried out with a gas chromatograph (GC, Agilent 6890 N) equipped with mass selective detector (MSD, Agilent 5973). Soil samples were extracted with the traditional soxhlet extraction. OCPs and OPPs in grain, leaf and stem parts of wheat samples were determined by QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) method.

Maximum concentration of OCPs in soil samples was determined for  $\Sigma$ HCH ( $\alpha$ -HCH,  $\beta$ -HCH,  $\gamma$ -HCH,  $\delta$ -HCH) and  $\Sigma$ Endosulfan (endosulfan I, endosulfan II, endosulfan sulfate) in the range of 8.74 - 71.8  $\mu\text{g kg}^{-1}$  and 1.99 - 112  $\mu\text{g kg}^{-1}$ , respectively. Malathion and chlorpyrifos were the dominant OPPs in soil and wheat samples. Maximum concentrations of malathion and chlorpyrifos in soil samples were 222  $\mu\text{g kg}^{-1}$  and 556  $\mu\text{g kg}^{-1}$ , respectively. Maximum total OCPs and total OPPs in the grain were 2.32 mg  $\text{kg}^{-1}$  and 15.4 mg  $\text{kg}^{-1}$ , respectively.  $\Sigma$ DDT was determined in the range of 0.02 – 0.06 mg  $\text{kg}^{-1}$  in grain samples. Almost all compounds were determined above the Maximum Residue Limit (MRL) values given by Turkish Food Codex. It was concluded that the Konya soils and the wheat cultivated in this region are excessively contaminated with OCPs and OPPs. Besides, prohibited pesticides are obviously still being used in the area.

**Keywords:** Organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), soil, wheat, pollution.

### 1. INTRODUCTION

In parallel to the economic and technological development the spectrum and amount of substances polluting food sources have been increased. Pesticides are one of the important groups of these synthetic substances that is excessively used. Due to the population growth, demand for food has grown and pesticides have long been used to increase agricultural productivity. Uncontrolled and excessive applications of pesticides result in soil accumulation and contaminated agricultural products (Mahmood et al., 2014). Pesticides are categorized in the Persistent Organic Pollutants (POPs) and can be sorbed by soil. Moreover, they can be changed to mutagenic and carcinogenic by-products as a result of biologic activities in soils (HSDB, 2015). Therefore, monitoring and/or accumulation of these pollutants in soils and agricultural products as well as food-chain are of importance for environmental health.

OCPs are still found in food and feed crops although they were applied about 40 years ago. There is a considerable knowledge gap concerning the extent of soil and crop contamination by OCPs. Hilber et al. (2008) performed two surveys in 2002 and 2005 to assess the loads of OCPs in 41 Swiss horticultural fields under organic and conventional production. OCPs were detected in 27 out of 41 fields (65.9%). They determined that no significant influence of the measured soil properties on the OCP-load of soils and cucumbers, although there is evidence that the bioavailability of OCPs in soils to cucurbitaceae plants was influenced by the sorption of the compounds to soil organic matter and by the polarity of the pesticides molecules. According to the literature, organic pollutants levels accumulated in soil and crops exceed mostly the limit values and pose risk for human health. For the above mention reasons, it is very important to carry out research on accumulation effects of pollutants in soil and it is also very important to determine residual pollution on crops for human health.

OPPs attained the growing importance in pests control because of their rapid decomposition and not likely to be accumulated. They are still of great concern to contaminate water sources because of their high solubility in water and excessive usage. Their usage amounts were elevated after they were introduced as replacements for the highly persistent OCPs (Bai et al., 2006).

Konya has always been an important Agriculture, Transit Trade and Industry Center due to its location as a passage between East and West. Konya has flat-wide and spread-out arable land. It has named as Grain House of Turkey for years. In this study it is aimed to determine the concentration levels of OCPs and OPPs in agricultural soil of Konya city along the main drainage channel and in crops grown on these fields in order to examine the transport of pollutants via the food chain.

## 2. MATERIALS AND METHODS

### 2.1. Study area and sampling

Soil and wheat samples were taken along the main drainage channel in Konya city in 2011-2012. The main drainage channel, which receives all wastewaters from the city Konya was formed by dredging to a length of 150 km up to the Salt Lake. There are three pump stations along the channel. 27 soil samples and 13 wheat samples were taken from the field along this channel in the line of three pump stations. At the selected areas soil samples were taken near channel and in a distance of 100 m and 500 m from the channel in the depth of 0-25 cm, 25-50 cm and 50-70 cm. Besides, 3 soil samples were taken from soil without agricultural activity and 3 soil samples were taken from an agricultural field far away from main drainage channel for comparison. Wheat samples were also collected from these sampling locations. The samples were stored in suitable containers and transported to the laboratory according to standard methods in order to prevent the degradation of the products and pollutants. The samples were stored in a freezer until analyses.

### 2.2. Determination of physico-chemical properties of the soil samples

Soil pH was determined in distilled water/0.01 M CaCl<sub>2</sub> (1/1, v/v) suspension, using pHmeter (Hach, USA). Electrical conductivity (EC) was measured in soil/distilled water suspension (1/5, w/w), using EC metre (Hach, USA) (SM 2510 B, 1998). Clay/silt/sand composition of soil samples were determined according to Bouyoucos Hydrometer Method (Bouyoucos, 2004). For the determination of Cation Exchange Capacity (CEC), soil samples were saturated with ammonium acetate solution and ammonium was determined with FOSS-Kjeltec 8100 distillation instrument. Organic matter content was determined by burning the soil samples at 550±50 °C for 20 min (SM 2540 E, 1998).

### 2.3. Extraction and Clean-up

Before extraction procedure, soil samples were sieved from 2 mm screen. Wheat samples were separated to grain, leaf and stem parts and grained. 10 g of soil sample was subjected to soxhlet extraction for 16 hours, using 150 mL n-hexane/acetone (1/1, v/v) mixture. Extract was concentrated to 2 mL by rotary evaporator and cleaned-up according to column chromatography method (US EPA Metot 3630C). 10 g 5% deactivated silica gel was used for the preparation of column chromatography. For the elution of OCPs and OPPs, 70 mL n-hexane and 60 mL n-hexane/ethyl acetate (1/1, v/v) mixture was used and obtained elutions were concentrated to 1 mL before GC-MS injection. OCPs and OPPs in grain, leaf and stem parts of wheat samples were determined by QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) method.

### 2.4. Determination of OCPs and OPPs in soil and wheat samples

OCPs ( $\alpha$ -HCH,  $\beta$ -HCH,  $\gamma$ -HCH,  $\delta$ -HCH, aldrin, dieldrin, heptachlor, heptachlor epoxide, endosulfan I, endosulfan II, endosulfan sulfate, p,p'-DDE, p,p'-DDD, p,p'-DDT, endrin, endrin aldehyde, endrin ketone, methoxychlor) and OPPs (malathion, parathion, methyl-parathion, chlorpyrifos, diazinon) were determined in soil and wheat samples. The determinations of OCPs and OPPs were carried out with a gas chromatograph (GC, Agilent 6890 N) equipped with mass selective detector (MSD, Agilent 5973). HP-5ms capillary column (film thickness 0.25  $\mu$ m, inner diameter 0.25 mm, length 30 m) was used in the system. 1 ng/ $\mu$ L mix OCPs and OPPs standards were used for determination of optimum conditions.

### 2.5. Quality control parameters

For the quality assurance of obtained experimental data, quality control; blank analysis, GC/MS calibration and tune were performed, linear response range was defined by parameters such as accuracy and repeatability. Each assay to monitor the accuracy and reproducibility of measurement was carried at least 4 replicates. Repeatability of the target compounds in the MS detector was obtained by Relative Standard Deviation (RSD) of the MS response to 5 replicate injection of 0.1 ng/mL standard solution. Prior to analysis of samples by GC-MS system, calibrations were performed by external standard method and calibration standard was injected at the level of a medium concentration once for every ten samples. Detection limit (LOD) and quantification limit (LOQ) values were

calculated by Signal/Noise (S/N) ratio, determined by injection of 0.1 ng/mL concentration of the standard solution in the optimum GC conditions. Recovery studies were also performed according to standart spike prcedure.

### 3. RESULTS AND DISCUSSION

#### 3.1. Analytical parameters for the determination of OCPs and OPPs

Analytical parameters for OCPs and OPPs can be seen in Table 1 and Table 2, respectively. Linear responses were gained in the range of 0.001-10 ng/µL for OCPs ( $R^2 > 0.996$ ) and 0.1-10 for OPPs ( $R^2 > 0.990$ ). LOD values were in the range of 0.011-0.052 µg/L for OCPs and 3-8 µg/µL for OPPs. LOQ values were in the range of 0.037-0.173 µg/L for OCPs and 10-27 µg/µL for OPPs. Recovery values were 76%- 110% for soil samples, 81%-106% for grain samples, 82%-107% for leaf samples, 82%-105% for stem samples. Obtained results reveal the success of the optimized method.

**Table 1. Analytical parameters for OCPs analyses in GC-MS system**

Compound	LOD	LOQ	Linear Response Range	$R^2$	RSD
	µg/L	µg/L	ng/µL		%
α-HCH	0.011	0.037	0.001-10	0.999	1.68
β-HCH	0.012	0.040	0.001-10	0.999	2.50
γ-HCH	0.016	0.053	0.001-10	0.999	2.18
δ-HCH	0.013	0.043	0.001-10	0.999	2.60
Heptachlor	0.013	0.043	0.001-10	0.999	2.35
Aldrin	0.011	0.037	0.001-10	0.999	2.80
Heptachlor epoxide	0.012	0.040	0.001-10	0.999	1.60
Chlordane II	0.020	0.067	0.001-10	0.999	1.90
Endosulfan I	0.023	0.076	0.001-10	0.999	2.16
Chlordane I	0.018	0.060	0.001-10	0.999	2.10
p,p-DDE	0.011	0.037	0.001-10	0.996	3.12
Dieldrin	0.012	0.040	0.001-10	0.999	2.10
Endrin	0.013	0.043	0.001-10	0.998	3.80
Endosulfan II	0.019	0.063	0.001-10	0.998	2.34
p,p-DDD	0.012	0.040	0.001-10	0.997	2.72
Endrin aldehyde	0.012	0.040	0.001-10	0.999	3.10
Endosulfan sulfate	0.025	0.083	0.001-10	0.999	2.32
p,p-DDT	0.022	0.073	0.001-10	0.999	2.25
Endrin ketone	0.019	0.063	0.001-10	0.999	2.34
Methoxychlor	0.052	0.173	0.001-10	0.999	2.38

**Table 2. Analytical parameters for OPPs analyses in GC-MS system**

Compound	LOD	LOQ	Linear Response Range	R <sup>2</sup>	RSD
	µg/µL	µg/µL	ng/µL		%
Diazinon	8	27	0.1-10	0.998	5.61
Metilparathion	5	12	0.1-10	0.998	5.60
Malathion	5	13	0.1-10	0.992	5.47
Chlorpyrifos	3	10	0.1-10	0.990	8.10
Parathion	4	17	0.1-10	0.993	7.32

### 3.2. Phsico-chemical properties of the soil

pH values of soil samples were in the range of 8.55-9.48, that show highly alkaline structure. Konya city has arid and semi-arid climate with low precipitation. Low precipitation generally causes alkaline structure of soil. High alkaline structure has adverse effect on plant uptake of nutrients from soil. Phosphorus and trace elements accumulation are common situations for this type of soils. According to clay/silt/sand composition analyses, soils were determined to have clayey and clayey-loamy structure. High alkaline and clayey structure decrease mobility and result in accumulation of contaminants in top layer of soil. CEC values of soil samples were in the range of 54.83-126.38 meq/100 g. Clay type and amount, organic matter amount and pH of the soil are the parameters that effect CEC. Higher percent of clay in soil result in higher CEC values. CEC also positively effects buffering capacity of soil. Organic matter percent of soil samples was in the range of 0.69-9.18%. 56% of soil samples had high (>4%) organic matter ingredient, that is also positively effect accumulation of contaminants in soil. EC values of soil samples were in the range of 111.3-1983 µS/cm.

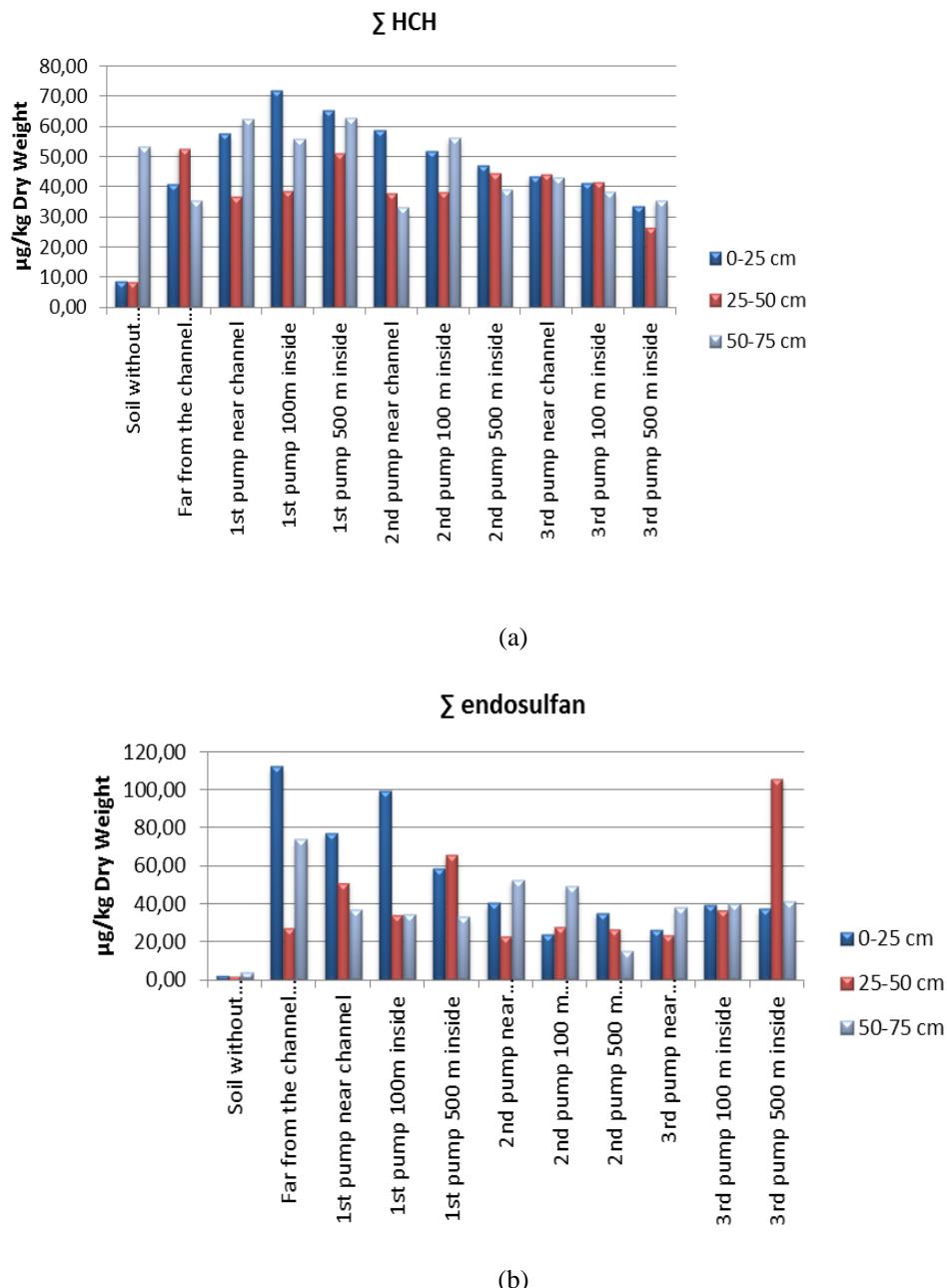
### 3.3. OCPs and OPPs accumulation in soil

Maximum concentration of OCPs in soil samples was determined for ΣHCH ( $\alpha$ -HCH,  $\beta$ -HCH,  $\gamma$ -HCH,  $\delta$ -HCH) and ΣEndosulfan (endosulfan I, endosulfan II, endosulfan sulfate) (Fig.1), in the range of 8.74 - 71.8 µg kg<sup>-1</sup> and 1.99 - 112 µg kg<sup>-1</sup>, respectively. ΣDDT (p,p'-DDE, p,p'-DDD, p,p'-DDT), Σheptachlor (heptachlor, heptachlor epoxide), aldrin, Σchlordane (chlordane I, chlordane II), Σendrin (endrin, endrin aldehyde, endrin ketone), methoxy chlor were determined in the range of 1.13-9.48 µg kg<sup>-1</sup>, 2.46-30.05 µg kg<sup>-1</sup>, 0.34-8.48 µg kg<sup>-1</sup>, n.d.-1.77 µg kg<sup>-1</sup>, 1.13-9.48 µg kg<sup>-1</sup>, 0.22-1.99 µg kg<sup>-1</sup>, respectively. Analyzed compounds were also determined in soil samples taken from nonagricultural area, that show transport of pesticides in the region. Soil samples taken far away from the channel and the vicinity of the channel had similar accumulation of pesticides.

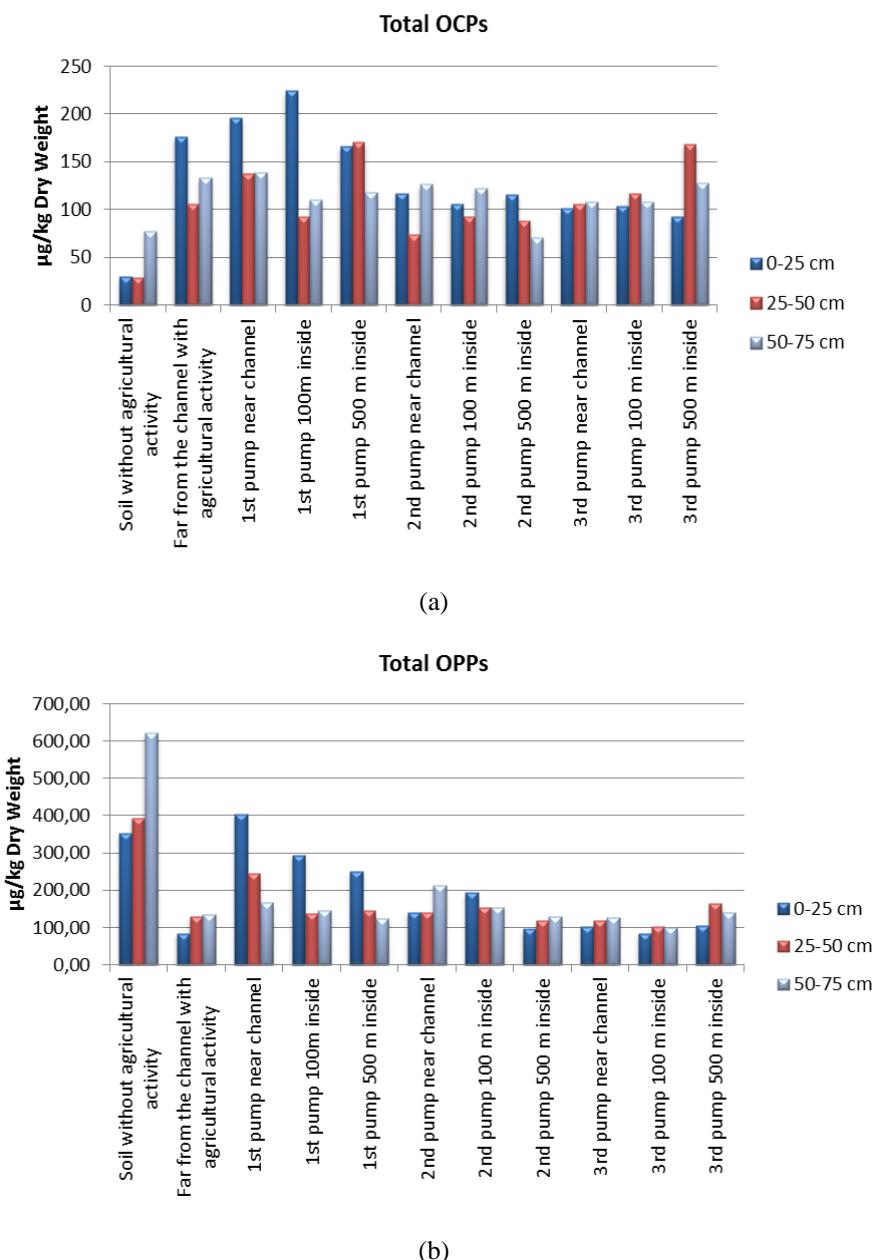
Endosulfan is categorized as highly toxic by EPA and was forbidden in Turkey since 2009. DDT and the other groups of OCPs were forbidden since 1982. Lindane is one of the OCPs and typically contained 5-15% in HCH solutions and lindane has been used since 1978. Use of lindane was limited by the U.S. Environmental Protection Agency (EPA) however it is still being used in agriculture in some countries. Determination of these pesticides in soil show not only past accumulation, but also continuing use. Bioaccumulation nature of these compound make them more important for human health (HSDB, 2015).

Maximum concentration of OPPs in soil samples was determined for malathion and chlorpyrifos. Concentrations of malathion and chlorpyrifos in soil samples were in the range of 8.77-222 µg kg<sup>-1</sup> and 31.4-556 µg kg<sup>-1</sup>, respectively. Total OCPs and total OPPs are given in Fig.2. After forbidden of OCPs, OPPs are the most common pesticides. Similar to OCPs, OPPs are also determined in nonagricultural area. When two group of pesticides are compared OPPs are in higher concentration both in nonagricultural and agricultural areas. It is obvious that OPPs are also transported in the field, probably as a result of spraying and evapotransportation. No regular change was found for soil profile. When top layer had higher pesticide accumulation in some points, deeper parts of soil had higher pesticide concentration for some other points.

OPPs are known to cause inhibition of acetylcholinesterase (AChE) in target tissues which leads to accumulation of acetylcholine. According to its key physiological role in nerve transmission, AChE is the target of various insecticides. AChE is an enzyme vital for normal nerve function and AChE inhibition leads to over stimulation of the central and peripheral nervous systems, resulting in neurotoxic effects in organisms. Target of OPPs usage is its inhibition effect on pests, but it also has a similar effect on human brain.



