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## O 1. WILDFIRES FORECAST PERFORMANCE (WFP) IN ALBANIA DURING THE SUMMER SEASON 2017

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**ABSTRACT:** Albania is characterized by a Mediterranean climate, with dry and warm or hot summers. Like other Mediterranean countries, Albania is repeatedly threatened by wildfires causing frequently ecological, economic losses, even sometimes threatening the human lives. The wildfire risk forecast is one of the key risk mitigation measures, which helps to safeguard the human properties and lives from natural hazards. The Wildfire Risk Forecast is a daily procedure conducted by the National Centre for Forecast and Monitoring of Natural Hazards (NCFMNH), which is part of the Institute of Geosciences, Energy, Water and Environment (IGEWE) of Albania. The risk forecast is issued and disseminated in a daily basis to the General Directorate of Civil Emergencies, including wildfire occurrence probability (risk) by country's administrative unit (prefecture). The wildfires risk forecast, since 2016, is based on the fire weather index of the European Forest Fires Information System (EFFIS). The study aims to evaluate the accuracy of the wildfire risk forecasts issued during the 2017 summer season, calculating and analyzing results of the Wildfires Forecast Performance (WFP) for each Prefecture, and draw recommendations for possible improvement of forecast. The study proved high accuracy for the "High Risk Level" forecast alerts, and for the "Very Low Risk Level" forecast alerts. But on the other side, the study suggests that the accuracy for the "Moderate Risk Level" and "Low Risk Level" could be improved if other thresholds would be used to devide the levels.

**Keywords:** *Wildfires, forecast, risk, natural hazard*

### 1. INTRODUCTION

Albanian territory is often affected by wild-land fires which result in significant economic and ecological losses differing from year to year. Thus, building an accurate assessment system that forecast the risk of forest fires over the country in order to enable the notification of the level of risk for fires over the country is of key importance.

Several forest fire danger rating systems are built with this purpose, worldwide. One of the most used fire danger rating system is The Canadian FWI system which was the first subsystem developed in the CFFDRS (Van Wagner, 1987, Van Wagner and Pickett, 1985). Even though Canadian FWI is specifically calibrated to describe the fire behaviour in a standard jack pine stand *Pinus banksiana* typical of the Canadian forests (Van Wagner 1974), the index has successfully been used in countries where vegetation is dissimilar to Canada (Taylor and Alexander 2006) such as Australia (Cruz and Plucinski 2007), New Zealand, and Malaysia (Taylor and Alexander 2006). Given those results the Fire Weather Index module of the CFFDRS has been adapted for use in several countries.

The Fire Weather Index (FWI) is currently being used by the European Forest Fire Information System (Camia et al. 2006), which is developed in the framework of the Copernicus Emergency Management Services to monitor and forecast fire danger in Europe (Di Giuseppe et al. 2016). Nevertheless, the FWI algorithms in EFFIS have been slightly changed to the original FWI System of the CFFDRS in order to better suit the remarkable differences in day length in European Union when going from the Mediterranean to the Boreal countries (Lopez et al., 2002; San-Miguel-Ayanz et al., 2003). Besides, EFFIS uses medium-range (1–10-day lead time) weather forecasts, instead of observations, to extend the advance warning.

The Centre for Forecasting and Monitoring of Natural Hazards (CFMNH), in Institute of Geosciences, Water and Environment (IGEWE), started to provide information about the Forest Fire Risk, in the summer of 2011, delivering daily information on the upcoming risk of fires for the following day. Beginning the year 2016 the FWI index delivered by EFFIS have been used in order to define the daily fire risk forecasts for each prefecture in Albania. Anyway, in order to comply with the categories of the Meteoalarm platform, CFMNH rates the Fire Danger into four levels of risk, unlike EFFIS which rates the Danger in six classes. Table one shows the respective thresholds used for each level of risk by EFFIS and by CFMNH. As seen in the table, CFMNH uses the same thresholds as EFFIS in order to

determine the two lower levels, while, for the two upper levels CFMNH uses the EFFIS thresholds of two gathered levels for each. That is, CFMNH “Moderate Risk” level corresponds to EFFIS “Moderate” and “High” and CFMNH “High Risk” level corresponds to EFFIS “Very High” and “Extreme”.

**Table 1:** IGewe vs. EFFIS Fire Danger Classes

EFFIS Fire Danger Classes	FWI ranges	CFMNH Fire Danger Classes	FWI ranges
<b>Very low</b>	< 5.2	<b>No Risk</b>	< 5.2
<b>Low</b>	5.2 - 11.2	<b>Low Risk</b>	5.2 - 11.2
<b>Moderate</b>	11.2 - 21.3	<b>Moderate Risk</b>	11.2 – 38.0
<b>High</b>	21.3 - 38.0	<b>High Risk</b>	>= 38.0
<b>Very high</b>	38.0 - 50.0		
<b>Extreme</b>	>= 50.0		

This study aims to evaluate the Wild-fires Forecast Performance (WFP) in Albania during the summer season 2017, while using these thresholds, and contribute to improvement of the forecast with recommendations and suggestions for the future.

## 2. METHODOLOGY

The relationship between the FWI values and fire occurrence was investigated by several studies. In most of them was found moderate to high correlations between FWI values and fires occurrence, Stocks B. J. (1971), by Gillet et al. (2004), Dimitrakopoulos et al. (2011) and Bedia et al. (2012). While, studies that investigated the correlation between FWI values and burned area found poor to moderate correlation between them, Harrington et al. (1983) and Dimitrakopoulos et al. (2011).

Given those findings, the Wildfire Forecast Performance in this study, was evaluated only investigating the fire occurrence over the prefectures of Albania. The fire occurrence was investigated on each level of risk according the forecasts conducted each day during the summer. It consisted of two steps. The first step was assessment of the Prefecture Hit Probability (PHP) which was conducted for each level of forecast alert following [Formula 1]. In the second step, the revealed PHP values were assembled in three categories, using the thresholds as shown in the table 2, rating the Wildfire Forecast Performance (WFP) as “