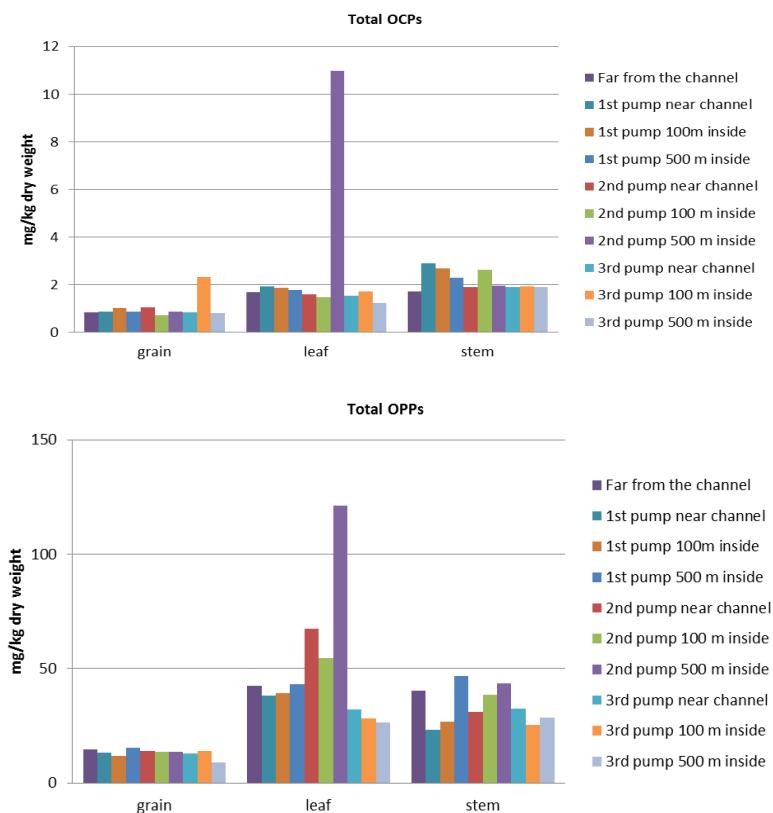
**Figure 1.** (a) ΣHCH and (b) Σendosulfan concentrations in soil samples



**Figure 2.** (a) Total OCPs and (b) Total OPPs concentrations in soil samples

### 3.4. OCPs and OPPs contamination of wheat samples

All of the analyzed pesticides except endosulfane sulfate were determined in wheat samples. Total OCPs and OPPs are given in Fig.3. All of the pesticides exceed maximum residue limits (MRL) given by Turkish Food Codex (TFC) (2011). For example, MRL conducted for dieldrin for grain ( $0.01 \text{ mg kg}^{-1}$ ) was exceeded for all samples. OPPs were determined in higher concentration when compared with OCPs. Leaf and stem parts include higher concentration of both OCPs and OPPs. These parts of wheat are generally used as feed for animal, which can be another bioaccumulation route. Maximum concentrations were determined for  $\Sigma\text{HCH}$  among OCPs as  $1.74 \text{ mg kg}^{-1}$  (MRL;  $0.02 \text{ mg kg}^{-1}$ ) and for malathion among OPPs as  $10.12 \text{ mg kg}^{-1}$  (MRL;  $5 \text{ mg kg}^{-1}$ ) for grain samples. Maximum total OCPs and total OPPs in the grain were  $2.32 \text{ mg kg}^{-1}$  and  $15.4 \text{ mg kg}^{-1}$ , respectively.  $\Sigma\text{DDT}$  was determined in the range of  $0.02 - 0.06 \text{ mg kg}^{-1}$  in grain samples, that reveal continuing application.



**Figure 3.** Total OCPs and OPPs contamination of wheat samples

#### 4. CONCLUSION

People consume wheat in their daily diet. Permanent consumption of wheat make its contamination more critical for human health. Pesticides are known to have lipophilic nature. Lipophilic compounds are easily absorbed and rapidly distributed to lipid-rich organs and tissues which can result in their bioaccumulation. In this study, it was determined that Konya soils around the main drainage channel and wheats cultivated in this region are polluted with OCPs and OPPs. Pesticide residues in grain part of wheat exceed MRL conducted by TFC. OCPs contamination of wheat parts reveal that these pesticides are still being used.

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## OCCURRENCE AND ECOTOXICOLOGICAL RISK ASSESSMENT OF ANALGESICS IN WASTEWATER

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### ABSTRACT

In this study, analgesics such as Acetaminophen (ACETAM), Indomethacin (INDO), Acetylsalicylic acid (ACETLY. ACID), Phenylbutazone (PHENYL) Codeine (CO) were determined in wastewaters and ecotoxicological risk level was evaluated using obtained results. Firstly, analytical method for determination of analgesics in wastewater was optimized. Solid phase extraction (SPE) procedure was carried out different conditions. The effect of the sample pH and volume, type of the cartridge (Oasis MCX and Oasis HLB cartridges), analit concentration were studied. Pretreatment of the sample and matrix effect were also investigated. The detection of analgesics was carried out by HPLC-MS. Limit of Detection (LOD) values for studied compounds were determined between 0.161 and 8.413 ng/L, while Limit of Quantification (LOQ) values were determined between 0.536 and 28.04 ng/L. Wastewater samples were taken from Konya Urban Wastewater Treatment Plant input and output. INDO was not detected in influent and effluent samples. CO, PHENYL, ACETYL ACID and ACETAM were detected as 126 ng/L, 1768 ng/L, 44 ng/L and 768 ng/L in influent samples, respectively. CO, PHENYL, ACETYL ACID and ACETAM were detected as 121 ng/L, 2860 ng/L, 88 ng/L and 696 ng/L in effluent samples, respectively. The HQ values for ACETLY ACID and CO were determined below 0.1, which means insignificant risk to aquatic organisms. The HQ values of ACETAM for fish and algae were determined below 0.1 while the value for Daphnia magna was determined between 0.1 and 1 which indicates potential risk.

**Keywords:** Analgesics, Ecotoxicological Risk Assessment, Pharmaceutical, Wastewater

### 1. INTRODUCTION

Pharmaceuticals have an important role in the treatment and prevention of disease in humans and animals and they are classed environmental pollutants. Pharmaceutical compounds are used in medicine and veterinary medicine, agriculture and water. Their use has become essential and indispensable elements in the culture of modern life. Pharmaceuticals are classified according to their purpose e.g., antibiotics, analgesics, anti-inflammatory, psychiatric drugs etc. (Kümmerer, 2008).

Analgesics generally affect central nervous system and are used to prevent pain. Analgesics and non-steroidal anti-inflammatory drugs (NSAIDs) are among the most prescribed drugs. Analgesics are extensively used without prescription in many countries. Prolonged presence of xenobiotic such as analgesics in the aquatic environment increases the potential threat to people's endocrine system. A significant portion of pharmaceutical in wastewater is composed of anti-inflammatory (AI) and analgesic drugs (AN).

Pharmaceuticals are generally released in natural waters via wastewater treatment plants, hospitals, industrials, households and farming. Excretion is the major source of water and soil pollution by pharmaceuticals. Some studies showed that pharmaceutical compounds are not removed in conventional wastewater treatment plant. Pharmaceuticals have very low biodegradability. So these compounds discharged into waters with effluent waters. Systematic studies still are not carried out on the presence and fate of pharmaceuticals in the environment in many countries. Presence of pharmaceuticals in environmental water is considered as an emerging environmental problem due to their detrimental effects on aquatic organisms at low concentrations.

Analgesic compounds have been detected in surface waters, river water, treated and untreated drinking water, input and output of wastewater treatment plant and sewage sludge at variable concentrations in different literature works (Lacey et al., 2008; López-Serna et al., 2010; Rosal et al., 2010; Gracia-Lor et al., 2011; Valcárcel et al., 2011; Wang et al., 2011; Guerra et al., 2014). 160 types of drugs were determined in wastewater treatment plant effluents, groundwater and surface water in the literature.

Generally, detection of analgesics are carried out by HPLC-MS or HPLC-MS/MS. A pre-concentration step is necessary for analysis of pharmaceuticals. Solid Phase Extraction (SPE) method is used usually as a pre-concentration step in determination of analgesics. Oasis HLB, Oasis MCX and Strata X cartridges are usually used in SPE system (Nebot et al., 2007; López-Serna et al., 2010).

The hazard quotient (HQ) is the ratio of the potential exposure to a substance and the level at which no adverse

effects are expected and used determination of risk characterization. HQ is calculated according to EU guidelines as the quotient between the measured environmental concentration (MEC) and the Predicted No Effect Concentration (PNEC).

The aim of this study is firstly analytical method optimization for determination of analgesics and then to determine the presence of analgesics including Acetaminophen (ACETAM), Indomethacin (INDO), Acetylsalicylic acid (ACETLY. ACID), Phenylbutazone (PHENYL) Codeine (CO) in wastewater samples of Konya Wastewater Treatment Plant input and output. Besides ecotoxicological risk assessment was evaluated for each compounds.

## 2. MATERIALS AND METHODS

### 2.1. Standards and Reagents

HPLC-grade methanol, acetonitrile, hydrochloric acid (37%), formic acid (98%) and Na<sub>2</sub>EDTA (ethylenediaminetetraacetic acid disodium salt solution) were purchased from Merck. While ACETAM and INDO were purchased from Fluka, ACETLY. ACID and PHENYL from Sigma, CO from Cerilliant. Glass fiber filters (1.2 µm) were obtained from Whatman, nylon membrane filters from Sartorius. Oasis HLB (Hydrophilic Lypophilic) cartridges (60 mg, 3 mL) and Oasis MCX cartridges were obtained from Waters Corporation. High-purity nitrogen gas obtained from the nitrogen generator (Peak Scientific). Stock solutions were prepared as PHENYL were dissolved in methanol/acetonitrile (1/1, v/v) and ACETAM, INDO, ACETLY. ACID and CO compounds were dissolved in methanol and stored at -20°C in amber vials in dark.

### 2.2. Sample Collection and Preparation

The wastewater treatment plant (Konya, Turkey) serves approximately 1300000 people with an average wastewater flow of 170 000 m<sup>3</sup>/day. Konya sewer system is combined sewer system, wastewater and rainwater is collected in the same channel. 24 h composite wastewater samples were taken input and output of Konya WWTP. Samples were kept at 4°C until analyzed. Wastewater samples filtered through 1.2 µm glass fiber filters followed 0.45 µm nylon membrane filters. 0.1 M Na<sub>2</sub>EDTA (final concentration of 0.1%) was added to the samples as a chelating agent to reduce analgesic binding to cations.

Preconcentration of samples was performed by solid phase extraction (SPE), using Oasis HLB (60 mg, 3 mL) and Oasis MCX cartridges (150 mg, 6 mL). Oasis HLB and MCX cartridges were preconditioned with MeOH (2×2.5 mL) and HPLC-grade deionised water (2×2.5 mL, pH adjusted 2.5 and 7) at a flow rate of 2 mL/min. Aliquots of 200 mL of sample were loaded into the cartridge at a flow rate of 1 mL/min, rinsed with 2.5 mL of ultrapure water. Then cartridges were eluted with 4×2.5 mL of MeOH at 1 mL/min. Extracts were evaporated until almost dryness and re-constituted with 1mL of methanol/water (50/50, v/v). The detection of analgesics was carried out by HPLC-MS.

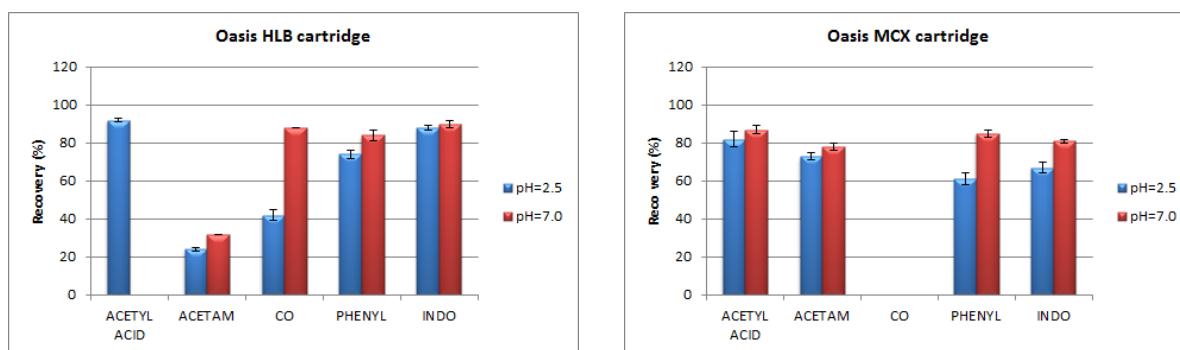
### 2.3. HPLC-MS Analysis

Agilent 1260 series HPLC system was used for analysis of analgesics. Separation was performed HPLC series 1260 equipped with Agilent Poroshell 120 EC-C18 (3.0x100 mm, 2.7 µm) analytical column. Analysis were carried out in positive (ESI<sup>+</sup>) and negative (ESI<sup>-</sup>) ion mode by trying different mobil phases. Flow rates were studied between 0.3-0.6 mL/min and Injection volume 1-5 µL. Column temperature is 35°C.

## 3. RESULTS AND DISCUSSION

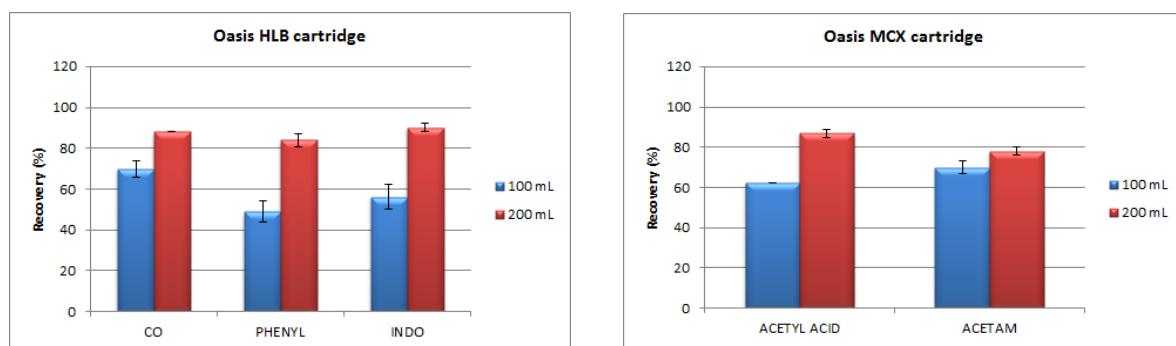
### 3.1. Optimization of SPE

Firstly, sample pH was optimized. 200 mL ultrapure water was fortified with 1000 ng/L of each analgesics and then pH of samples was adjusted to 2.5 and 7. Then SPE procedure was applied using Oasis HLB and MCX cartridges. Recoveries of studied analgesics have been shown in Figure 1. Recoveries are between 24% (ACETAM) and 92% (ACETYL. ACID) at pH 2.5 value, 32% (ACETAM) and 90% (INDO) at pH 7 value for extraction by Oasis HLB cartridge. Recovery value has not been obtained for ACETLY ACID at pH 7 with Oasis HLB cartridge. ACETYL ACID and ACETAM compounds were extracted on HLB sorbent with the lowest recoveries at pH 7 value. Recoveries are between 61% (PHENYL) and 82% (ACETYL. ACID) at pH 2.5 value, 78% (ACETAM) and 87% (ACETLY ACID) at pH 7 value for extraction by Oasis MCX cartridge. Recovery value was not obtained for CO compounds at pH 2.5 and 7 value by Oasis MCX cartridge. So, Oasis MCX cartridge was used extraction of ACETYL ACID and ACETAM at pH 7 value. Extraction studies were continued using Oasis HLB cartridge for CO, PHENYL and INDO compounds at pH 7 value while using Oasis MCX cartridge for ACETLY ACID and ACETAM compounds at pH 7.



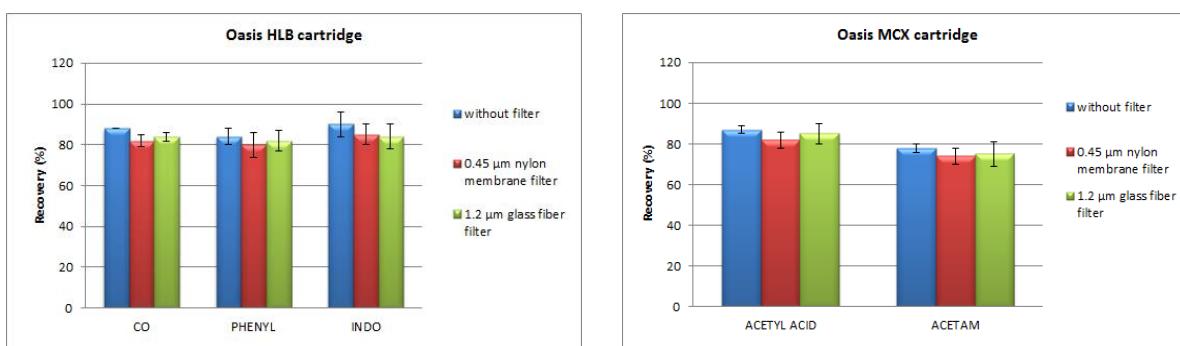
**Figure 1.** Effect of sample pH

The sample volume effect on extraction was also studied. 100 mL and 200 mL ultrapure waters were fortified with 1000 ng/L of each analgesic compounds and then pH of samples was adjusted to 7. SPE procedure was applied. Recovery values have been shown in Figure 2. Recoveries are between 49% (PHENYL) and 70% (CO) for 100 mL sample volume and between 84% (PHENYL) and 90% (INDO) for 200 mL sample volume of CO, PHENYL, INDO compounds extraction with Oasis HLB cartridges. Recoveries of ACETYL ACID and ACETAM compounds which were extracted by Oasis MCX cartridge are between 62% (ACETYL ACID) and 70% (ACETAM) for 100 mL sample volume and between 78% (ACETAM) and 87% (ACETYL ACID) for 200 mL sample volume. 200 mL sample volume was used for extraction because of higher recoveries.



**Figure 2.** Effect of sample volume

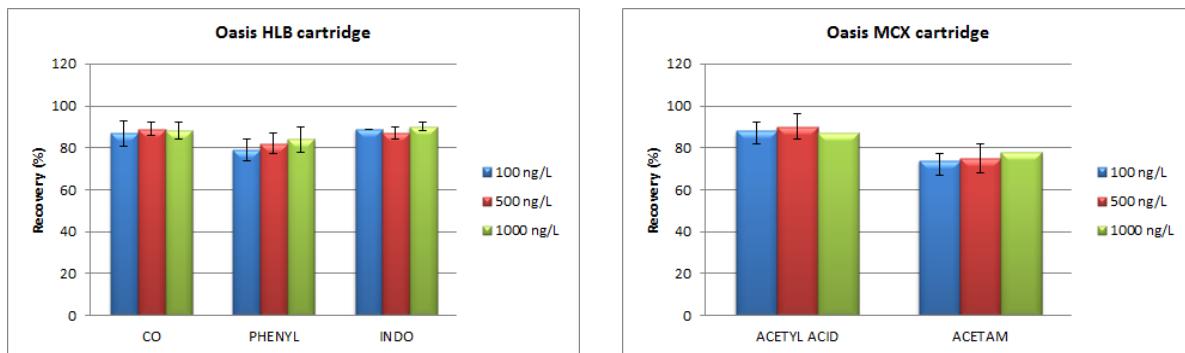
Sample pre-treatment (filtration) effect on extraction was also investigated. 200 mL ultrapure water was fortified with 1000 ng/L of each analgesic compounds and then pH of samples was adjusted to 7. Samples filtered through 1.2 µm glass fiber filters followed by 0.45 µm nylon membrane filters. Then SPE procedure applied. Recoveries have been shown in Figure 3. Recoveries are without filtration between 78% (ACETAM) and 90% (INDO). Sample recoveries which were filtrated nylon membrane filters with a 0.45 µm pore diameter are between 74% (ACETAM) and 85% (INDO). Sample recoveries which were filtrated glass fiber filters with a 1.2 µm pore diameter between 75% (ACETAM) and 85% (ACETYL ACID). Negative effect of pretreatment of sample was not determined on SPE.



**Figure 3.** Effect of sample pre-treatment

To determine effect of analit concentration on extraction, 200 mL ultrapure water was fortified with 100, 500, 1000 ng/L of each analgesic compounds. After pH adjustment (pH=7) SPE procedure was applied. Recoveries are between 74% (ACETAM) and 89% (INDO) for 100 ng/L spike concentration, between 75% (ACETAM) and

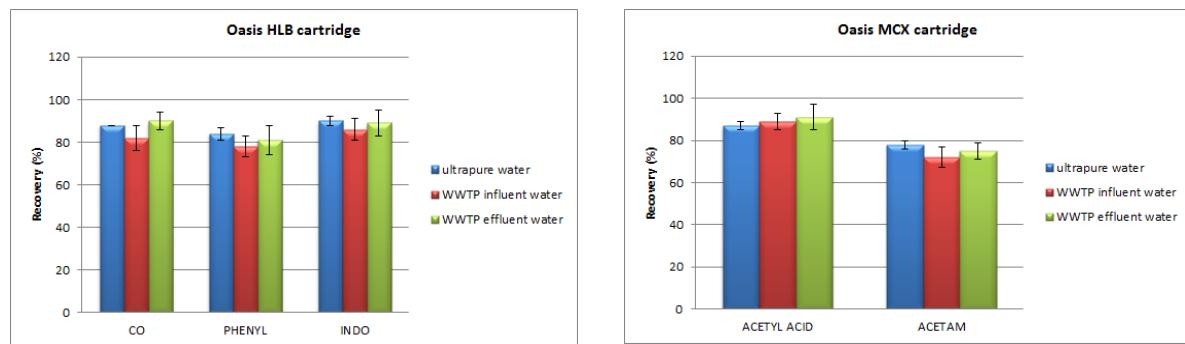
90% (ACETYL. ACID) for 500 ng/L spike concentration, between 78% (ACETAM) and 90% (INDO) for 1000 ng/L spike concentration (Figure 4). Negative effect of different analit concentration was not determined on SPE.



**Figure 4.** Effect of analit concentration

Finally matrix effect was also investigated. 200 mL composite wastewater samples which were taken from Konya Wastewater Treatment Plant input and output. were fortified with 500 ng/L of each analgesic compounds. Samples were filtered through 1.2 µm glass fiber filters followed by 0.45 µm nylon membrane filters. 0.1 M Na<sub>2</sub>EDTA (0.1%) was added all samples. Because Na<sub>2</sub>EDTA reduces pharmaceutical compounds binding to cations in water (Lopez-Serna et al., 2011). Recoveries are between 78% (ACETAM) and 90% (INDO) for spiked to ultrapure water, between 72% (ACETAM) and 89% (ACETYL. ACID) for spiked to influent water, between 75% (ACETAM) and 91% (ACETYL. ACID) for spiked to effluent water (Figure 5).

INDO was not detected in influent and effluent samples. CO, PHENYL, ACETYL ACID and ACETAM were detected as 126 ng/L, 1768 ng/L, 44 ng/L and 768 ng/L in influent samples, respectively. CO, PHENYL, ACETYL ACID and ACETAM were detected as 121 ng/L, 2860 ng/L, 88 ng/L and 696 ng/L in effluent samples, respectively.



**Figure 5.** Matriks effect

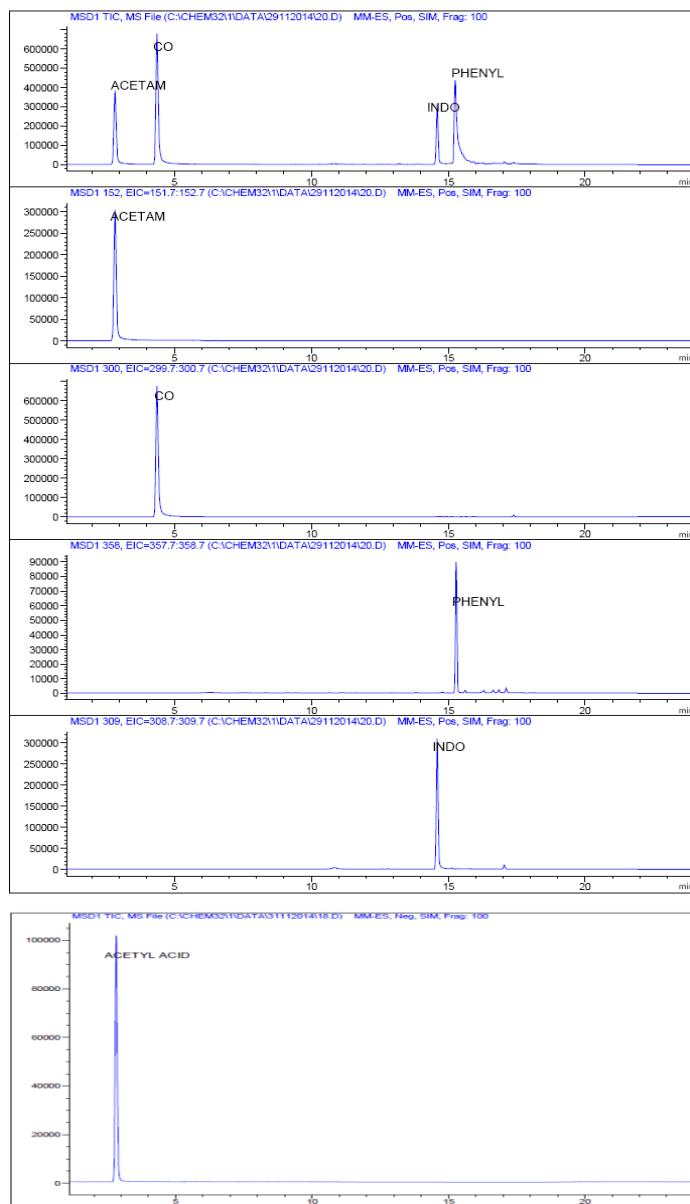
Shaaban and Górecki (2011) developed a method for analysis of some pharmaceuticals including analgesics by ultra high-pressure liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS). SPE procedure was applied using Oasis HLB cartridge without pH adjustment. Recoveries were obtained between 9.7±4.5% (ACETYL. ACID) and 76.7±4.6% (PHENYL) for spiked 100 µg/L between 10.1±4.1% (ACETYL. ACID) and 77.5±4.3% (PHENYL) for spiked 1000 µg/L to ultrapure water.

Grujić et al. (2009) determined analgesics in surface water, ground water and wastewater treatment plant by HPLC-MS. SPE method was optimized at different sample pH and sample volume. The highest recoveries were obtained at 100 mL sample volume and pH=3. Recoveries are between 35% (ACETAM) and 100% (ACETYL. ACID). Guerra et al. (2014) investigated analgesics by SPE-LC-MS/MS. ACETAM compound was determined as 36000-50000 ng/L concentration in influent water, 16-62000 ng/L in effluent water. CO compound was determined as 77-5700 ng/L in influent water, 80-3300 ng/L in effluent water. López-Serna et al. (2010) determined analgesics by SPE-LC-MS/MS as INDO 93.88 ng/L, ACETAM 77.83 ng/L, CO 350.12 ng/L concentrations while PHENYL compound were not detected in effluent water.

### 3.2. HPLC-MS Analysis

Most suitable mobile phase was found A: water with %0.1 formic acid ve 5 mM ammonium formate, B: methanol for analgesics which is worked in positive ion mode. A: water with 10 mM ammonium acetate, B: methanol for analgesics which is worked in negative ion mode. Optimal flow rate was determined as 0.6 mL/min, injection volume was determined as 2 µL. A linear gradient progressed with 90% A and 10% B for 1 min,

ramping to 30% B at 3 min, 70% B at 8 min, 95% B at 2 min and it was held for 2 min. Standard chromatogram of analgesic compounds at optimum HPLC-MS conditions have been shown at Figure 6.



**Figure 6.** Standard chromatogram of analgesic compounds at optimum HPLC-MS conditions (10 ng/μL)

LC-MS analytic quality parameters LOD, LOQ, linear response range, linearity, repeatability and m/z values for were given Table 1. Limits of detection (LOD) and quantification (LOQ) were calculated using signal to noise (S/N) ratios. LOD were calculated as concentrations that would give S/N ratio of 3, whereas LOQ correspond to S/N= 10.

Table 1. LOD, LOQ, linear response range, linearity, repeatability and m / z values for analgesics obtained with HPLC-MS systems

Compound	m/z value	LOD	LOQ	Linear Response Range	R <sup>2</sup>	Repeatability (RSD) n=6
		ng/L	ng/L	ng/µL		%
ACETYL CID	137 [M-H] <sup>-</sup> 152, 110[M+H] <sup>+</sup>	2.443	8.144	0.001-10	0.9997	1.82
ACETAM	300 [M+H] <sup>+</sup>	2.347	7.826	0.001-10	0.9997	4.47
CO	309 [M+H] <sup>+</sup>	0.161	0.536	0.001-10	0.9936	1.13
PHENYL	358,231[M+H] <sup>+</sup>	2.594	8.649	0.001-10	0.9991	3.97
INDO		8.413	28.04	0.001-10	0.9999	3.03

### 3.3. Ecotoxicological Risk Assessment

The hazard quotient (HQ) for each individual compound was calculated according to EU guidelines as the quotient between the measured environmental concentration (MEC) and the Predicted No Effect Concentration (PNEC). The individual concentration quantified for each analgesic compounds in the wastewater samples was taken as MEC. PNEC values were derived from the available aquatic toxicity data using three different species (algae, crustaceans and fish) from different tropic levels. The HQ values for ACETYL ACID and CO were determined below 0.1, which means insignificant risk to aquatic organisms. The HQ values of ACETAM for fish and algae were determined below 0.1 while the value for Daphnia magna were determined between 0.1 and 1 which indicates potential risk.

### 4. CONCLUSIONS

A method has been developed for analysis of five analgesics using SPE-LC-MS. Then optimized method was applied to wastewater. For extraction of analgesic compounds Oasis HLB (CO, PHENYL, INDO) and Oasis MCX cartridge (ACETYL ACID and ACETAM.) were used to obtain high recoveries. pH of sample was determined 7 for analgesics in solid phase extraction. The results show that 200 mL sample volume is most suitable for extraction of analgesics. Low sample volumes were preferred at different method works which is studied effect of sample volume. Increasing sample volume leads to prolongation of analysis time, degradation of analytes and desorption of pharmaceutical compounds. Also it is thought that the formation of matrix effects in high sample volumes. Adverse effects of different pharmaceuticals concentrations, filtering and matrix on solid phase extraction were not detected. Analgesics were detected up to 1768 ng/L concentrations influent water. Outlet of wastewater treatment plant, the highest analgesic concentration was 2860 ng/L. The HQ values for ACETYL ACID and CO were determined below 0.1, which means insignificant risk to aquatic organisms. The HQ values of ACETAM for fish and algae were determined below 0.1 while the value for Daphnia magna were determined between 0.1 and 1 which indicates potential risk. There are very few studies on the ecotoxicological risk assessment of pharmaceuticals in the literature. So more ecotoxicological studies on are needed to fully assess the risks of pharmaceuticals.

**Acknowledgments** –This study was supported by TUBA-GEBIP Project.

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## COMBINED ANAEROBIC-ADSORPTION PROCESS FOR TREATMENT OF REAL TEXTILE WASTEWATER: COD AND COLOR REMOVAL

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### ABSTRACT

The aim of this study was removal of chemical oxygen demand (COD) and color of real textile wastewater (RTE) using adsorption as post-treatment followed by anaerobic degradation. Initially, sequencing batch reactor (SBR) was anaerobically operated for 60 days under steady state conditions and high wastewater treatment performance was observed, corresponding to 75.9 % color (Pt-Co unit) and 65.4% COD removal. The use of low-cost and ecofriendly adsorbents has been investigated. The rest of the study, banana peel, sugar beet pulp and pineapple peel were used to identify the adsorption capacity of the adsorbents and adsorption isotherms at constant particle size. The effect of operational parameters such as initial pH (3.0-11.0), adsorbent dosage (4-0.25 mg/L), contact time (15-60 min) parameters with physicochemical activation methods (acid, base and temperature activation) was investigated during adsorption studies. The optimum operating condition varied according to using adsorbent material and the maximum color removal efficiency of 83% were achieved by pineapple at contact time 60 min, initial pH 11.0, initial adsorbent dosage 0.5 mg/l without activation methods. All of the activation methods played a key role, which enhanced the color removal. However, it could not observed a significant reduction in effluent COD at the all condition applied during adsorption.

**Keywords:** Adsorption, Banana peel, Pineapple peel, Real textile wastewater, Sugar beet pulp

### 1. INTRODUCTION

The textile industry wastewaters are known as one of the main sources of severe pollution problems worldwide. The textile industry consumes considerable amount of water in the manufacturing process (Modi et al., 2010; Lu et al., 2010). This wastewater can cause serious environmental problems due to their high colour, large amount of suspended solids, high chemical oxygen demand and low biodegradability (Kim et al., 2004). Standard discharge limits of textile effluent are becoming more stringent in recent days creating continuous problems for industries to comply with. Generally the treatment options can be divided into three main categories namely biological, chemical and physical methods (Ozbebek et al., 2014; Raj et al., 2005). Of the various treatment methods applied to dyeing wastewater, biological treatment is one of the most popular methods (Robinson et al., 2001; Senan and Abraham, 2004; Olukanni et al., 2006). Biological methods are generally cheap and simple to apply and are currently used to remove organics and color from dyeing and textile wastewater. However this wastewater cannot be readily degraded by conventional biological processes. To achieve a marked color reduction after a biological process, a further application of relatively expensive tertiary treatments is required, typically performed by techniques such as adsorption with active carbon, membrane filtration (Konsowa, 2003), ozonation (Kim et al., 2004; Tizaoui et al., 2007), coagulation flocculation (Gianluca and Nicola, 2001; Allegre et al., 2004), photocatalytic degradation (Arslan and Isil, 2002; Tizaoui et al., 2007) and electrochemical techniques(Bertanza et al., 2001; Chen et al., 2003; Kim et al., 2003). Most of the existing processes include an initial step of anaerobic treatment to remove the organic matter followed by oxidation, UV radiation, membrane separation, or adsorption (Chang and Lin, 2000; Robinson et al., 2001; Pearce et al., 2003). The adsorption process is one of the most efficient methods to remove dye which also provides attractive alternative treatment. Activated carbon is the widely used as adsorbent for decolorized color from textile effluents due to its high capacity for organic matter but its use is limited because of high cost (Namasivayam et al., 2002). Now the research is focused on the use of low cost adsorbents derived from agricultural wastes such as coir pith, maize bran, rice husk, orange peel, lemon peel, barley straw, egg shell, sunflower stalks and pea nut hulls (Johnson et al., 2008).

The main objective of this study is removal of COD and color of real textile wastewater by adsorption as post-treatment followed by anaerobic degradation. In the biological step, SBR was performed under condition influent COD of 1000 mg/L. Afterwards the performance of banana peel, pineapple peel and sugar beet pulp adsorbents has been compared and on adsorption process as post treatment to remove the residual COD and color from SBR effluent at different operation conditions (pH, contact time, adsorbent dosage, activation

methods). The study shows that the material has good potential for the removal of color from textile effluent.

## 2. MATERIALS AND METHODS

### 2.1. Adsorbent

Waste banana peel, pineapple peel and sugar beet pulp were used in this study. The adsorbents were washed with deionized water to remove the available color and dirty. These adsorbents then dried in oven at 105 °C for 24 hours sieved through 600 micron sieves. Adsorbent were kept in a desiccator until use for the batch adsorption and was used for the study.

### 2.2. Adsorbent activation

In this study, activation methods associated with acid, base and heat treatment were performed to increase the adsorption capacity of adsorbents. Each adsorbent (5 g) were mixed with 100 mL of 0.1M H<sub>2</sub>SO<sub>4</sub> and 1 M KOH solution for 24 h at room temperature using a shaker. The adsorbents were rinsed thoroughly with deionized water. Then activated adsorbents was dried 2h at 105 °C. The sieved adsorbents were heated 60 min at 100 °C for heat-treat activation. The deionized water was decanted and the adsorbents were dried dried 2 h at 105 °C. Adsorbents were kept in a desiccator.

### 2.2. Real Textile Wastewater

Real textile wastewater was collected once a week from the wastewater treatment plant of Kipaş Textile Industry in Kahramanmaraş, Turkey. The influent was stored at 4 °C and the SBR was operated at room temperature of 23±2 °C. It is worth mentioning that the dyeing process of this factory is continuous and utilizes many different dye types. Considering the alkali characteristics of the wastewater, the pH was adjusted to 7.0 with 0.1M hydrochloric acid (HCl) before being fed to the SBR.

### 2.3. Experimental procedure for biological treatment stage

A mixed bacterial culture obtained from wastewater treatment plant of Kipaş Holding in Kahramanmaraş, Turkey was used to start up SBR. (Bioflo 115, New Brunswick Scientific Co., Edison, NJ, USA) with total and effective working volumes of 6 L and 5 L, respectively. The content of the reactor was mixed by a single shaft impeller system at a speed of 400 rpm. The reactor was temperature controlled at 20 °C and was not adjusted pH during the experiments. Operation of the SBR consisted of a start phase (10 min), an influent phase (3 min) in which 2.5 L fresh medium was supplied, a biomass withdrawal phase (5 min) in which 200 mL (25 days SRT, considering also biomass removed with the effluent) mixed reactor liquor was withdrawn, a settling phase (30 min), and an effluent withdrawal phase (5 min). SBR operation was designed for two cycles a day (12h cycle time) under batch mode. The reactor system was operated with real textile wastewater for 60 days under anaerobic condition in order to evaluate color and DOC removal efficiency.

### 2.4. Experimental procedure of adsorption stage for post-treatment

Anaerobically pretreated SBR effluent was used for adsorption experiments at room temperature. The adsorption tests were performed in “Jar test” equipment (VELP scientific, JLT 6, Italy), capable of 6 simultaneous tests. The three adsorbent materials used (banana peel, pineapple peel and sugar beet pulp) were selected by the sieving, particles with about 600 mm of diameter. The jars (500 milliliters capacity) were submitted to a constant rotation speed of 150 rpm and the total test duration of 60min. Samples were withdrawn from the stirrer at different time intervals. Then the adsorbents were separated from the sample by using syringe filter.

**Table 1. Operational conditions of adsorption process**

PARTS	Adsorbent material	pH	Adsorbent dose (mg/L)	Activated methods	Contact time (min)
<b>I. Part</b> <b>Effect of pH</b>	Banana peel	3	2000	---	0-60
		7	2000	---	0-60
		11	2000	---	0-60
	Pineapple peel	3	2000	---	0-60
		7	2000	---	0-60
		11	2000	---	0-60
	Sugar beet pulp	3	2000	---	0-60
		7	2000	---	0-60
		11	2000	---	0-60
<b>II. Part</b> <b>Effect of adsorbent dose</b>	Banana peel	7	3000	---	0-60
		7	4000	---	0-60
		11	1000	---	0-60
	Pineapple peel	11	500	---	0-60
		11	250	---	0-60
		11	1000	---	0-60
	Sugar beet pulp	11	500	---	0-60
		11	500	---	0-60
		11	500	---	0-60
<b>III. Part</b> <b>Effect of activated methods</b>	Banana peel	7	2000	Acid	0-60
		7	2000	Base	0-60
		7	2000	Thermal	0-60
	Pineapple peel	11	250	Acid	0-60
		11	250	Base	0-60
		11	250	Thermal	0-60
	Sugar beet pulp	11	500	Acid	0-60
		11	500	Base	0-60
		11	500	Heat-treat	0-60

The batch adsorption experiments were conducted to study optimum removal of residual color and DOC from real textile wastewater. This study was composed of three parts (Table 1). In the first part of study, the adsorption experiments were carried out to investigate the effect of pH on adsorption at solution pH 3.0, 7.0 and 11.0 keeping other parameters constant. In all cases, the pH of the solution was adjusted by using acid or alkali without affecting the volume of the solution. Then the effect of adsorbent dose on efficient removal of color and COD from real textile wastewater the study were evaluated at the optimum pH obtained from the first part of the study (Part II). In the rest of the study, the effect of some physicochemical activation methods (HCl, NaOH and heat-treat) were also investigated to improve the adsorption capacity of the adsorbents.

## 2.5. Analytical Methods

Before the measurements of color, and DOC, liquid samples were centrifuged (Eppendorf Centrifuge, 5415R, Hamburg, Germany) at 10000 rpm for 5 min. Afterwards, centrifuged samples were filtered using 0.45 µm filters. DOC parameters were measured using TOC-TN analyzer (Shimadzu, TOC-VCPN Kyoto, Japan). For color measurements, RES parameter ( $m^{-1}$ ) was applied according to the standards of European Norm EN ISO 7887. The absorbance measurements at three wavelength, namely 436nm, 525nm and 620nm; were used to calculate the spectral absorption coefficient (adsorption per unit path length) as shown in following equation (Eq. 1). A is the absorbance of the sample at wavelength, d is the optical path length of the cell (mm) and f is the conversion factor between mm and m, which is 1000.

$$\text{RES}(\lambda) = (A/d) \times f \quad (1)$$

pH was measured using a pH probe in adsorption experimental (340i, WTW, Oslo, Norway). MLSS concentration was measured as absorbance at 600 nm using centrifuged samples as blank followed by reference

to an experimentally derived standard curve ( $\text{ABS}_{600\text{nm}} = 0.9529 \times \text{MLSS} + 320.74$ ;  $R^2 = 0.9799$ ). All assays were run in triplicate and mean values were presented.

### 3. RESULTS AND DISCUSSION

#### 3.1. Anaerobic biodegradation process performance

In this study, SBR was fed with real textile effluent containing about chemical oxygen demand (COD) of  $1000 \pm 15$  mg/L, color of  $51 \text{ m}^{-1}$  ( $\lambda_{436}$ ),  $53 \text{ m}^{-1}$  ( $\lambda_{525}$ ),  $57 \text{ m}^{-1}$  ( $\lambda_{620}$ ) and 3920 Pt-Co. Under this condition 83.1% ( $\lambda_{436}$ ), 65.7% ( $\lambda_{525}$ ), 72.2% ( $\lambda_{620}$ ) and 75.9% color removal efficiencies were observed corresponding to about  $29 \text{ m}^{-1}$ ,  $27 \text{ m}^{-1}$ ,  $35 \text{ m}^{-1}$  effluent RES values, respectively. During this stage, DOC removal efficiency was observed corresponding to 65.4 % and the effluent DOC concentration was below 247 mg/L at the end of the reaction time.

#### 3.2. Adsorption performance

##### 3.2.1. Effect of pH on color removal capacity of different adsorbents

The pH of the dye solution plays an important role in whole adsorption process and particularly on the adsorption capacity, influencing not only the surface charge of the adsorbent but also the dye chemistry. In the first part, pH value was increased stepwise from 3.0 to 7.0 and 11.0 at the constant adsorbent dose of 2 mg/L. According to this study, banana peel, pineapple peel and sugar beet pulp showed different removal performances at different initial pH due to characteristic of adsorbents. The pH 7.0, pH 11.0 and pH 11.0 were found optimum on adsorption process for banana peel, pineapple peel and sugar beet pulp, respectively (Fig. 2).

Figure.1 shows that the pH of the solution significantly affects the adsorption of dyes by banana peels. At average pH, the more effective dye adsorption capacity of banana peels was observed. The optimum adsorption capacity was achieved at pH 7. Under this condition 58% ( $\lambda_{436}$ ), 70% ( $\lambda_{525}$ ), and 51% ( $\lambda_{620}$ ) color removal efficiencies were observed corresponding to about  $11 \text{ m}^{-1}$ ,  $8 \text{ m}^{-1}$ ,  $9 \text{ m}^{-1}$  effluent RES values, respectively. At lower and high pH, functional oxidized groups of the peels are promoted of banana peels for binding of dye become less available. The effect of various pH levels on color performance in adsorption using sugar beet peel is shown in Fig. 1. The maximum adsorbed color amount was observed at pH 11. Under this condition 93% ( $\lambda_{436}$ ), 95% ( $\lambda_{525}$ ), and 97% ( $\lambda_{620}$ ) color removal efficiencies were observed corresponding to about  $1.1 \text{ m}^{-1}$ ,  $0.5 \text{ m}^{-1}$ ,  $0.4 \text{ m}^{-1}$  effluent RES values, respectively. Observed maximum color adsorption performances of pineapple peel as adsorbent was 80% (Pt-Co unit) at the pH value 11 due to higher adsorption capacity.

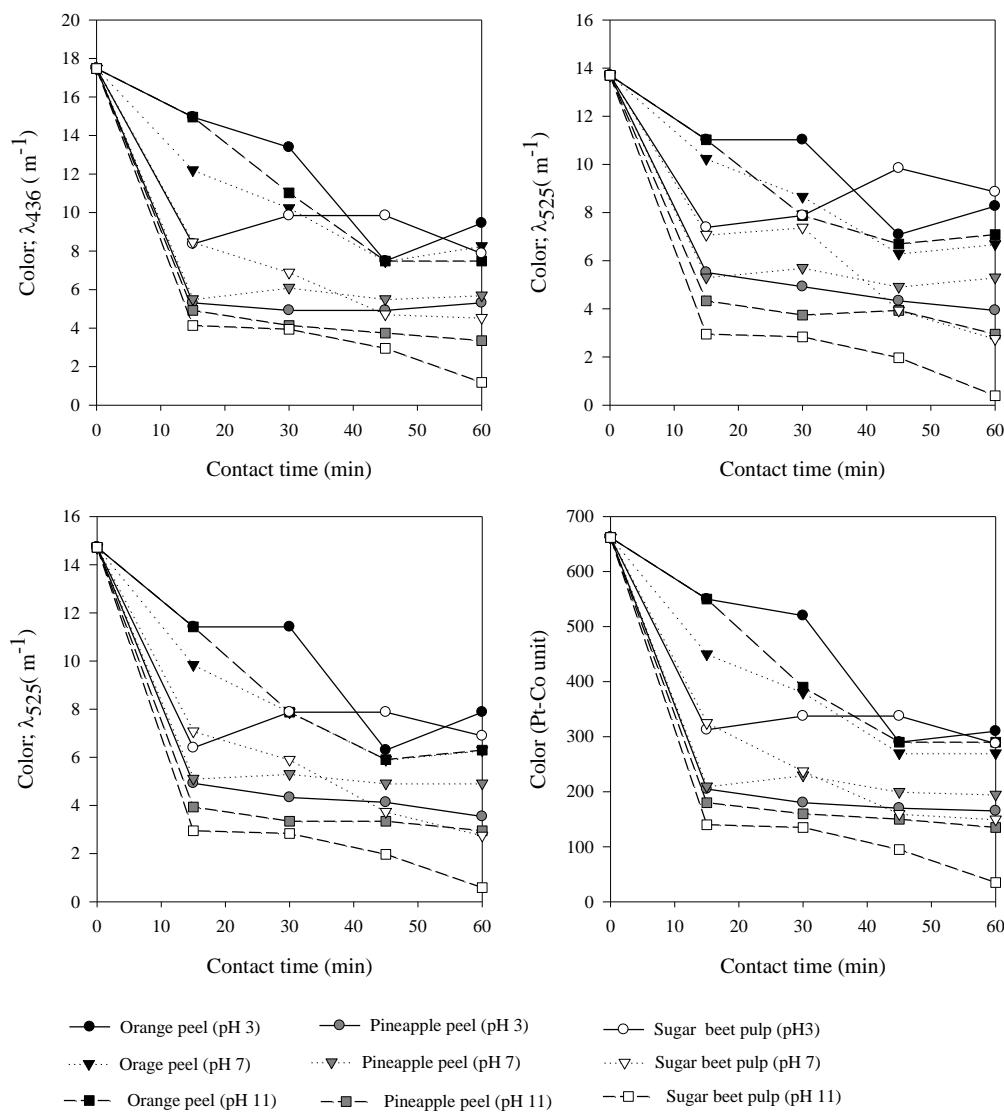


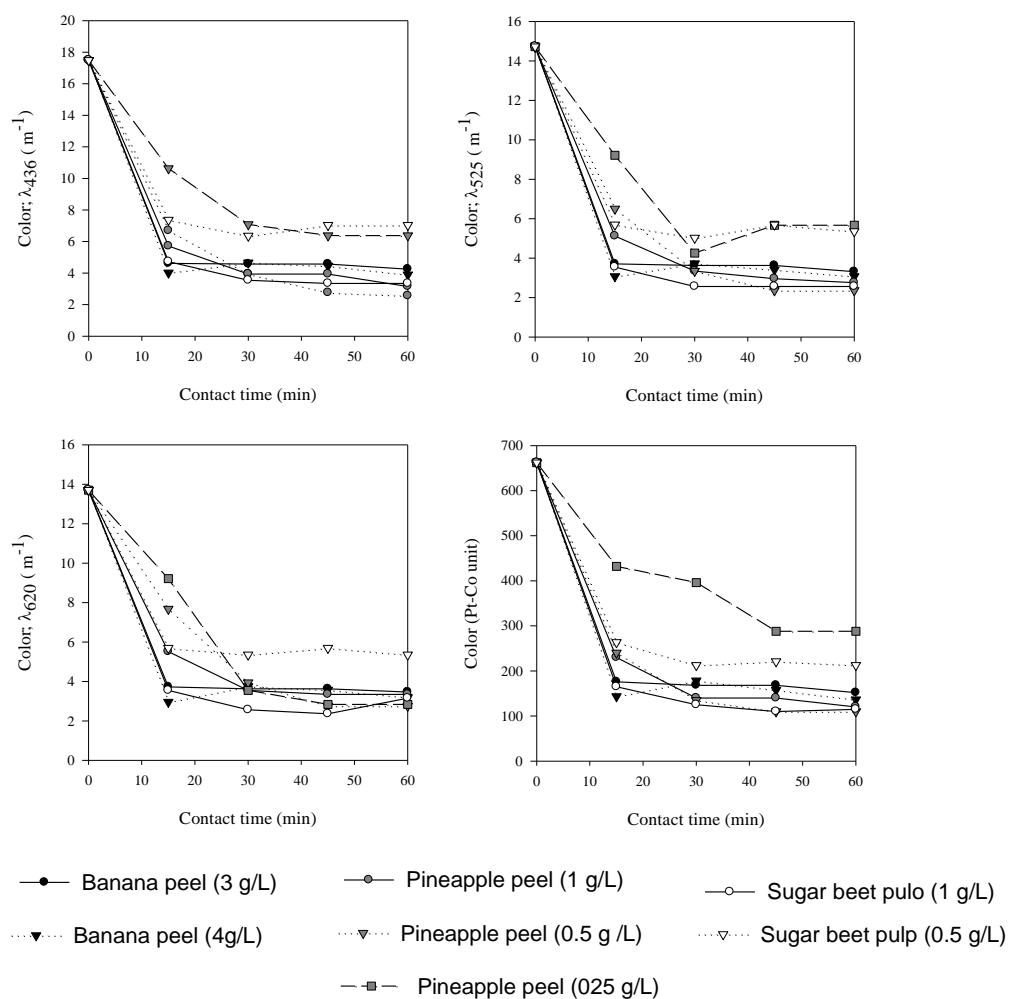
Fig.1. The effect of pH on color removal capacity of different adsorbents

### 3.2.2. Effect of initial adsorbent dosage on color removal capacity

The variation in the adsorption capacity between the various concentrations of adsorbent is depending on surface area required for adsorption. With increasing adsorbent concentration more surface area is available for the adsorption due to increased active site of adsorbent. After the beginning period, the adsorption was not affected due to equilibrium.

The different doses of adsorbents namely sugar beet pulp and pineapple peel taken such as 1g to 0.25g with 1 L textile effluent in polyethylene bottle in shaker at about 25°C, 150 rpm and optimum pH. It was found that maximum color removal efficiency for sugar beet pulp was 82% at 1 g dose of adsorbent for 60 minutes and for pineapple peel 84% at dose of 0.5g of adsorbent when shaking time was 60 minutes. From the comparative results it was found that banana peel is more effective than pineapple peel. The graphical representation is shown in Figure 2.

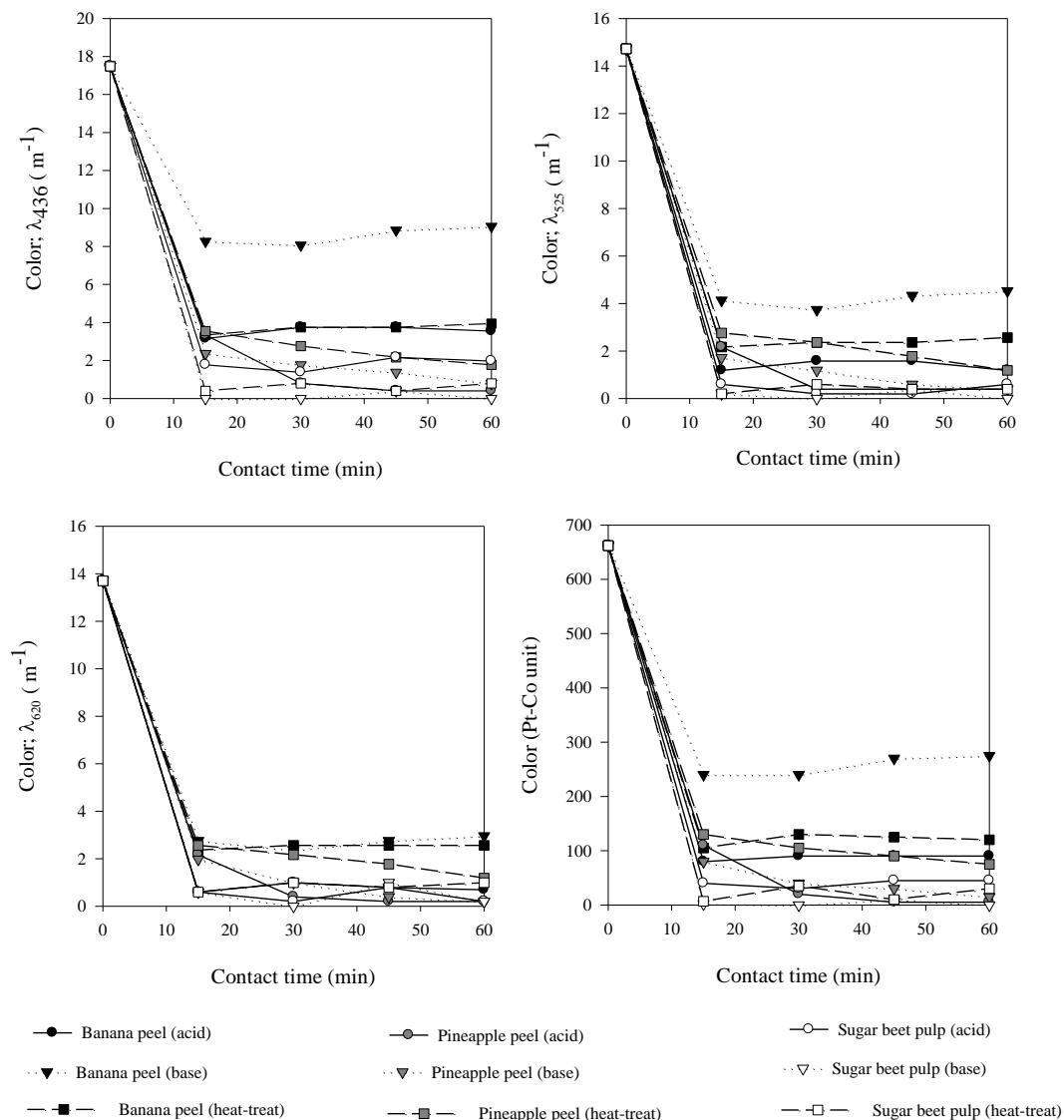
Fig. 2 indicates the color removal efficiency as Pt-Co unit and RES with various adsorbent doses for banana peel. The maximum color removal efficiencies were 77%, 75%, and 46%, at RES $\lambda_{436}$ , RES $\lambda_{525}$  and RES $\lambda_{620}$ , respectively at 3g /L. Dye amount adsorbed by pineapple peel was higher than adsorbed by banana peel and sugar beet pulp although initial dye concentration and applied adsorbent dose were constant.



**Fig.2.** The effect of adsorbent dosage on color removal capacity of different adsorbents

### 3.2.3. Effect of activation methods on color removal capacity

The most common regeneration techniques employed in industrial processes used acid, base and thermal reactivation. Adsorption using sugar beet pulp, banana and pineapple pulp process performance are shown under different activation methods in Fig. 3. All three activation method was improved color removal capacity of adsorbent and color removal efficiency was increased. Observed maximum color adsorption performances of sugar beet pulp as adsorbent was 98% (Pt-Co unit) at the basic activation due to higher adsorption capacity. Under this condition 98% ( $\lambda_{436}$ ), 99% ( $\lambda_{525}$ ), and 99% ( $\lambda_{620}$ ) color removal efficiencies were observed corresponding to about  $1.1 \text{ m}^{-1}$ ,  $0.5 \text{ m}^{-1}$ ,  $0.4 \text{ m}^{-1}$  effluent RES values, respectively. Adsorption capacity of natural adsorbents are lower than that of activated adsorbents with all (acid, base, heat-treat) methods and color removal performance increased. This study showed that activation methods were a successful strategy to enhance adsorption capacity of adsorbent.



**Fig.3.** The effect of activation methods on color removal capacity of different adsorbents

#### 4. CONCLUSION

In this paper was removal of COD and color of real textile wastewater using adsorption as post-treatment followed by anaerobic degradation. Combined biological and adsorption processes showed good performance for the removal of color from the combined industrial biotreated effluent. The optimum operating condition varied according to using adsorbent material and the maximum color removal efficiency of 83% were achieved by sugar beet pulp at contact time 60 min, initial pH 11.0, initial adsorbent dosage 0.5 mg/l and basic activation methods. The results of this study have demonstrated the effectiveness and feasibility that post adsorption is a feasible option.

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## TREATMENT OF REAL TEXTILE WASTEWATER USING ADSORPTION AS POST-TREATMENT FOLLOWED BY ANAEROBIC BIODEGRADATION

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### ABSTRACT

The aim of this study was to investigate the treatability of dissolved organic carbon (DOC) and color from real textile wastewater using anaerobic treatment and adsorption using natural adsorbents. In the first part of the study, anaerobic sequencing batch reactor (SBR) performance was investigated at 12-h cycle times. Afterwards (Part II), adsorption using olive seed and rice husk as adsorbent was applied as post treatment to remove the residual DOC and color from SBR effluent at the different operating conditions. Initially, the effect of different pH and contact time were simultaneously studied at the 2 mg/L adsorbent dose and it was determined that pH have a significant effect on the decolorization. Additionally, increasing contact time from 15 to 60 min enhanced adsorbent capacity. The maximum dye removal yield for olive seed reached around 74% at pH 3.0, while the dye removal performance for rice husk reached around 88% under pH 11.0. Further, 2-fold and 4-fold decreases in initial adsorbent dose were performed to minimize the adsorbent waste at the optimum pH determined previously. Color removal efficiency was adversely affected by decreasing adsorbent dose from 2 to 0.5 g/L due to the insufficient amount of available adsorbent to remove the residual color. In the rest of the study, the effect of some physicochemical activation methods was investigated to improve the adsorption capacity of the adsorbents. Our results showed that the unremoved DOC during biological treatment was also resistant to adsorption and could not to be prominently removed.

**Keywords:** Adsorption, Decolorization, Olive seed, Real textile wastewater, Rice husk

### 1. INTRODUCTION

Textile industry wastewater constitutes one of the most important industrial sewage in the world. Due to the use of different technologies applied in the textile industry, treatment of these wastewaters with a standard treatment method is impossible. The textile industry wastewater contains various chemicals and dyestuffs used during the production process; accordingly, colored high-volume and toxic wastewaters are released (Mahmoodi and Arami, 2009; Mahmoodi et al., 2011). Typical textile wastewater industry is characterized by high chemical oxygen demand (COD), biochemical oxygen demand (BOD), pH, and salinity (Dos Santos et al., 2007), however, the major problem encountered in textile industry wastewater is its high dyestuff content. Turkish Water Pollution Control Regulation (WPCR) contains 280 Pt-Co as color discharge standard, however; it is expected to be tightened further with future revisions. Textile enterprises have generally preferred biological treatment processes due to its lower operating and investment cost, but majority of established biological treatment plant is aerobic activated sludge process and is insufficient for color removal. As color standard becomes mandatory, industries have to meet the color discharge standards by determining the appropriate treatment technology.

Most dyes are known toxic; however, their components and breakdown products can be more toxic. To overcome this problem, much attention has been focused on the effective treatment of dyes discharged from the dying and textile industries. Many different physicochemical or biological techniques such as membrane (Akbari et. al., 2002), electrochemical (Raghu and Basha, 2007), coagulation/flocculation (Papic et al., 2004; Shi et al., 2007), microbial degradation (Gonzalez-Gutierrez and Escamilla-Silva, 2009; Türkgay et al., 2011), adsorption (Uğurlu, 2009; Vieira et al., 2009; Wiesen et al., 2014), etc. have been studied to remove dyes from wastewaters. Among the treatment techniques, adsorption process using natural materials is considered to be relatively superior to other techniques due to low cost, high efficient, design simplicity to remove concentrated form of dyes, pigments and other colorants (Kannan and Sundaram, 2001; Ugurlu 2009; Vieira et al., 2009). Adsorption is a process that collects soluble substances (VOC's, pesticides, phenolics, complex synthetic organics, heavy metals and dye) from solution on an interface or surface. Adsorption mechanisms are generally categorized as either physical or chemical adsorption. Physical adsorption is the results of intermolecular forces of attraction between adsorbent molecules and the adsorbate substance with Van der Waals forces. Chemical adsorption involves the formation of strong chemical bond force between adsorbate and adsorbent.

Many important factors have been known to affect achieving high wastewater removal such as operating conditions (pH, temperature, adsorbent dosage, and contact time), adsorbent nature, solubility, surface area, wastewater characteristic (Figueiredo et al., 2011; Wan Ngah et al., 2011). So far, different operating conditions and adsorbent material have been examined to improve performance and minimize material cost. It has been known that adsorbent characteristic allows improvement of adsorption rate, adsorption capacity and adsorbate-adsorbent interactions, thereby affecting wastewater removal. Additionally, hydrogen and hydroxide ions are adsorbed quite strongly, and so pH of solution influences the adsorption of other ions.

This study aims at evaluating the performance of DOC and color removal of real textile wastewater by adsorption as post-treatment followed by anaerobic biodegradation. In the biological step, anaerobic SBR was operated to investigate performance of textile wastewater treatment at 12-h cycle times. Afterwards, the adsorption performance of olive seed adsorbent has been compared to rice husk adsorbent in respect to color and organic carbon removal efficiency at different operation conditions (pH, contact time and adsorbent dosage). The rest of the study, the effect of some physicochemical activation methods on adsorption capacity enhancement of natural adsorbents performance was investigated at the best-performed operation conditions.

## 2. MATERIALS AND METHODS

### 2.1. Real Textile Wastewater and Inoculum Source

Real textile wastewater was taken once a week from a full-scale wastewater treatment plant of Kipas Textile Industry in Kahramanmaraş, Turkey. The influent was stored at 4°C. It is worth mentioning that the dyeing process of this factory is continuous and utilizes many different dye types. The influent pH was adjusted to 7.0 by adding 0.1 M hydrochloric acid since the pH value of wastewater was usually up to 10.0. DOC concentration in the real wastewater was around 715±15 mg/L throughout study the biochemical treatment of highly colored textile wastewater.

### 2.2. Adsorbents

The natural adsorbents used in this study were olive seed and rice husk. In the experiments, the adsorbents were firstly washed with deionized water to remove the adhering dirt and available color. Adsorbents were dried in an oven at 105°C for 24 h and then were crushed and sieved through 0.6mm sifter. Adsorbents were kept in a desiccator until use.

### 2.3. Adsorbent Activation

In this study, activation methods associated with acid, base and heat-treat were performed to improve the adsorption capacity of adsorbents.

Acid activation: 5 g of each adsorbent were mixed with 100 mL of 0.1M H<sub>2</sub>SO<sub>4</sub> solution for 24 h at room temperature using a shaker. Then the supernatant (acid solution) was decanted by filtration and the adsorbent pellet was washed three times by deionized water to remove the residual acid. Activated adsorbents were dried 2 h at 105°C. Activated adsorbents were kept in a desiccator until use in the studies.

Base activation: 5 g of each adsorbent were mixed with 100 mL of 0.1 M KOH solution for 24 h at room temperature using a shaker. Then the supernatant (base solution) was decanted by filtration and the adsorbent pellet was washed three times by deionized water to remove the residual base. Activated adsorbents were dried 2 h at 105°C. Activated adsorbents were kept in a desiccator until use.

Heat-treat activation: 5 g of each adsorbent were boiled through 60 minutes with deionized water heated to 100°C. Then the deionized water was decanted by filtration and the activated adsorbents were dried 2 h at 105°C. Activated adsorbents were kept in a desiccator until use in the studies.

### 2.4. Anaerobic SBR Design and Operation

Experiment was started with sludge inoculation to the SBR. A mixed bacterial culture was collected from anaerobic digester of Kipas Textile Industry Wastewater Treatment Plant in Turkey and acclimatized to the described operation conditions for 60 days. The experimental SBR consisted of a 6.5-L vessel (Bioflo 115, New Brunswick Scientific Co., Edison, NJ, USA) with an effective working volume of 5 L. The contents of SBR were mixed by a single shaft impeller system at a speed of 400 rpm. SBR system was operated with a solid retention time of 25 days. SBR operation was designed for two cycles a day (12h cycle time) under batch mode. The SBR was operated at room temperature and were not adjusted pH during the experiments. The reactor medium was constantly filled with nitrogen gas at low flow rates to provide the anaerobic conditions. The performance of SBR containing real textile wastewater as pre-treatment was evaluated for 60 days with anaerobic mixed culture.

## 2.5. Adsorption Experiments Design and Operation

SBR effluent was used in adsorption experiments to remove residual color and DOC. The adsorption experiments were carried out at room temperature and batch mode. Batch adsorption studies were conducted using Jar test apparatus (VELP scientific, JLT 6, Italy) at speed of 150 rpm for varied period. The batch tests were performed in 500 ml glass bottles and conducted for 60 minutes until adsorption reached equilibrium. The initial pH values were adjusted to the desired value with 0.1 M HCl and 0.1 M NaOH using pH meter (WTW 340I Weilheim, Germany).

Adsorption process using olive seed and rice husk as adsorbent was applied anaerobically pretreated SBR effluent at the different operating conditions (Table 1). The adsorption process performance was evaluated in eight periods for each adsorbent. In the first three periods, pH level was increased stepwise from 3.0 to 7.0 and 11.0 at the constant adsorbent dose of 2 g/L. The adsorption experimental effluent was sampled at every 15 minutes (contact time) for the measurements of DOC and color to determine the system performance. In the periods IV, V and VI, 2-fold and 4-fold decrease in influent adsorbent dose was performed at the optimum pH level obtained from the previous part of the study. In the rest of the study (periods VII, VIII and IX), the effect of some physicochemical activation methods (HCl, NaOH and heat-treat) were investigated to improve the adsorption capacity of the adsorbents.

**Table 1.** Operational conditions of adsorption experimental

Periods	pH	Contact (min)	time Adsorbent (g/L)	dose	Activation methods
Periods for Olive seed					
I	3	15-60	2	-	
II	7	15-60	2	-	
III	11	15-60	2	-	
IV	3	15-60	2	-	
V	3	15-60	1	-	
VI	3	15-60	0.5	-	
VII	3	15-60	0.5	Acid	
VIII	3	15-60	0.5	Base	
IX	3	15-60	0.5	Heat-treat	
Periods for Rice husk					
I	3	15-60	2	-	
II	7	15-60	2	-	
III	11	15-60	2	-	
IV	11	15-60	2	-	
V	11	15-60	1	-	
VI	11	15-60	0.5	-	
VII	11	15-60	0.5	Acid	
VIII	11	15-60	0.5	Base	
IX	11	15-60	0.5	Heat-treat	

## 2.6. Analytical Methods

The pH, dissolved oxygen (DO) and oxidation-reduction potential (ORP) in the reactor was monitored continuously using a pH electrode (Mettler Toledo, Switzerland), DO electrode (Hamilton, Switzerland) and ORP meter equipped with a redox electrode (Mettler Toledo, Greifensee, Switzerland), respectively. Before the measurements of color and DOC, liquid samples were centrifuged using a Eppendorf Centrifuge 5415R centrifuge at 3000 rpm for 10 min. Samples taken for DOC analyses were filtered through 0.45 µm sterile syringe filter (Sartorius AG, Gottingen, Germany). Carbon concentrations were determined using TOC analyzer (Shimadzu, TOC-VCPN, Kyoto, Japan). Mixed liquor suspended solid (MLSS) was measured as absorbance at 600 nm followed by reference to an experimentally derived standard curve ( $ABS_{600nm}=0.621 \text{ MLSS} + 213.93$ ) in the SBR. In adsorption experimental, pH was measured using a pH probe (340i, WTW, Oslo, Norway). The color value of centrifuged wastewater was measured by spectrophotometer (Hach Lange, DR 5000, Germany) in 1 cm glass cuvettes as platinum-cobalt (Pt-Co) and number of colors (RES) values. The color was measured at wavelength of 465 nm as Pt-Co unit. According to EN ISO 7887, RES parameter ( $\text{m}^{-1}$ ) was also measured at three wavelengths, namely 436 nm, 525 nm and 620 nm. All assays were run in triplicate and the data illustrated in all figures were the mean values of the measurements.

### 3. RESULTS AND DISCUSSION

#### 3.1. Anaerobic sequencing batch reactor performance

In this study, SBR was fed with real textile wastewater containing about DOC of 715 mg/L, color of  $51 \pm 3 \text{ m}^{-1}$ (RES $\lambda_{436}$ ),  $53 \pm 2 \text{ m}^{-1}$ (RES $\lambda_{525}$ ),  $57 \pm 5 \text{ m}^{-1}$ (RES $\lambda_{620}$ ) and  $3920 \pm 50$  Pt-Co. SBR was anaerobically operated with 12-h cycles under batch mode. Dye reduction is an oxidation–reduction reaction. Electrons released from the biological oxidation of available DOC are transferred to dye as electron acceptor, thereby resulting in biological color removal. In this process, while the DOC removal efficiency reached to 65.4%, the color removal efficiencies were 83.1%, 65.7%, 72.2% and 75.9%, at RES $\lambda_{436}$ , RES $\lambda_{525}$ , RES $\lambda_{620}$  and Pt-Co units, respectively at the end of the reaction time.

#### 3.2. Adsorption Performance

The adsorption using olive seeds and rice husk as adsorbent was applied as post treatment to remove the residual DOC and color from SBR effluent at the different operating conditions (variable pH, contact time, adsorbent dose and physicochemical activation methods). However, the results showed that the unremoved DOC from real textile wastewater during biological treatment was also resistant to adsorption using olive seeds or rice husk and could never visibly removed at the all operating condition applied during adsorption (data not shown).

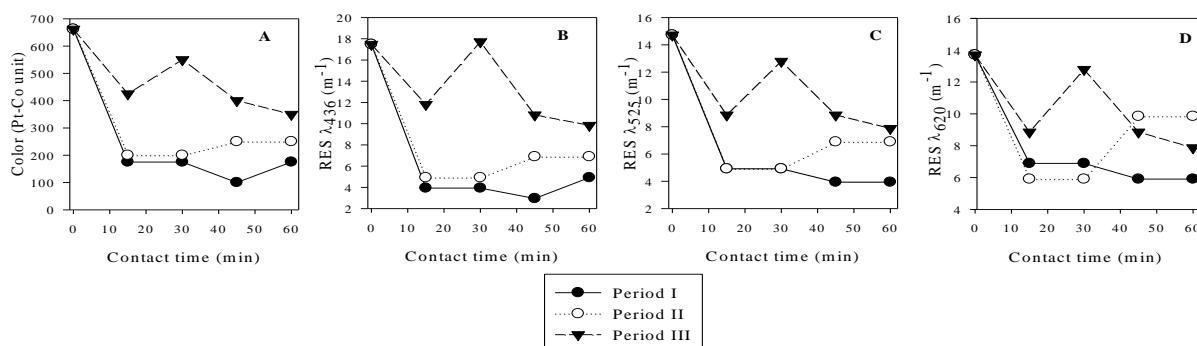
##### 3.2.1. Adsorption Using Olive Seed

In this study, the adsorption characteristics of olive seed were investigated in terms of color and DOC removal efficiency. The effect of pH, contact time, adsorbent dose and activation methods were examined and the results obtained from the batch adsorption studies were discussed.

Effect of pH level and contact time on adsorption process

The wastewater pH is an important parameter on dye adsorption. Adsorption process as post-treatment followed by anaerobic SBR was studied at the pH 3.0, 7.0 and 11.0 in period I, II and III, respectively. The adsorbent dose and initial organic carbon concentration were 2 g/L and 247 mg/L, respectively. Anaerobically pretreated SBR effluent containing color of about  $17.4 \text{ m}^{-1}$ ( $\lambda_{436}$ ),  $14.7 \text{ m}^{-1}$ ( $\lambda_{525}$ ),  $13.7 \text{ m}^{-1}$ ( $\lambda_{620}$ ), 662 Pt-Co was used in adsorption experiments. The color profile obtained from batch experiments are presented in Figure 1.

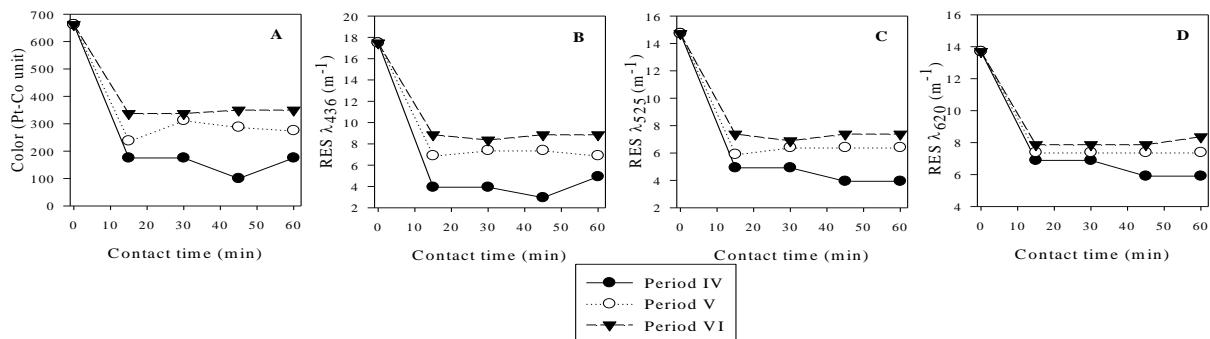
The initial wastewater pH had an effective effect on the dye adsorption onto olive seed due to various functional groups of olive seed, such as amino, hydroxyl and carbonyl groups that are affected by the pH of solutions. The maximum color removal efficiency was obtained at lower pH value (period I) and reached 85% at the end of the 45 minute contact time, corresponding to effluent color of 100 Pt-Co. Additionally, a large proportion of the color were removed at the beginning of contact time (first 15 minutes). The dominant adsorption mechanism results from the electrostatic attraction as well as the structure of dye molecules and olive seed surface. In the acidic medium, a considerable high electrostatic attraction exists between the positively charged surface of the adsorbent and dye anions, due to the ionization of functional groups of adsorbent and negatively charged anionic dye molecules (Namasivayam et al., 2002; Arami et al., 2005; Mahmoodi et al. 2011).



**Figure 1.** Color (A), RES $\lambda_{436}$  (B), RES $\lambda_{525}$  (C) and RES $\lambda_{620}$  (D) profiles observed at different pH level

Effect of initial adsorbent dose on adsorption process

Adsorbent dosage is an important factor in high adsorption efficiency due to determination the adsorption capacity of the adsorbate. Additionally, increasing adsorbent amount directly affects the operational cost. In the period I, II and III, the olive seed dose was varied from 2 g/L to 1 g/L and 0.5 g/L in at constant initial color of  $17.4 \text{ m}^{-1}$ ( $\lambda_{436}$ ),  $14.7 \text{ m}^{-1}$ ( $\lambda_{525}$ ),  $13.7 \text{ m}^{-1}$ ( $\lambda_{620}$ ), 662 Pt-Co, respectively. In Figure 2, color (Pt-Co and RES unit) profiles observed at different adsorbent dose are shown.

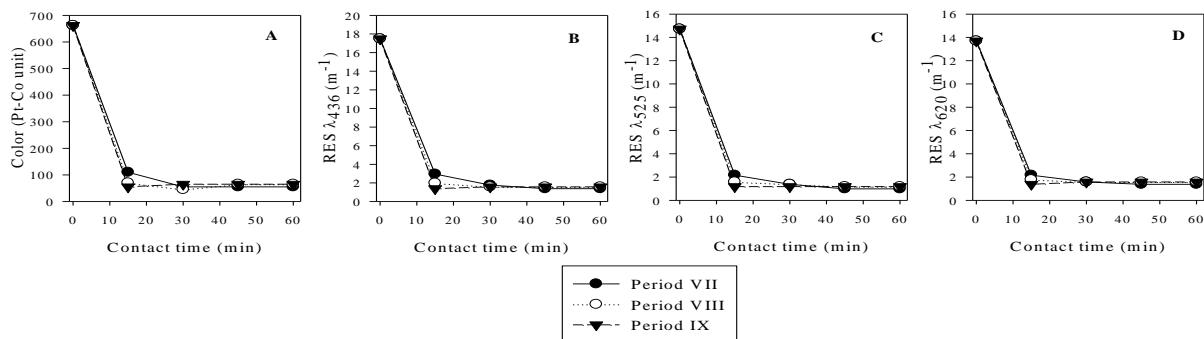


**Figure 2.** Color (A), RES $\lambda_{436}$  (B), RES $\lambda_{525}$  (C), RES $\lambda_{620}$  (D) profiles observed at different adsorbent dose

As seen from Figure 2, color was effectively removed from the real textile wastewater even at small adsorbent doses ( $\geq 50\%$  color removal). When the adsorbent dosage was increased from 0.5 g/L to 1 g/L and 2 g/L, the adsorption percentage of color was raised from around 50% to 64% and 85%, respectively, due to increment in active sites for penetration of the color on the adsorbent.

#### Effect of different activation methods on adsorption process

The three activation methods were performed to enhance the adsorption capacity of olive seed, namely, acid, base and heat-treat activation method (Figure 3).



**Figure 3.** Color (A), RES $\lambda_{436}$  (B), RES $\lambda_{525}$  (C), RES $\lambda_{620}$  (D) profiles observed under different activation methods

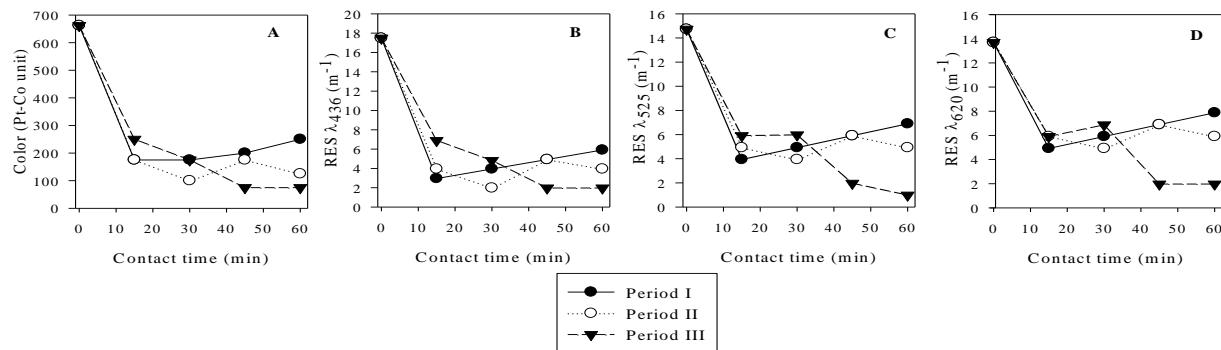
Experiments were carried out at the optimum operating conditions obtained from the previous step of the study (60-minute contact time, pH 3 and 0.5 g/L adsorbent dose, Period VI). All three activation method was improved color removal capacity of adsorbent and color removal efficiency was increased 40% (Figure 3), corresponding to average 92% color removal performance.

#### 3.2. Adsorption Using Rice Husk

In this part of study, the adsorption characteristics of rice husk were investigated in terms of color removal efficiency. The effect of pH, contact time, adsorbent dose and activation methods were examined and the results obtained from the batch adsorption studies were discussed.

#### Effect of pH level and contact time on adsorption process

In this study, the adsorption experimental was operated at pH 3.0, 7.0 and 11.0. Effects of various pH levels on color (Pt-Co and RES units) performance in adsorption using rice husk are shown in Figure 4. It was found that the increasing initial pH wastewater led to an increase adsorption amount of color by adsorbent. The maximum adsorbed color amount was observed at pH 11.0 (period III) which is operational parameter affecting the adsorption performance, corresponding to 89% removal efficiency. Therefore, pH value was chosen as basic pH for color adsorption. The adsorbed color amount and adsorption capacities of adsorbent reached equilibrium concentration at contact time of 45 minutes and pH 11.0. In the basic medium, adsorbent surface becomes negatively charged due to the presence of excess OH<sup>-</sup> ions and thus electrostatic repulsion decreases between the cationic dye molecules and negative charge on the rice husk surface. A positively charged site on the adsorbent favors the adsorption of cationic dyes at high pH, while a negatively charged site on the adsorbent favors the adsorption of real textile wastewater containing anionic dyes at low pH in due to the electrostatic attraction (Namasivayam and Kavitha, 2002; Arami et al., 2005; Mahmoodi et al., 2011).

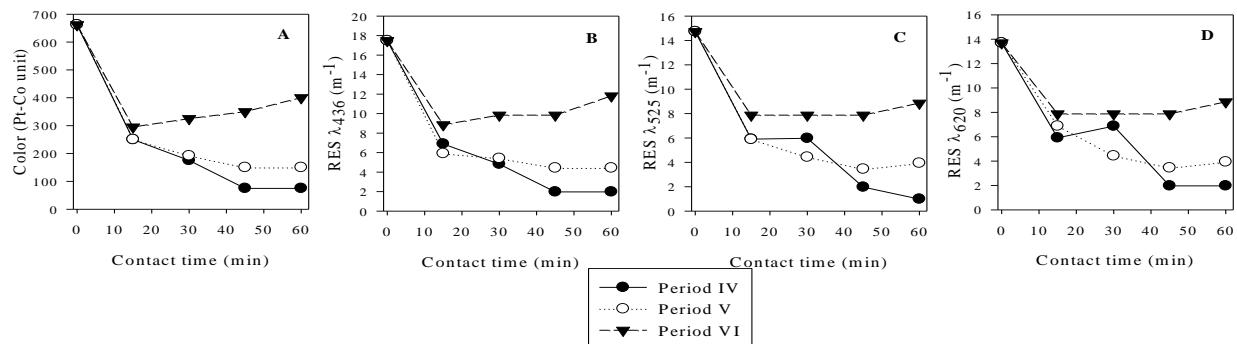


**Figure 4.** Color (A),  $\text{RES}_{\lambda 436}$  (B),  $\text{RES}_{\lambda 525}$  (C),  $\text{RES}_{\lambda 620}$  (D) profiles observed at different pH level

According to this study, olive seed and rice husk showed different removal performances at same initial pH due to characteristic of adsorbents. The pH 3.0 (period I) and pH 11.0 (period III) were found optimum on adsorption process for olive seed and rice husk, respectively (Figure 1 and Figure 4). Additionally, adsorption using rice husk performed better than adsorption using olive seed in terms of color removal performance at optimum pH level and around 4% larger color removal was achieved at adsorbent dose of 2 g/L, corresponding to 75 Pt-Co effluent color.

#### Effect of initial adsorbent dose on adsorption process

Adsorbent dose is an important factor for economic feasibility and optimizing of the adsorption process. The agitation time was determined as to be 60 min at 150 rpm. The rice husk amount added to wastewater solutions to determine the optimum adsorbent dosage varied between 0.5 g/L and 2 g/L at optimum pH level (pH 11.0). Figure 5 indicates the color removal efficiency as Pt-Co and RES unit with various adsorbent doses. Increasing rice husk concentration from 0.5 g/L to 2 g/L resulted in increasing color removal yield, corresponding to 55% and 89% removal efficiencies as Pt-Co unit when adsorption reached equilibrium, respectively (Period IV and Period VI). Additionally, the color removal efficiencies were 88%, 93%, and 85%, at  $\text{RES}_{\lambda 436}$ ,  $\text{RES}_{\lambda 525}$  and  $\text{RES}_{\lambda 620}$ , respectively at period IV. This obvious color removal efficiencies difference was probably resulted from the availability of more active surface sites with increasing adsorbent dose for adsorption.

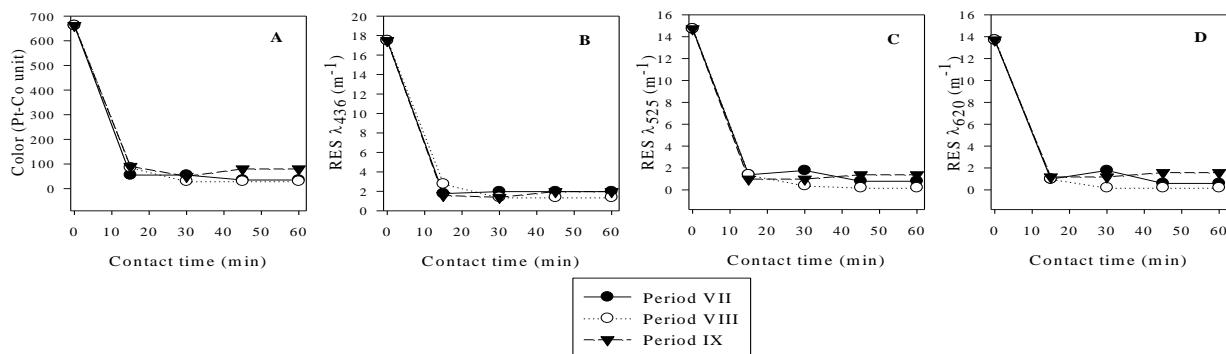


**Figure 5.** Color (A),  $\text{RES}_{\lambda 436}$  (B),  $\text{RES}_{\lambda 525}$  (C),  $\text{RES}_{\lambda 620}$  (D) profiles observed at different adsorbent dose

Dye amount adsorbed by rice husk was higher than adsorbed by olive seed, although initial dye concentration and applied adsorbent dose were constant. The maximum color removal performances of rice husk and olive seed as adsorbent were 55% and 50%, respectively at the 0.5 g/L minimum adsorbent dose due to higher adsorption capacity (Period VI in Figure 2 and Figure 5).

#### Effect of different activation methods on adsorption process

The effects of the activation methods on color adsorption using rice husk are shown in Figure 6. Acidic, basic and thermally activation methods were applied on natural rice husk in period VII, VIII and IX, respectively. As seen in Figure 5A and 6A, adsorption capacity of natural rice husk (period VI) is lower than that of activated rice husk with any methods and color removal performance increased from 55% to average 94%. However, effluent color was not affected from varying activation methods, corresponding to average 35 Pt-Co; 1.9 m<sup>-1</sup>( $\text{RES}_{\lambda 436}$ ), 0.8 m<sup>-1</sup>( $\text{RES}_{\lambda 525}$ ) and 0.6 m<sup>-1</sup> ( $\text{RES}_{\lambda 620}$ ). This study showed that activation methods associated with acid, base and heat-treat were a successful strategy to enhance adsorption capacity of adsorbent.



**Figure 6.** Color (A), RES $\lambda_{436}$  (B), RES $\lambda_{525}$  (C), RES $\lambda_{620}$  (D) profiles observed under different activation methods

## CONCLUSION

Results of the present study show that DOC and color removal from real textile wastewater treatment was possible by adsorption as post-treatment followed by anaerobic biodegradation. A large proportion of the DOC and color were consumed in anaerobic SBR, while consumed DOC were negligible during the adsorption using olive seed and rice husk as post treatment. This study shows that pH, adsorbent type, contact time, adsorbent dose and activation methods play an important role on color removal performance from real textile wastewater in the adsorption process as post-treatment. The olive seed and rice husk showed different removal performances at different initial pH due to characteristic of adsorbents and the optimum pH levels were found pH 3.0 and pH 11.0 for olive seed and rice husk, respectively. Adsorption using olive rice husk performed better than adsorption using olive seed in terms of color removal performance at optimum pH levels and around 4% higher color removal was achieved at adsorbent dose of 2 g/L. Increasing adsorbent dose resulted in increasing color removal due to the more formed active surface area. However, color removal efficiency up to 50% was observed at minimum adsorbent dose of 0.5 g/L. Contact time required to reach equilibrium of dye on adsorbent varied according to used adsorbent type. Additionally, the activation methods associated with acid, base and heat-treat were a successful strategy to enhance adsorption capacity of adsorbent.

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## PHYTOREMEDIATION: ALTERNATIVE APPROACH TO CLEAN UP THE ENVIRONMENT

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### ABSTRACT

Phytoremediation is defined as use of green plants to clean up the environment. It is the direct use of living green plants for in situ (in-place or on-site) risk reduction for contaminated soil, sludges, sediments, and groundwater, through removal, degradation, or containment of the contaminant.

Phytoremediation is an emerging technology that uses either naturally occurring or genetically engineered plants to remediate contaminated soils, sediments, and water. Plant systems and their associated rhizospheric microorganisms are used to remove, degrade, or stabilize a wide variety of environmental contaminants. Phytoremediation targets currently include contaminating metals, metalloids, petroleum hydrocarbons, pesticides, explosives, radionuclides, chlorinated solvents, industrial by-products, and excess nutrients.

Phytoremediation can be a cost effective alternative approach for reducing the leaching of contaminants through soil or groundwater, reducing the run-off of contaminated stormwater, beginning an initial level of cleanup, and improving the aesthetic condition of a site. Phytoremediation warrants consideration for use in conjunction with other technologies when the redevelopment and land use plans for the site include the use of vegetation.

The design of a phytoremediation system varies according to the contaminants, the conditions at the site, the level of cleanup required, and the plants used. Contaminants and site conditions are perhaps the most important factors in the design and success of a phytoremediation system. Five main subgroups of phytoremediation have been identified: Phytoextraction, Phytodegradation, Rhizodegradation, Rhizofiltration, Phytostabilisation, Phytovolatilisation.

In this review, phytoremediation techniques and their utilization are summarised.

**Keywords:** fitoremediation, environment, pollution, hyperaccumulator plant, phytoextraction

### 1. THE PROBLEM: ENVIRONMENTAL POLLUTION

#### 1.1. What is Pollution?

Pollutant is a waste or harmful material that pollutes environmental elements (air, water, soil etc.). Pollution occurs when pollutants contaminate the natural surroundings; which brings about changes that affect our normal lifestyles adversely. It mostly causes harmful or inconvenience effects to humans and other living organisms.

#### 1.2. Types of Pollution

Pollution is a significant problem facing the environment. As the world's population continues to grow, so does the amount of potentially toxic substances that are released into the ecosystem. Pollutants can be derived from a number of sources<sup>24</sup>. Environmental pollution consists of three major types of pollution, namely, air, water and soil.



**Figure 1.** Air pollution caused by factory chimneys<sup>25</sup>

<sup>24</sup> <http://www.livestrong.com/article/221368-types-of-environmental-pollutants>

<sup>25</sup> <http://environment.nationalgeographic.com/environment/global-warming/pollution-overview>

Air pollution is caused by the injurious smoke emitted by cars, buses, trucks, trains, and factories, namely sulphur dioxide, carbon monoxide and nitrogen oxides. Excessive burning of fuel which is a necessity of our daily lives for cooking, driving and other industrial activities; releases a huge amount of chemical substances in the air everyday; these pollute the air<sup>26</sup> (Figure 1).



**Figure 2.** Water pollution caused by industrial waste<sup>27</sup>

Water pollution is the contamination of natural water bodies by chemical, physical, radioactive or pathogenic microbial substances<sup>28</sup>. Water pollution can be caused in a number of ways, one of the most polluting being city sewage and industrial waste discharge. Indirect sources of water pollution include contaminants that enter the water supply from soils or groundwater systems and from the atmosphere via rain. Groundwaters contain the residue of human agricultural practices and also improperly disposed of industrial wastes<sup>29</sup> (Figure 2).



**Figure 3.** Soil pollution caused by fossil oil spills<sup>30</sup>

Soil pollution occurs when chemicals are released by spill or underground storage tank leakage which releases heavy contaminants into the soil. These may include hydrocarbons, heavy metals, MTBE, herbicides, pesticides<sup>31</sup> (Figure 3).

### 1.3. Effect of Pollution

Pollution produces physical and biological effects that vary from mildly irritating to lethal. The more serious of the two are the biological effects. The physical effects of pollution are those that we can see, but they include effects other than actual physical damage. The most serious result of pollution is its harmful biological effects on human health and on the food chain of animals, birds, and marine life. Pollution can destroy vegetation that provides food and shelter. It can seriously disrupt the balance of nature, and, in extreme cases, can cause the death of humans<sup>32</sup>.

Carbon dioxide emissions cause ocean acidification, the ongoing decrease in the pH of the Earth's oceans as CO<sub>2</sub> becomes dissolved. The emission of greenhouse gases leads to global warming which affects ecosystems in many ways. Nitrogen oxides are removed from the air by rain and fertilise land which can change the species composition of ecosystems. Sulfur dioxide and nitrogen oxides can cause acid rain which lowers the pH value of soil. Invasive species can out compete native species and reduce biodiversity. Smog and haze can reduce the amount of sunlight received by plants to carry out photosynthesis and leads to the production of tropospheric

<sup>26</sup> <http://www.conserve-energy-future.com/PollutionTypes.php>

<sup>27</sup> <http://imgbucket.com/pages/i/industrial-water-pollution>

<sup>28</sup> <http://www.eoearth.org/view/article/156920>

<sup>29</sup> [http://wwf.panda.org/about\\_our\\_earth/teacher\\_resources/webfieldtrips/water\\_pollution](http://wwf.panda.org/about_our_earth/teacher_resources/webfieldtrips/water_pollution)

<sup>30</sup> [http://www.uws.edu.au/gclbi/our\\_research/contaminated\\_soils\\_are\\_costly](http://www.uws.edu.au/gclbi/our_research/contaminated_soils_are_costly)

<sup>31</sup> [http://www.uccee.org/Environmental\\_Pollution.html](http://www.uccee.org/Environmental_Pollution.html)

<sup>32</sup> [http://navyadvancement.tpub.com/14325/css/14325\\_12.htm](http://navyadvancement.tpub.com/14325/css/14325_12.htm)

ozone which damages plants. Soil can become infertile and unsuitable for plants. This will affect other organisms in the food web<sup>33</sup>.

## **2. PHYTOREMEDIATION: Alternative Technique to Clean Up The Environment**

Concentration of pollutants that are harmful or toxic effects to all living organisms, is increasing day by day due to rapid industrialization, increasing anthropogenic activities, modern farming practices and improper waste disposal methods (Pulford and Watson, 2003; Eapen and D'Souza, 2005).

Hazards of the pollutants have several technologies for remediation. However, due to the excessive cost of these technologies, attention has been diverted towards development of alternative or complementary technologies such as phytoremediation techniques.

### **2.1. What is Phytoremediation?**

The general term ‘phytoremediation’ consists of the Greek prefix *phyto* (plant), attached to the Latin root *remedium* (to correct or remove an evil) (Cunningham et al., 1996).

Phytoremediation is a broad term that has been used since 1991 to describe the use of plants to reduce the volume, mobility, or toxicity of contaminants (EPA, 2000) and to remove, destroy or sequester hazardous substances from the environment (Glick, 2003). Phytoremediation is the direct use of living green plants for in situ (in-place or on-site) risk reduction for contaminated soil, sludges, sediments, and groundwater, through removal, degradation, or containment of the contaminant (EPA, 2001b).

Phytoremediation is an ecologically friendly, solar-energy driven clean-up technology that utilizes the inherent abilities of living plants based on the concept of using nature to cleanse nature. (Etim, 2012). Phytoremediation has also been called green remediation, botano-remediation, agroremediation, and vegetative remediation (EPA, 2001a).

### **2.2. Types of Area and Pollutants Treated by Phytoremediation**

Types of area at which phytoremediation has been applied or evaluated include: pipelines; industrial and municipal landfills; agricultural fields; wood treating sites; military bases; fuel storage tank farms; gas stations; army ammunition plants; sewage treatment plants; and mining sites.

Plants have the potential to enhance remediation of petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylene (BTEX), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), trichloroethene (TCE) and other chlorinated solvents, ammunition wastes and explosives, heavy metals, pesticide waste, radionuclides, and nutrient wastes (phosphates, nitrates etc.) (EPA, 2001b)

### **2.3. Plants Species Used for Phytoremediation**

Plants species are selected for use according to their ability to treat the contaminants of concern and achieve the remedial objectives for redevelopment, and for their adaptability to other site-specific factors such as adaptation to local climates, depth of the plant’s root structure, and the ability of the species to flourish in the type of soil present. Often the preferred vegetation characteristics include: an ability to extract or degrade the contaminants of concern to nontoxic or less toxic products, fast growth rate, adaptability to local conditions, ease of planting and maintenance (EPA, 2000; EPA, 2001b)

### **2.4. Advantage and Disadvantage of Phytoremediation**

Phytoremediation is cost effective method. It is suited to remediation of large areas of soil. It is environmentally friendly. Phytoremediation sites are more aesthetically pleasing. Phytoremediation sites are low maintenance. It involves no noisy and expensive equipment<sup>34</sup>.

Phytoremediation is limited to the surface area and depth occupied by the roots. Not as effective for sites with high contaminant concentrations. Phytoremediation is slower than conventional methods. Slow growth and low biomass require a long-term commitment with plant-based systems of remediation. It doesn’t work through the winter (Seasonal effect)<sup>35</sup>

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<sup>33</sup> <https://en.wikipedia.org/wiki/Pollution>

<sup>34</sup> <https://en.wikipedia.org/wiki/Phytoremediation>

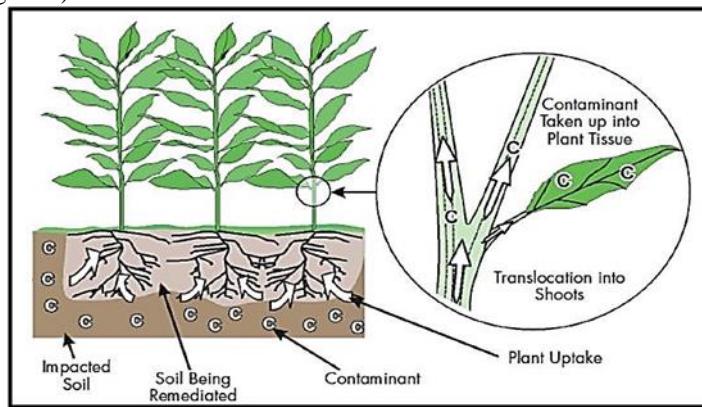
<sup>35</sup> <http://www.rpi.edu/dept/chem-eng/Biotech-Environ/MISC/phytorem.html>

## 2.5. Phytoremediation Strategies

Phytoremediation techniques include different modalities, depending on the chemical nature and properties of the contaminant (if it is inert, volatile or subject to degradation in the plant or in the soil) and the plant characteristics. Thus, phytoremediation essentially comprise six different strategies, though more than one may be used by the plant simultaneously (Favas et al., 2014).

### 2.5.1. Phytoextraction

Phytoextraction (also called phytoaccumulation) refers to the uptake and translocation of metal contaminants in the soil by plant roots into the above ground portions of the plants. Phytoextraction is primarily used for the treatment of contaminated soils, sediments, and sludges. To remove contamination from the soil, this approach uses plants to absorb, concentrate, and precipitate toxic metals from contaminated soils into the above ground biomass (shoots, leaves, etc.) Contaminants are generally removed by harvesting the plants (EPA, 1999; EPA, 2000; Etim, 2012) (Figure 4).



**Figure 4.** Schematic representation of phytoextraction<sup>36</sup>

It is mainly applied to metals (Cd, Ni, Cu, Zn, Pb) (Suresh and Ravishankar, 2004). It can also be used for other elements (Se, As) and organic compounds. This technique preferentially uses hyperaccumulator plants, that have the ability to store high concentrations of specific metals in their aerial parts (0.01% to 1% dry weight, depending on the metal). *Elsholtzia splendens*, *Alyssum bertolonii*, *Thlaspi caerulescens* and *Pteris vittata* are known examples of hyperaccumulator plants for Cu, Ni, Zn/Cd and As, respectively (Favas et. al., 2014).

### 2.5.2. Rhizofiltration

Rhizofiltration is the adsorption or precipitation onto plant roots or absorption into the roots of contaminants that are in solution surrounding the root zone (EPA, 1999).

Generally, plants with large root systems are used. Commonly used for treatment of industrial discharge, agricultural run off, metals and radioactive contamination (Suresh and Ravishankar, 2004). Rhizofiltration can be used for Pb, Cd, Cu, Ni, Zn, and Cr, which are primarily retained within the roots (Etim, 2012).

Plants with high root biomass, or high absorption surface, with more accumulation capacity (aquatic hyperaccumulators) and tolerance to contaminants achieve the best results. Promising examples include *Helianthus annus*, *Brassica juncea*, *Phragmites australis*, *Fontinalis antipyretica* and several species of *Salix*, *Populus*, *Lemna* and *Callitrichie* (Favas et. al., 2014). (Figure 5).



**Figure 5.** *Brassica juncea* plant in field<sup>37</sup>

<sup>36</sup> <http://www.biology-online.org/articles/phytoremediation-a-lecture/phytoextraction.html>

### 2.5.3. Phytostabilization

Phytostabilization is the use of certain plant species to immobilize contaminants in the soil and ground water through absorption and accumulation by roots, adsorption onto roots, or precipitation within the root zone of plants. This process reduces the mobility of the contaminant and prevents migration to the ground water or air, and it reduces bioavailability for entry into the food chain (EPA, 1998).

This technique can also be used to reestablish vegetation cover at sites where natural vegetation fails to survive due to high metals concentrations in surface soils or physical disturbances to surface materials. Metal-tolerant species used to restore vegetation at contaminated sites, thereby decreasing the potential migration of pollutants through wind erosion and transport of exposed surface soils and leaching of soil contamination to ground water. Phytostabilization can occur through the sorption, precipitation, complexation, or metal valence reduction. It is useful for the treatment of lead (Pb) as well as arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu) and zinc (Zn) (Etim, 2012). Species of genera *Haumaniastrum*, *Eragrostis*, *Ascolepis*, *Gladiolus* and *Alyssum* are examples of plants cultivated for this purpose (Favas et. al., 2014). (Figure 6)



**Figure 6.** *Haumaniastrum* plant in wild flora<sup>38</sup>

### 2.5.4. Phytodegradation

Phytodegradation, also called phytotransformation, is the breakdown of contaminants taken up by plants through metabolic processes within the plant, or the breakdown of contaminants external to the plant through the effect of compounds (such as enzymes) produced by the plants. Pollutants are degraded, incorporated into the plant tissues, and used as nutrients (EPA, 2000).



**Figure 7.** *Myriophyllum spicatum* plant<sup>39</sup>

Phytodegradation has been observed to remediate some organic contaminants, such as chlorinated solvents, herbicides, and munitions, and it can address contaminants in soil, sediment, or groundwater (Etim, 2012. *Populus* species and *Myriophyllum spicatum* are examples of plants that have these enzymatic systems (Favas, 2014). (Figure 7).

### 2.5.5. Rhizodegradation

Rhizodegradation, also called enhanced rhizosphere biodegradation, phytostimulation, or plant-assisted bioremediation/degradation, is the breakdown of contaminants in the soil through microbial activity that is enhanced by the presence of the rhizosphere and is a much slower process than phytodegradation (PA, 1998).

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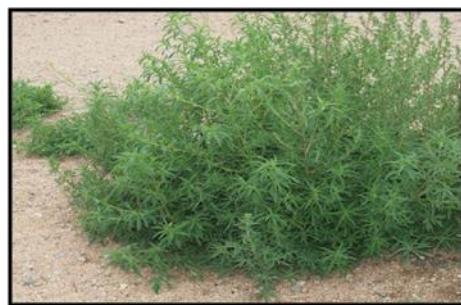
<sup>37</sup> <http://www.mining-technology.com/features/featuremetal-munching-plants-a-new-frontier-for-green-mining-4328586>

<sup>38</sup> [http://copperflora.org/eflora/species.php?id\\_e=146](http://copperflora.org/eflora/species.php?id_e=146)

<sup>39</sup> [http://www.nahuby.sk/obrazok\\_detail.php?obrazok\\_id=295984](http://www.nahuby.sk/obrazok_detail.php?obrazok_id=295984)

The application of phytostimulation is limited to organic contaminants (Favas et. al., 2014).

It is primarily useful in contaminated soil, and it has been investigated and found to have at least some successes in treating a wide variety of mostly organic chemicals, including petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), chlorinated solvents, pesticides, polychlorinated biphenyls (PCBs), benzene, toluene, ethylbenzene, and xylenes (Etim, 2012). It can also be seen as plant-assisted bioremediation, the stimulation of microbial and fungal degradation by release of exudates/enzymes into the root zone (rhizosphere) (Zhuang et al., 2005). (Figure 8).



**Figure 8.** Kochia plant in wild vegetation<sup>40</sup>

Red mulberry, crabapple, osage orange, rice, Kochia sp., and hybrid poplar tree are examples of plants capable of rhizodegradation.

#### 2.5.6. Phytovolatilization

Phytovolatilization is the uptake and transpiration of a contaminant by a plant, with release of the contaminant or a modified form of the contaminant to the atmosphere from the plant through contaminant uptake, plant metabolism, and plant transpiration. Phytovolatilization has mainly been applied to groundwater, but it can be applied to soil, sediments, and sludges. (EPA, 2000). Contaminants taken up by the roots pass through the plants to the leaves and are volatized through stomata where gas exchange (Suresh, and Ravishankar, 2004). Some element ions of the groups IIB, VA and VIA of the periodic table (specifically Hg, Se and As) are absorbed by the roots, converted into non-toxic forms, and then released into the atmosphere. This technique can also be used for organic compounds.



**Figure 9.** Astragalus bisulcatus plant<sup>41</sup>

As examples the species *Astragalus bisulcatus* and *Stanleya pinnata* for Se or transgenic plants (with bacterial genes) of *Arabidopsis thaliana*, *Nicotiana tabacum*, *Liriodendron tulipifera* or *Brassica napus* for Hg can be mentioned. (Favas et. al., 2014). (Figure 9).

### 3. CONCLUSION

The use of plants for reduce or clean up pollution in environmental surrounding is a cost effective method. Phytoremediation offers site restoration, partial decontamination, maintenance of the biological activity and physical structure of environment, and there is the possibility of biorecovery of waste material. It is also easy to implement and maintain, doesn't require the use of expensive equipment or specialized personnel and is environmentally friendly.

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<sup>40</sup> <http://cals.arizona.edu/yavapaiplants/imageviewer.php?genus=Kochia&species=scoparia&imagenum=4>

<sup>41</sup> <http://www.ars.usda.gov/SP2UserFiles/Place/20801500/PPClassPPSlides/3-27-08DavisSelenium.pdf>

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## DETERMINING THE WATER QUALITY OF BROOK MAZMANLI THROUGH PHYSICO-CHEMICAL METHODS

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### ABSTRACT

Today, with the high population growth, water quality and water quality problems became one of the most important problems of our era. This problem, as it is in entire world, also increase gradually in our country. Because of the increased need for clean and reliable water, knowing the physical and chemical properties of the fresh water resources is very important for being able to utilize them efficiently and in planned way.

In order to determine the water quality characteristics of Brook Mazmanlı that emerges from the foothills of Amanos Mountains at northeastern Mediterranean region and merges with Stream Afrin in Amik Lake basin and pours into Mediterranean sea by mixing into Küçük Asi River in Zülfühān Village, this study has been started on May 2004 at 2 stations, and water samples have been collected in monthly base for 12 months. Because of its location, Brook Mazmanlı plays important role in its region. It is the main water source that is utilized for meeting the watering water and table water requirements of Mazmanlı Village and the water needs of trout farm established in that region. Among the water quality parameters, the analyses have been performed for temperature, pH, dissolved oxygen, saltiness, chemical oxygen demand (COD), biological oxygen demand (BOD), total alkalinity, total hardness, suspended solid matter (SSM), ammonium nitrogen, nitrite, nitrate, phosphate, sulfite, sulfate, chloride, potassium, sodium, and silica. As a result of performed analyses, the water quality of Brook Mazmanlı has been monitored via physico-chemical methods for 1 year, monthly water quality data have been recorded, they have been analyzed from the aspect of aquaculture, and a database has been established for future studies.

**Keywords:** Water Quality, Water Pollution, Brook Mazmanlı, Hassa, Hatay

### INTRODUCTION

Being the main element in sustaining the lives of living creatures, water is one of the most important natural resources. Deterioration of water quality or natural water balance is considered as water pollution (Torunoğlu et al., 2006). Rapidly increasing world population, increased industrial and agricultural activities and increased fresh water need increase globally (Aksungur and Firidin. 2008).

Only 3.5% of global water stock is usable. When the oceans, seas and icebergs in poles are excluded from the total stock, fresh water stock consists of rivers and lakes, and it is a limited amount of water (Mutlu and Yanık, 2012).

Fresh water resources, which are of great importance nowadays, are under the threat of pollution, and this threat together with increased water requirement leads to the increase in number of studies on water pollution. In order to determine the pollution in streams, physico-chemical and biological factors are utilized.

Brook Mazmanlı, where this study has been carried out, emerges from the foothills of Amanos Mountains at northeastern Mediterranean region and merges with Stream Afrin in Amik Lake basin and pours into Mediterranean Sea by mixing into Küçük Asi River in Zülfühān Village. Brook Mazmanlı has been named after Mazmanlı Village located in Hass district of Hatay city because it passes through this village. In this region, where the Mediterranean climate dominate, the annual precipitation is 1130 mm, mean temperature is 18.4 C, annual evaporation is 1836 mm, ad mean relative humidity is 69% (Anonym., 2012).

Brook Mazmanlı contributes to the economy of region by providing the water for trout farms on this brook and the water need for watering the agricultural lands that are harvested twice a year. The aim of this study is, by determining the water quality of Brook Mazmanlı (Hatay-Hassa) through physico-chemical methods, to records the monthly changes in water quality data, and to provide database for future studies on this region because there is no previous data on this topic.

## MATERIAL AND METHOD

### Study area

Brook Mazmanlı, which is located within the borders of Hassa district of Hatay city in eastern Mediterranean region, is famous with that it is one of the rare rivers, where the trout farming is executed. Mazmanlı village, which is 78 Km away from Antakya and 18 Km from Hassa district, is utilized as picnic and residential area. The source of Brook Mazmanlı is Mount Amanos. By passing through a steep valley, Brook Mazmanlı reaches at Mazmanlı village, then merges with Arfin Stream in Amik Lake basin, and then pours into Mediterranean Sea by mixing into Küçük Asi River within the borders of Zülfühān village of Kırıkhan district. Meeting the table water needs of Mazmanlı Village, Brook Mazmanlı is very important because it is a brook hosting a trout farm and is also the water source of agricultural lands in the region.

In this study, in order for them to be able to represent the entire brook, 1<sup>st</sup> station has been chosen to be 10m away from the source, and 2<sup>nd</sup> station has been chosen to be the exit point of Mazmanlı Village.



**Figure 1** Location of Brook Mazmanlı of Hatay City

### Water Analyses

In order to determine the levels of some of physical and chemical parameters constituting the water quality, the sampling has been started in May 2004, and the analyses of samples collected monthly from both of the stations have been performed for 12 months until May 2005. The sampling containers used in study have been washed 1 day before the sampling with acid bath (1-2% HCl) and then pure water, respectively. And then, the sampling containers that have been rinsed with pure water have been left for drying in drying oven (Boyd and Tucker., 1992). By sinking the containers 15 cm under the water surface, the water samples have been taken with water's own flow-force. The water samples taken have been delivered to the laboratory within 3 hours. Among the water quality parameters; dissolved oxygen, temperature, pH and saltiness have been measured via land-type devices. In measuring oxygen and temperature, the YSI brand Model 52 oxygen-meter has been used, while YSI brand Model 30 salinometer and Orion brand Model 420A pH-meter have been used in salinity and pH measurements.

Total alkalinity, total hardness, ammoniac, nitrite, nitrate, phosphate, sulfite, sulfate, chloride, potassium, silica, sodium, suspended solid matter (SSM), chemical oxygen demand (COD), and biological oxygen demand (BOD), among other parameters determining the water quality, analyses of water samples have been performed in laboratory of Faculty of Fisheries in Mustafa Kemal University. Total alkalinity analysis has been performed by using sulfuric acid, while EDTA-titration has been utilized in total alkalinity analyses. The results have been

expressed in mg/L CaCO<sub>3</sub> in both of the analyses. Chemical oxygen demand (COD) levels have been calculated by using titration with ferrous ammonium sulfate, which is based on determining, by using strong chemical oxidants, the amount of oxygen consumed during the decomposition of natural and pollutant organic load. The amount of chloride (Cl<sub>2</sub>) has been found via titration with Hg (NO<sub>3</sub>)<sub>2</sub> solution. Biological oxygen demand (BOD) level has been determined via WTW ONTOP IS 6 BOI measurement device by leaving the water samples in drying oven at 20°C for 5 days. In measurements of nitrate (NO<sub>3</sub><sup>-</sup>), nitrite (NO<sub>2</sub><sup>-</sup>), ammoniac (NH<sub>3</sub>), and phosphate (PO<sub>4</sub><sup>3-</sup>) requiring photometric measurement have been performed with Shimadzu brand Model UV-1601 PC spectrophotometer. Suspended solid matter (SSM) analysis has been executed via SU Whatman brand No:42 0.45 µm membrane filters by filtering the water samples through filter paper and then calculating the weight difference after 24 hours in drying oven at 103 °C. All of the water analyses specified above have been performed in accordance with standard analysis methods stated by Boyd and Tucker (1992). Sulfite, sulfate, potassium, sodium, and silica analyses have been performed via Nova 60 spectrophotometer and Merck kits.

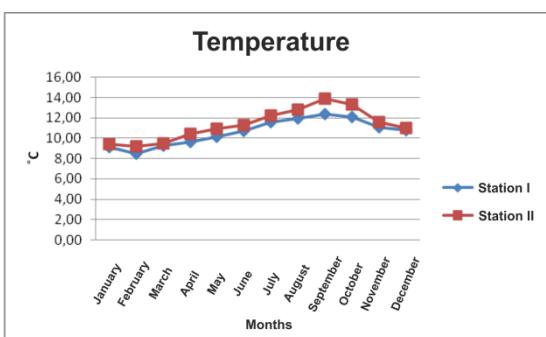
Monthly mean values, standard deviations, and graphics of each parameter have been prepared by using Office Excel 2007 software of Microsoft Office Professional Edition 2007.

## FINDINGS

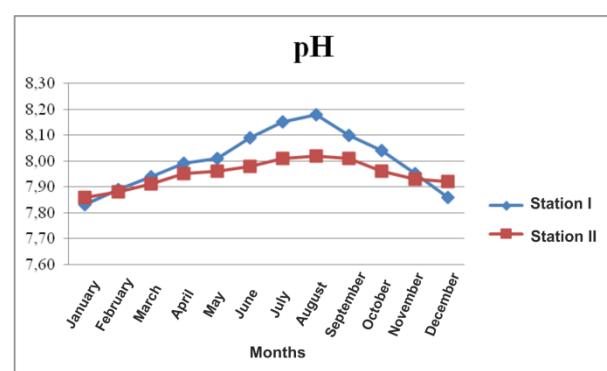
Temperature of Brook Mazmanlı has shown variation between the stations during the year. Annual mean temperature of the stations has been found to be 10.9 °C. The temperature has reached its minimum level (8.5°C) in 1<sup>st</sup> station in February 2005, while it has peaked in 2<sup>nd</sup> station in September 2004 (13.9°C). The seasonal mean temperature values have been found to be 11.75°C in summer, 12.4°C in autumn, 9.6°C in winter and 9.9°C in spring.

Indicating the acidic and basic structure of the waters, pH value has shown that the waters at both of the stations were relatively basic. Annual mean pH value has been found to be 7.97. Minimum value has been found to be 7.83 in January 2005 in 1<sup>st</sup> station, while the maximum value has been determined to be 8.18 in August 2004 in 1<sup>st</sup> station.

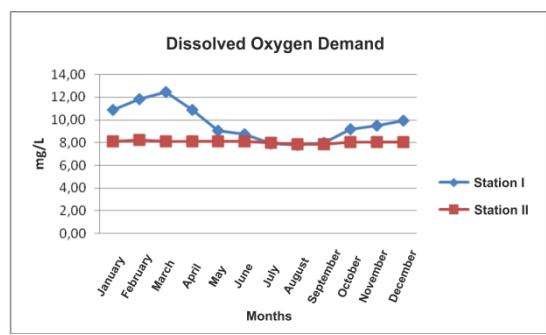
**Figure 3.1** Monthly mean temperature values of stations (°C)



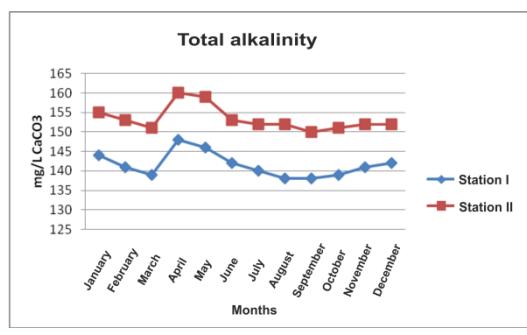
**Figure 3.2** Monthly mean pH values of stations



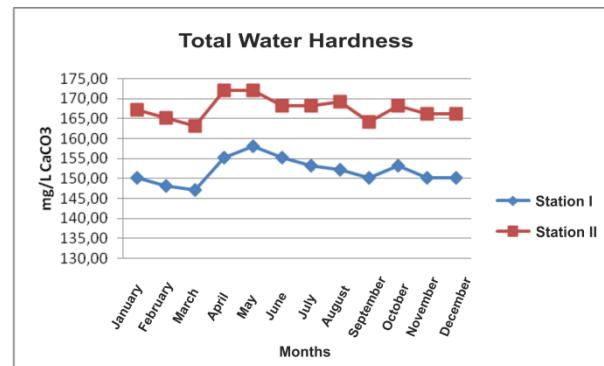
**Figure 3.3** Monthly mean dissolved oxygen values of stations



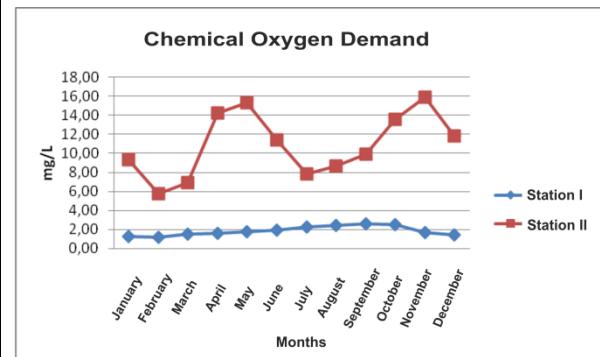
**Figure 3.4** Monthly mean total alkalinity values of stations



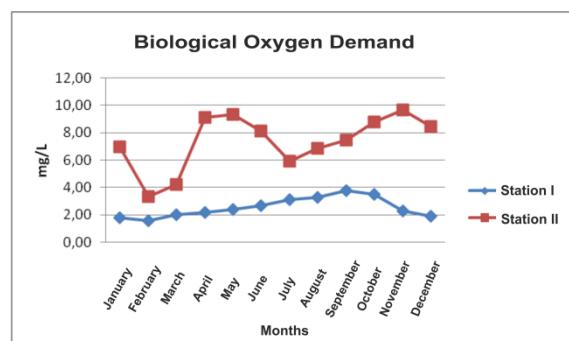
**Figure 3.5** Monthly mean total hardness values of stations



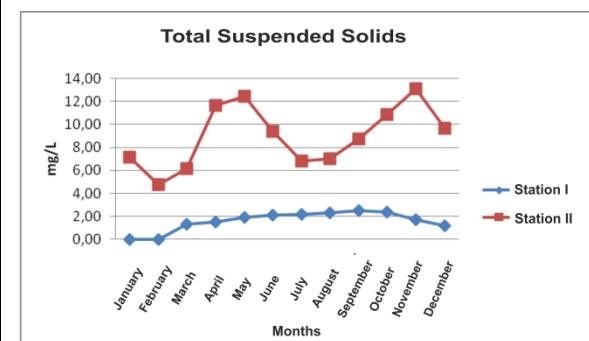
**Figure 3.6** Monthly mean chemical oxygen demand values of stations



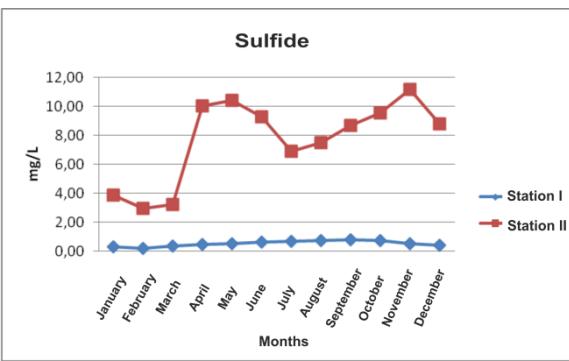
**Figure 3.7** Monthly mean biological oxygen demand (BOD) values of stations



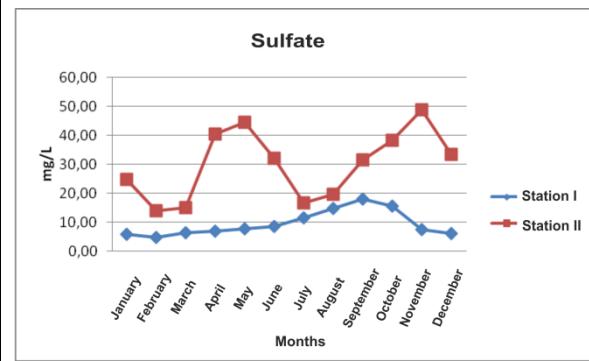
**Figure 3.8** Monthly mean suspended solid matter (SSM) values



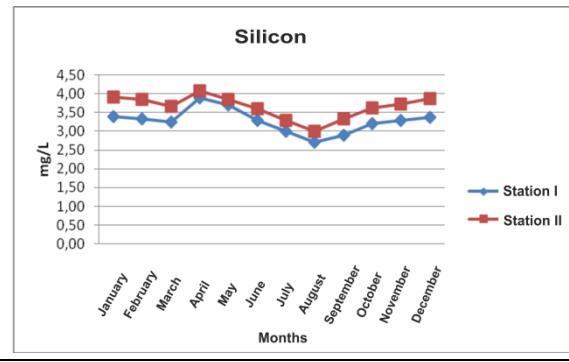
**Figure 3.9** Monthly mean sulfite concentrations



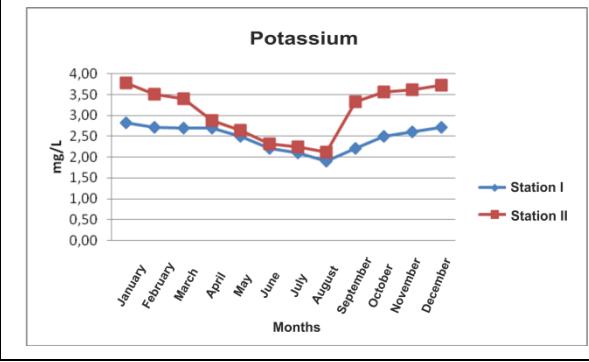
**Figure 3.10** Monthly mean sulfate values



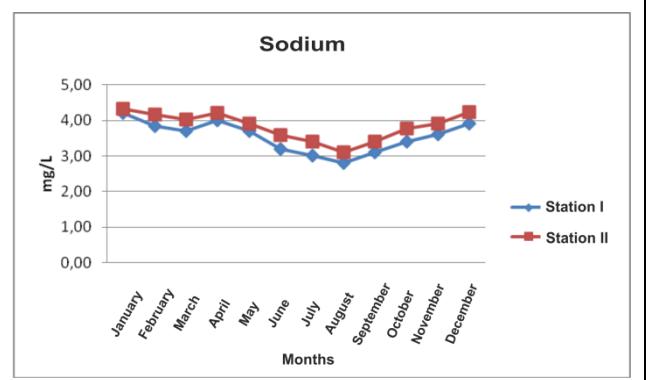
**Figure 3.11** Monthly mean silica values



**Figure 3.12** Monthly mean potassium levels



**Figure 3.13** Monthly mean sodium values



During the year, the oxygen levels have shown variations between the stations and seasons, and the annual mean value has been found to be 8.86 mg/L; the minimum value has been found to be 7.79 mg/L in August 2004 in 1<sup>st</sup> station, while the maximum value has been found to be 11.83 mg/L in February 2005 in 1<sup>st</sup> station. The mean seasonal oxygen values for summer, autumn, winter and spring have been found to be 8.07 mg/L, 8.42 mg/L, 9.50 mg/L, and 9.46 mg/L, respectively.

As expected, the salinity have not shown variation during the year, and measured to be 0.1 and 0.2 ppt. In summer season, when the evaporation is high, the salinity level has increased to 0.2 ppt.

Seasonal mean values of total alkalinity have been shown to be very close to each other. Alkalinity of the stations has increased until autumn and the minimum value has been determined to be 138 mg/L CaCO<sub>3</sub> in 1<sup>st</sup> station in August and September of 2004. It has increased until spring, and the maximum value have been found to be 160 mg/L CaCO<sub>3</sub> in 2<sup>nd</sup> station in April 2005.

The seasonal mean total alkalinity values of autumn, winter, spring and summer have been found to be 145.1 mg/L CaCO<sub>3</sub>, 147.8 mg/L CaCO<sub>3</sub>, 150.5 mg/L CaCO<sub>3</sub> and 146.1 mg/L CaCO<sub>3</sub>.

Monthly mean total hardness values of Brook Mazmanlı have been determined to be 158.6 mg/L CaCO<sub>3</sub> in autumn, 157.7 mg/L CaCO<sub>3</sub> in winter, 161.2 mg/L CaCO<sub>3</sub> in spring, and 158.6 mg/L CaCO<sub>3</sub> in summer. The minimum total hardness value has been found to be 147 mg/L CaCO<sub>3</sub> in 1<sup>st</sup> station in March 2005, while the maximum value has been found to be 172 mg/L CaCO<sub>3</sub> in 2<sup>nd</sup> station in April and May 2005.

Chemical oxygen demand (COD) has shown significant variation between the stations during the months, and the annual mean value of the stations has been found to be 6.36 mg/L. Minimum value has been found to be 1.2 mg/L in 1<sup>st</sup> station in February 2005, while the maximum level has been found to be 15.3 mg/L in 2<sup>nd</sup> station in May 2004.

Seasonal mean chemical oxygen demand values of autumn, winter, spring and summer have been found to be 7.7 mg/L, 5.13 mg/L, 6.88 mg/L and 5.75 mg/L.

Biological oxygen demand (BOD) values have shown significant variation between the stations and the months. The minimum biological oxygen demand (BOD) value has been found to be 1.6 mg/L in February 2005 in 1<sup>st</sup> station, while the maximum level has been found to be 9.68 mg/L in November 2004 in 2<sup>nd</sup> station. Seasonal mean BOD values of autumn, winter, spring and summer have been found to be 5.91 mg/L, 4.01 mg/L, 4.87 mg/L and 4.91 mg/L.

Suspended solid matter (SSM) amounts in Brook Mazmanlı have shown significant variation between the stations and the seasons. Annual mean value of the brook has been found to be 5.28 mg/L. Seasonal mean suspended solid matter levels of the brook for autumn, winter, spring and summer seasons have been found to be 6.55 mg/L, 3.79 mg/L, 5.82 mg/L and 4.97 mg/L.

Minimum suspended solid matter level has been found to be 0 mg/L in January and February 2005 in 1<sup>st</sup> station, while the maximum value has been found to be 13.14 mg/L in November 2004 in 2<sup>nd</sup> station.

During the study period, the levels of ammoniac, nitrite and nitrate have been determined to be lower in summer months than in other months. The seasonal mean ammoniac concentration of Brook Mazmanlı have been determined to be 0.023 mg/L in autumn, 0.026 mg/L in winter, 0.013 mg/L in spring and 0.010 mg/L in summer. The minimum level of ammoniac has been observed in August 2004 as 0.001 mg/L in 1<sup>st</sup> station, while the maximum level has been found to be 0.043 mg/L in January 2005 in 2<sup>nd</sup> station. During the study, the mean

nitrite concentration of Brook Mazmanlı has been calculated to be 0.020 mg/L. The minimum and maximum nitrite concentrations of nitrite, as are for ammoniac, have been determined to be 0.001 mg/L in 1<sup>st</sup> station in August 2004 and 0.047 mg/L in 2<sup>nd</sup> station in January 2005. Seasonal mean nitrite concentrations have been calculated to be 0.023 mg/L in autumn, 0.030 mg/L in winter, 0.020 mg/L in spring, and 0.010 mg/L in summer, while the annual mean concentration has been found to be 0.020 mg/L.

Annual mean concentration of nitrate has been found to be 3.75 mg/L; the maximum concentration has been found to be 2.51 mg/L in 1<sup>st</sup> station in August 2004, while the maximum value has been observed in 5.24 mg/L in 2<sup>nd</sup> station in January 2005. Seasonal mean nitrate concentrations have been found to be 3.89 mg/L in autumn, 4.11 mg/L in winter, 3.67 mg/L in spring, and 3.34 mg/L in summer.

Being one of the most important nutrient minerals sustaining the aquatic life, the concentrations of phosphate has shown slightly variation in Brook Mazmanlı between the months and the stations. The annual mean concentration has been calculated to be 0.088 mg/L. The minimum value has been observed as 0 mg/L in January and February 2005 in 1<sup>st</sup> station, while the maximum concentration has been found to be 0.292 mg/L in 2<sup>nd</sup> station in November 2004.

Phosphate concentrations have increased during autumn months, while they have been observed to be at low level during winter months. In our study, the concentrations of chloride have been found to be very low. Coursing generally at zero levels, chloride concentration has peaked (0.006 mg/L) in 2<sup>nd</sup> station in September and November 2004. Sulfide concentrations have shown significant variation between the months and the stations. Sulfide concentration has increased from 0.21 mg/L in 1<sup>st</sup> station in February to 0.78 mg/L in September, and this concentration is the maximum level. After September, sulfide concentration has decreased gradually until February to its minimum level in 1<sup>st</sup> station. And in 2<sup>nd</sup> station, it has decreased from 10.42 mg/L in May to 2.98 mg/L in August. The annual mean sulfite concentration has been found to be 4.11 mg/L.

In our study, the sulfate concentration has increased in 1<sup>st</sup> station from 4.7 mg/L in February to 17.9 mg/L in September. From October to January, it has decreased from 15.6 mg/L to 5.9 mg/L. And in 2<sup>nd</sup> station, it has varied between 13.8 and 48.7 mg/L between April and May. The minimum sulfate concentration has been found to be 4.7 mg/L in 1<sup>st</sup> station in February 2005, while the maximum concentration has been found to be 48.7 mg/L in 2<sup>nd</sup> station in November 2004. The annual mean concentration of sulfate has been found to be 19.67 mg/L.

Silica concentration has coursed at 3.30 mg/L levels during the year. In August 2004, the minimum concentration has been found to be 2.70 mg/L in 1<sup>st</sup> station, while the maximum concentration has been observed in 2<sup>nd</sup> station as 4.22 mg/L in April 2005. Seasonal mean silica concentrations in autumn, winter, spring and summer have been found to be 3.35 mg/L, 3.62 mg/L, 3.74 mg/L and 3.74 mg/L.

Potassium and sodium salts have decreased from January to August in both of the stations, and then started to increase from August to January. Annual mean concentration of potassium salt has been found to be 2.78 mg/L; the minimum level has been measure in 1<sup>st</sup> station in August 2004 as 1.9 mg/L, while the maximum level has been observed to be 3.77 mg/L in 2<sup>nd</sup> station in January 2005. Seasonal mean values of the potassium in stations in autumn, winter, spring and summer have been calculated as 2.97 mg/L, 3.21 mg/L, 2.80 mg/L and 2.14 mg/L. The minimum sodium level has been observed in 1<sup>st</sup> station in August 2004 as 2.8 mg/L, while the maximum level has been found to be 4.33 mg/L in 2<sup>nd</sup> station in January 2005; the annual mean concentration has been calculated to be 3.68 mg/L. Seasonal mean sodium levels of autumn, winter, spring and summer have been found to be 3.53 mg/L, 4.11 mg/L, 3.92 mg/L and 3.18 mg/L, respectively.

## RESULTS AND DISCUSSION

In this study that has been carried out in Brook Mazmanlı in Hassa district of Hatay city, mean values and standard deviations of water quality parameters monthly measured in 2 stations determined are presented in Table 1.

Temperature is one of the most important parameters affecting the aquatic environment. The changes that have occurred in the water during our study have stayed within the normal seasonal limits. The annual changes of water temperature determined in brook have never exceeded the level that is harmful for aquatic life. Maximum temperature of Brook Mazmanlı has been observed to be 16.1 °C in 1<sup>st</sup> station in August 2004.

In natural water, pH affects the water quality in various ways. By measuring the pH of the water, the CO<sub>2</sub> concentration of water and its alkali or acidic structure can be determined (Çiçek and Ertan, 2012). The limit values in table water standards and aquaculture are 6.5 - 8.5 dir. (Gedik et al., 2010). Although the level of change in pH of stations at Brook Mazmanlı was not high, the value indicates that the brook has mildly alkali structure. Increasing in summer season, pH value has decreased in winter season. Mean pH value of the stations has been found to be 7.97; according to this result, it can be said that the pH level of Brook Mazmanlı is suitable for aquatic life. Moreover, it is in 1<sup>st</sup> class in terms of table water standards and Water Pollution Control

Regulation (Anonym. 2010).

It is a fact that dissolved oxygen arranges and limits the aquatic life. In this study, the amounts of dissolved oxygen have shown variation during the summer months; accordingly, the water of Brook Mazmanlı is in 1<sup>st</sup> Class according to Water Pollution Control Regulation and Table Water Standards (Anonym., 2004).

**Table 1 Water Quality Parameters' Mean Values and Standard Deviations for Brook Mazmanlı**

	Jan.	Feb.	Mar.	Apr	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
pH	7.85	7.89	7.93	7.97	7.99	8.04	8.08	8.10	8.06	8.00	7.94	7.89
Std. Dev.	0.02	0.01	0.02	0.03	0.04	0.08	0.10	0.11	0.06	0.06	0.01	0.04
DISSOLVED OXYGEN (mg/L)	9.49	10.03	10.29	9.51	8.58	8.43	7.96	7.84	7.92	8.59	8.76	9.00
Std. Dev.	1.96	2.55	3.04	1.94	0.66	0.49	0.08	0.06	0.06	0.81	1.01	1.34
TEMPERATURE (°C)	9.25	8.85	9.40	10.00	10.50	11.00	11.90	12.35	13.15	12.70	11.35	10.90
Std. Dev.	0.21	0.49	0.14	0.57	0.57	0.42	0.42	0.64	1.06	0.85	0.35	0.14
SALTINESS (%)	0.02	0.02	0.02	0.10	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Std. Dev.	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
ALKALINITY (mg/LCaCO <sub>3</sub> )	149.85	147.00	145.0	154.0	152.5	147.50	146.00	145.00	144.0	145.0	146.5	147.0
Std. Dev.	7.78	8.49	8.49	8.49	9.19	7.78	8.49	9.90	8.49	8.49	7.78	7.07
HARDNESS (mg/LCaCO <sub>3</sub> )	158.66	156.66	155.16	163.66	165.17	161.66	160.66	160.66	157.16	160.66	158.16	158.16
Std. Dev.	12.03	12.03	11.33	12.03	9.91	9.20	10.62	12.03	9.91	10.62	11.33	11.33
AMMONIAC (mg/L)	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03
Std. Dev.	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
NITRITE (mg/L)	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.03	0.03
Std. Dev.	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02
NITRATE (mg/L)	4.22	4.05	3.93	3.66	3.44	3.18	3.60	3.26	3.73	3.93	4.02	4.06
Std. Dev.	1.44	1.36	1.24	0.18	0.34	0.40	1.27	1.05	1.39	1.42	1.41	1.43
PHOSPHATE (mg/L)	0.062	0.019	0.029	0.140	0.147	0.105	0.051	0.063	0.096	0.139	0.149	0.113
Std. Dev.	0.088	0.026	0.037	0.192	0.194	0.129	0.049	0.064	0.107	0.169	0.202	0.158
SULFITE (mg/L)	2.09	1.59	1.80	5.24	5.47	4.97	3.81	4.11	4.73	5.14	5.84	4.59
Std. Dev.	2.53	1.95	2.04	6.79	7.00	6.12	4.40	4.77	5.58	6.25	7.55	5.95
SULFATE (mg/L)	15.35	9.25	10.65	23.65	26.15	20.25	14.10	17.25	24.75	26.90	28.00	19.80
Std. Dev.	13.36	6.43	6.01	23.55	26.09	16.76	3.54	3.46	9.69	15.98	29.27	19.23
CHLORIDE (mg/L)	0.002	0.002	0.001	0.005	0.002	0.001	0.000	0.000	0.003	0.004	0.004	0.003
Std. Dev.	0.001	0.001	0.001	0.002	0.001	0.001	0.000	0.000	0.001	0.001	0.003	0.001
POTASSIUM (mg/L)	3.30	3.11	3.05	2.79	2.57	2.26	2.17	2.01	2.76	3.04	3.11	3.22
Std. Dev.	0.66	0.57	0.49	0.13	0.10	0.08	0.10	0.15	0.79	0.76	0.71	0.71
SILICA (mg/L)	3.66	3.59	3.46	3.99	3.78	3.46	3.15	2.85	3.12	3.42	3.52	3.63
Std. Dev.	0.37	0.36	0.30	0.12	0.11	0.22	0.21	0.21	0.31	0.30	0.30	0.35
SODIUM (mg/L)	4.27	4.00	3.87	4.11	3.80	3.39	3.20	2.95	3.25	3.58	3.76	4.07
Std. Dev.	0.09	0.24	0.22	0.16	0.14	0.27	0.28	0.21	0.21	0.25	0.23	0.23
BOD (mg/L)	5.30	3.50	4.20	7.90	8.55	6.65	5.05	5.55	6.25	8.05	8.80	6.60
Std. Dev.	5.66	3.25	3.82	8.91	9.55	6.72	3.89	4.45	5.16	7.85	10.04	7.35
SUSPENDED SOLID MATTER (mg/L)	3.57	2.39	3.74	6.58	7.16	5.75	4.50	4.66	5.61	6.63	7.42	5.42
Std. Dev.	5.04	3.38	3.45	7.18	7.44	5.16	3.25	3.34	4.40	5.98	8.09	5.97
BOD (mg/L)	4.38	2.48	3.11	5.65	5.87	5.40	4.51	5.09	5.62	6.14	5.99	5.17
Std. Dev.	3.65	1.24	1.57	4.88	4.91	3.82	1.99	2.53	2.57	3.73	5.22	4.62

Mean alkalinity value of the stations on Brook Mazmanlı has been found to be 147.42 mg/L CaCO<sub>3</sub>; the maximum value has been found to be 172 mg/L CaCO<sub>3</sub> in 2<sup>nd</sup> station in May and June, while the minimum value has been found to be 139 mg/L CaCO<sub>3</sub> in 1<sup>st</sup> station in March 2005. These values are suitable in terms of general water quality criteria, and it has been determined that the alkalinity character of Brook Mazmanlı is within the optimum limits from the aspect of fisheries.

Mean total hardness value of the stations on Brook Mazmanlı has been determined to be 159.66 mg/L CaCO<sub>3</sub>. Accordingly, it is in mildly-hard water group (150-205 mg/L CaCO<sub>3</sub>). From the aspect of hardness, the water is in mildly-hard waters (100-150 mg/L CaCO<sub>3</sub>) that are ideal for trout fish (Aras et al., 1995). For this reason, it cannot be said that Brook Mazmanlı is completely suitable.

The nitrogen sources mixing into surface waters originate generally from domestic, natural and agricultural sources. The increases and decreases in levels of ammoniac, nitrite and nitrate that are nitrogen derivatives have been monitored, and the changes in ammoniac and nitrite have been found to be parallel, while the changes in nitrate have differed. The maximum nitrate level has been observed to be 3.53 in 1<sup>st</sup> station in April 2005, while the minimum level has been observed to be 2.70 in 1<sup>st</sup> station in July 2004. While the highness of organic matter leads to nitrite and nitrate concentration, the level of dissolved oxygen in the medium decreases due to this change. Table water is expected to include no nitrite, because nitrite can easily transform into nitrate and may rarely reach at high concentration in surface waters (Baltaci, 2000). Mean ammoniac and nitrite values of Brook Mazmanlı have been found to vary between 0.001 - 0.04mg/L and 0.001-0.02mg/L, respectively. Ammoniac is the main waste originating from animal wastes. Besides that, ammoniac emerges as a result of decomposition of nitrogenous organic matters. Ammoniac accumulation in water is not desired since it is toxic for aquatic organisms, and its toxic effects increase with the increase in pH and water temperature (Tepe, 2009).

Nitrogenous compounds have significant effects on water pollution, and oxygen and eutrophication. Brook Mazmanlı is not under nitrogenous compound danger for aquatic life.

Phosphorus that is an important nutrient mineral affecting the productivity of natural water resources is the main element of eutrophication. The most important factor of phosphorus-induced pollution is known to be industrial and canalization wastes (83%). The increase observed in phosphate level in spring and summer season can be interpreted to arise from the increase in algae that can bind the phosphate in air or the use of phosphatic fertilizers (Tepe and Boyd, 2002). Moreover, the surface water plants developing during these months may contribute to the passage of phosphorus in soil into the water.

Chemical oxygen demand (COD) has been observed to reach its maximum level as 15.9 mg/L in 2<sup>nd</sup> station in November 2004, while its minimum level has been found to be 1.2mg/L in 1<sup>st</sup> station in February 2005. The reason of gradual increase in COD in March and April in Brook Mazmanlı is the organic-matter-rich surface waters arising from precipitation into the brook.

Silica concentration of natural waters is 2 - 20 mg/L (Tepe et al., 2006), while the mean silica concentration during our study has been found to be 3.28 mg/L. The silica concentration have shown variation between the study stations; the minimum level has been found to be 2.7 mg/L in 1<sup>st</sup> station in August 2004, while the maximum level has been observed to be 4.08 mg/L in 2<sup>nd</sup> station in April 2005.

The maximum SSM concentration in this study has been observed in 2<sup>nd</sup> station in November 2004 as 13.14 mg/L. The limit of allowable value in aquaculture is 100 mg/L (Niengwe, F.V, 2006). The lethal levels of chloride existing as dissolved mineral in water varies between 0.3 - 4.0 mg/L depending on fish species (Tepe et al. ,2006). The level of chloride has never reached at lethal concentration at any of the stations on Brook Mazmanlı.

Potassium and sodium concentrations in natural waters vary between 1 - 10 mg mg/L and 2 - 200 mg/L, respectively (Boyd, 1998). The mean level of potassium in this study has been found to be 2.47 mg/L, while the mean sodium concentration has been found to be 3.54 mg/L. Potassium and sodium concentrations have increased in winter and decreased in summer months. Both of these two parameters have never exceeded the level leading to pollution.

The sulfite measured in this study is Na<sub>2</sub>SO<sub>3</sub> (sodium sulfite), and the mean value has been found to be 4.11 mg/L. The sulfite concentration in natural waters varies between 5 - 100 mg/L, and the mean value has been found to be 19.68 mg/L. The sulfur (S) generally exists in fresh water in form of sulfate (SO<sub>4</sub>). Most of the sulfates are water-soluble. Dissolved sulfate can be considered as water's continuously dissolving material (Mutlu, 2004). Low doses of sulfates are not toxic for fish. The sulfate level of Brook Mazmanlı has been found to be lower than allowable limit.

The biological oxygen demand is affected by the amount of decomposed organic matter, the number of microorganism, the nutrient concentration, and the temperature. The highest BOD value is 2 mg/L for clear

waters and >10 mg/L in polluted waters (Çiçek and Ertan, 2012). In our study, the mean BOD value has been found to be 4.95 mg/L.

In this study on determining the water quality of Brook Mazmanlı through physico-chemical methods, the water samples collected monthly for 12 months have been analyzed in terms of certain physical and chemical parameters. As a result of the research, it has been determined that there was no significant problem in terms of water pollution. In analyses of water samples taken from Brook Mazmanlı, water of which can be considered as high-quality water, it has been determined that nitrate, phosphate, COD and BOD values have been found to be high in terms of trout farming. Even though Brook Mazmanlı, where there are still some trout farming facilities, has been seen to not posing an important danger in terms of aquatic creatures and fish lives, the situation should be taken into consideration in fish farms operating in trout farming business. Moreover, by determining the monthly and seasonal changes in the water quality parameters of this brook, where no study has been carried out, it has been determined that the brook is under threat of pollution.

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## GLOBAL CLIMATE CHANGE EFFECTS ON ECOLOGY

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### ABSTRACT

Climate fundamental provides limits opportunities of human activities and ecosystem functioning within global ecology. Climate changing could effect on alterations in the frequency and severity of droughts and floods; water supply; air, soil, and water quality; ecosystem health; human health; and resource use and the economy. Climate change may act through multiple pathways; interactions in and impacts on the global ecosystem can be different pathways. Within ecosystem environment, there are already numerous stressors that cause ecosystem change including land use change, pollution, eutrophication, invasion of exotic species, and acid precipitation. Climate changing should be considered as another agent of change acting in concert with other ecosystem stress. All over the world in many ecosystems, flora and fauna were affected with global warming and change of ecological environment change that many species in flora and fauna were under stress and some of them were lost the defence of ecological stress. Reduction of species number was also important effect on habitat. In this research, effects of global change on different ecological systems were investigated.

**Keywords:** Global warming, environment, soil, fauna, flora, habitat, ecological niche.

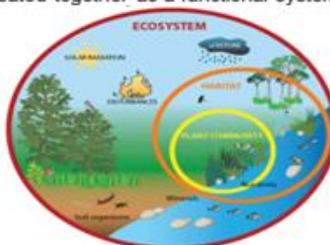
### INTRODUCTION

The impacts of global climate change on ecology are increasing day by day because of the human activity and other natural factors. In order to understand these impacts, it should be understood how the climate is changing. The first important factor representing climate change is increase of temperatures. The average global temperature has increased nearly 1.3 °F since 1850. Also, according to prediction, the global temperature of earth will increase more than 8 °F between 1990 and 2100 if the current trend of greenhouse gases (GHGs) emission continues. Moreover, warmer temperatures not only cause glaciers and land ice to melt which adds more water to the oceans but also cause seawater to expand in volume as it warms. Models indicate that sea levels may rise 2 feet or more by 2100 compared to 1990 levels. The other factor is acidification of water bodies. Because of the increase in CO<sub>2</sub> concentration in the atmosphere, the amount of CO<sub>2</sub> dissolving in the water bodies increase and causes the acidification problem. The last factor reflecting the global climate change is alterations in the water cycle and extreme weather conditions [URL-1].

The main purpose of this paper is investigating the effects of global climate change on different ecological systems. In order to understand these effects, the meaning of ecological systems should be defined clearly. Ecological systems represent repeating groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding.

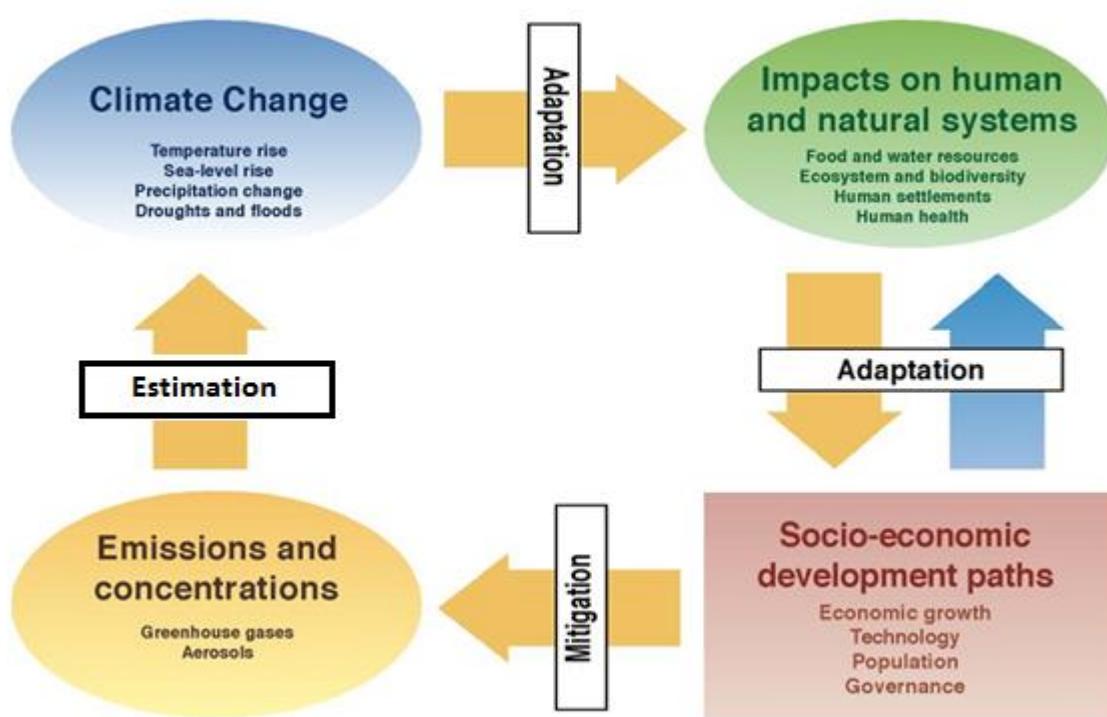
According to Figure 1, the connection between ecosystems and ecological systems can be seen clearly. Ecosystem includes a community and its physical environment which are behaving together as a functional system. The plant community is the part of a habitat and together with the other living creatures are affected from some forces like rainstorms or fire events. They are all the part of a big picture, ecosystem.

Ecosystem = an Ecological system;  
= A community and its physical environment  
treated together as a functional system.



**Figure 1** The schematic representation of an ecosystem

The climate change is part of an integrated framework. The effects of it on ecosystems could be explained clearly with this framework. The emissions and concentrations of the greenhouse gases especially the CO<sub>2</sub> whose concentration is higher than other gases in the atmosphere and aerosols causes the climate change. The climate change has impacts on humans and the other natural systems which are ecosystems and biodiversity, water sources and food chains. The climate change impacts on ecosystems vice versa affect the socio-economic development paths like technology, population, economic growth. Finally, these socio-economic paths impact the emissions and concentrations of greenhouse gases. In Figure 2, the integrated framework related to climate change is given [URL-2].



**Figure 2** Integrated Framework related to Climate Change

### EMMISIONS, CLIMATE CHANGE AND ECOSYSTEMS

The mostly known greenhouse gases are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), Nitrous oxide (N<sub>2</sub>O), nitrogen trifluoride (NF<sub>3</sub>), perfluorocarbons (PFCs), hydrofluorcarbons (HFCs), and sulphur hexafluoride (SF<sub>6</sub>) [URL-3]. The GHG emissions are seemed as air pollutant in simple point of view. However, they have important features which make them different from other air pollutants.

GHGs, and especially carbon dioxide, are emitted from many numbers of sources which can be both natural and anthropogenic and their amount also can be higher or lower. The emissions of these gases are distributed to the atmosphere rapidly and uniformly. Because they have global impacts, their contribution to the global concentrations is equally distributed wherever they are emitted. Unlike many conventional air pollutants, local concentrations of GHGs are not greater near large sources than they are in areas far away [URL-3].

Carbon dioxide equivalent (CO<sub>2</sub>) is the preferred measure for determining GHG emissions rates for any combination of these GHGs. Emissions of greenhouse gases are typically expressed in a common metric, so that their impacts can be directly compared, as some gases have a higher global warming potential (GWP) than others.

Greenhouse gas emissions in the 21st century can set in motion large-scale, high-impact changes in ecological systems over the coming decades. Sustained warming of a few °C leads to an increase in sea level of several meters due to loss of Greenland and Antarctic Ice. There will be given some examples related to emissions and ecological impacts of them.

Because of the human activities, the CO<sub>2</sub> amounts in the atmosphere increase. One of the main impacts of this increase is the acidification of water bodies. Atmospheric carbon dioxide dissolves into the water and makes a

reaction with H<sub>2</sub>O. This reaction produces carbonic acid (H<sub>2</sub>CO<sub>3</sub>) which produces bicarbonate and hydrogen ions in water. The marine animals require carbonate ion in order to protect their shells and skeletons and hydrogen ions make reaction with these carbonate ions. Thus, the skeletons and shells of marine organisms are destroyed that means acidification may cause serious harm to marine organisms such as corals, lobsters, and sea urchins.

Moreover, the climate change and resulting temperature rise cause severe damage to the Arctic Ice. The polar bears have evolved for a life on sea ice and their only food source, seals, lives on that ice. If ice melts, the only food source of polar bears dies so their survival rates are affected from this situation. Also, because of the lack of food, their body condition drops. The survival rates of baby polar bears decreases and the drowning and the cannibalism incidents increase. Therefore, the climate change impacts on ecosystem and biodiversity directly lead to the extinction of the species [URL-4].

Furthermore, the water cycle is affected from climate change negatively and the balance between water and atmospheric events is destroyed. High temperatures cause high evaporation rates. The warmer the air become, the more water will vapour which leads to the intense rainstorms. Rainstorms increase the flooding, that much of water runs into the rivers and streams, which makes the soil drier. Combined with temperature rise, this causes the drought lands. Projections indicate that on average dry areas will tend to get drier, and wet areas will tend to get wetter.

Curtis, et al. (2006) stated that atmospheric pollutants linked too many types of health problems of many body systems including the respiratory, cardiovascular, immunological, hematological, neurological and reproductive/developmental systems. On the other hand, Barnett et al., (2005) determined that higher airborne levels of PM10, NO<sub>x</sub> and SO<sub>2</sub> were all associated with significantly higher rates of childhood hospital admissions for pneumonia and acute bronchitis. Romieu et al., (1997) and Zemp et al., (1999) stated that significantly higher levels of chronic cough and phlegm production have been found in children exposed to higher ambient O<sub>3</sub> levels and in adults exposed to higher ambient PM10 levels. Inhaling such fine sand can cause a syndrome called El Eskan Disease, which involves a variety of respiratory and immunological problems. Recent investigations (Dursun, 2014a,b) have been showed that global warming, climate change and effect of these changes on ecosystem is still continuo in recent years (Ozturk et al, 2015).

## CONCLUSION

Global climate change has adverse effects on ecosystems. Because of the high temperatures and other factors such as sea level rise and precipitation change, climate change impacts the relative abundance of species leading to extinction. CO<sub>2</sub> emissions cause the body waters acidifications leading to damage the aquatic life. Higher temperatures lead to the flooding and the land drought so the living creatures in those areas damages. The climate challenge is large and complex. But it is very likely that many people, working from many angles, can help address climate change and its ecological consequences.

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## THE EFFECTS OF AGROBIODIVERSITY ON SUSTAINABLE AGRICULTURE

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### INTRODUCTION

Biodiversity states the richness of a living in terms of numbers and diversity. Agrobiodiversity is a sub- branch of Biodiversity (IPCC, 2002a). Agrobiodiversity is the result of natural selection processes and the careful selection and inventive developments of farmers, herders and fishers over millennia.. Many people's food and livelihood security depend on the sustained management of various biological resources that are important for food and agriculture. Agricultural biodiversity, also known as agrobiodiversity or the genetic resources for food and agriculture, includes:

- Harvested crop varieties, livestock breeds, fish species and non-domesticated (wild) resources within field, forest, rangeland including tree products, wild animals hunted for food and in aquatic ecosystems (e.g. wild fish);
- Non-harvested species in production ecosystems that support food provision, including soil micro-biota, pollinators and other insects such as bees, butterflies, earthworms, greenflies; and
- Non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems) (FAO, 2004).

### Why agrobiodiversity is disappearing?

There are too many examples like in Burkina Faso, and throughout the West African Sahel, rural women carefully collect the fruit, leaves and roots of native plants such as the baobab tree (*Adansoniadigitata*), red sorrel leaves (*Hibiscus sadderifa*), kapok leaves (*Ceibapentandra*) and tigernut tubers (*Cyperusesculentus L.*) for use in the families' diet. These supplement the agricultural grains (millet, sorghum) that provide only one part of the nutritional spectrum and may fail in any given year. More than 800 species of edible wild plants have been catalogued across the Sahel (Iknotes, 2000).

Locally varied food production systems are under threat, including local knowledge and the culture and skills of women and men farmers. With this decline, agrobiodiversity is disappearing. The scale of the loss is extensive. With the disappearance of harvested species, varieties and breeds, a wide range of farmers, especially those in environments where high-yield crop and livestock varieties rely on a wide range of crop and livestock types. This helps them maintain their livelihood in the face of pathogen infestation, uncertain rainfall and fluctuation in the price of cash crops, socio-political disruption and the unpredictable availability of agro-chemicals. So-called minor or underutilized crops, more accurately, companion crops, are frequently found next to the main staple or cash crops. They often grow side by side and their importance is often misjudged. In many cases, from a livelihoods perspective, they are not minor or underutilized as they can play a disproportionately important role in food production systems at the local level. Plants that will grow in infertile or eroded soils, and livestock that will eat degraded vegetation, are often crucial to household nutritional strategies. In addition, rural communities, and the urban markets with which they trade, make great use of these companion crop species of unharvested species also disappear.

### Change of agrobiodiversity throughout history

According to FAO (1999b), since the 1900s, some 75 percent of plant genetic diversity has been lost as farmers worldwide have left their multiple local varieties and landraces for genetically uniform, high-yielding varieties. As a result of loss 75 percent of the world's food is generated from only 12 plants and five animal species and only the 4 percent of the 250 000 to 300 000 known edible plant species,(150 to 200) are used by humans. Only three - rice, maize and wheat - contribute nearly 60 percent of calories and proteins obtained by humans from plants 30 percent of livestock breeds are at risk of extinction; six breeds are lost each month. Animals provide some 30 percent of human requirements for food and agriculture and 12 percent of the world's population live almost entirely on products from ruminants (FAO-1999b).

Fallow fields and wild lands can support large numbers of species useful to farmers. In addition to supplying calories and protein, wild foods supply vitamins and other essential micro-nutrients. In general, poor households rely on access to wild foods more than the wealthier. However, in some areas, pressure on the land is so great that wild food supplies have been exhausted.

The term ‘wild-food’, though commonly used, is misleading because it implies the absence of human influence and management. Over time, people have indirectly shaped many plants. Some have been domesticated in home gardens and in the fields together with farmers’ cultivated food and cash crops. The term ‘wild-food’, therefore, is used to describe all plant resources that are harvested or collected for human consumption outside agricultural areas in forests, savannah and other bush land areas. Wild-foods are incorporated into the normal livelihood strategies of many rural people, pastoralists, shifting cultivators, continuous croppers or hunter-gatherers. Wild-food is usually considered as a dietary supplement to farmers’ daily food consumption, generally based on their crop harvest, domestic livestock products and food purchases on local markets. For instance, fruits and berries, from a wide range of wild growing plants, are typically referred to as ‘wild-food’. Moreover, wild fruits and berries add crucial vitamins to the normally vitamin deficient Ethiopian cereal diet, particularly for children.

There are many reasons for this decline in agrobiodiversity. Throughout the twentieth century the decline has accelerated, along with increased demands from a growing population and greater competition for natural resources. The principal underlying causes include rapid expansion of industrial and green revolution agriculture which means intensive livestock production and industrial fisheries and aquacultures. Moreover, relatively few crop varieties are cultivated in monocultures and a limited number of domestic animal breeds, or fish, are reared or few aquatic species cultivated. As a result of Industrialism globalization and marketing has been growing so fast that industrial patenting or other property systems has led to widespread cultivation and rearing of fewer varieties and breeds.

As a consequence of this decline there have been, changes in farmers’ and consumers’ perceptions, preferences and living conditions, marginalization of small-scale diverse food production systems that conserve farmers’ varieties of crops and breeds of domestic animals. Other important issue is reduced integration of livestock in arable production that reduces the diversity for which livestock are needed. And the reduced use of nurture fisheries techniques that conserve and develop aquatic biodiversity. These situations have greatly affected biodiversity in negative ways.

The main cause of the genetic erosion of crops - as reported by almost all countries - is **the replacement of local varieties by improved or exotic varieties and species**. Frequently, genetic erosion occurs as old varieties in farmers’ fields are replaced by newer. Genes and gene complexes, found in the many farmers’ varieties, are not contained in the modern. Often, the number of varieties is reduced when commercial varieties are introduced into traditional farming systems. While FAO (1996) states that some indicators of genetic erosion have been developed, few systematic studies of the genetic erosion of crop genetic diversity have been made. Furthermore, in the FAO Country Reports (1996) nearly all countries confirm genetic erosion is taking place and that it is a serious problem.

### **The situation of biodiversity in Turkey**

Biodiversity in Turkey is rich in terms of genetic resources of cultivated plants, species, and ecosystems. The reasons of richness are geopolitical position, several landforms in very little area and Climatological movement of this region. Addition to this reasons the anthropological effects have greatly increased biodiversity in Anatolia (Demirsoy, 1996). The diversity of the geological structure in Anatolia enables high endemism and genetically variety. Turkey is the genetic bank of lots of plants. Anatolia contains %75 of plant species in Europe, %33 of this plants is endemic which mean sit can only be grown in Anatolia. Like plant species, Anatolia has a lot of animal species in it. Animal species in Anatolia are nearly one and half of all over Europe (Çepel, 2003). All over Anatolia 120 species of Mammals, 413 bird species, 93 species of reptilian, 18 species of amphibians, 276 species of sea fish, 192 species of inland water fish have identified (Turan, 1987). The origin of red deer and pheasant is Anatolia. The fauna of Anatolia contains over 80.000 species of bugs (Tekeli vd., 2006). The other interesting point of Anatolia is the endemic capacity of this region. A lot of animal species live in Anatolia such as Bald Ibis (Geronticuseremita), Turtles (Caretta caretta ve Cheloniemydas) and Mediterrean Sea Calf (Monachusmonachus) (Çepel, 2003).

### **THE ROLE OF AGROBIODIVERSITY**

The differentiation in plants can be used in many different areas. This plants can increase productivity, food security and economy. Also plant variation can reduce the pressure of agriculture on fragile areas, forests and endangered species and could make farming more sustainable and stable with its contribution to sound pest and disease management. Because of its compatibility with soil it wouldn’t harm soil, conserve soil fertility and health, conserve ecosystem structure and stability of species diversity .The distinction of plants enables the differentiation in usage so these differences can be used to increase income and reduce risks and dependency on external inputs (Adapted from Thrupp, 1997).

### **CONCLUSIONS**

Many components of agrobiodiversity would not survive without this human interference; local knowledge and culture are integral parts of agrobiodiversity management.

Many economically important agricultural systems are based on ‘alien’ crop or livestock species introduced from elsewhere (for example, horticultural production systems or Friesian cows in Africa). This creates a high degree of interdependence between countries for the genetic resources on which our food systems are based.

As regards crop diversity, diversity within species is at least as important as diversity between species.

Locally diverse food production systems are under threat and, with them, the accompanying local knowledge, culture and skills of the food producers.

The loss of forest cover, coastal wetlands, ‘wild’ uncultivated areas and the destruction of the aquatic environment exacerbate the genetic erosion of agrobiodiversity.

The main cause of genetic erosion in crops, as reported by almost all countries, is the replacement of local varieties by improved or exotic varieties and species.

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What Is Happening To Agrobiodiversity?

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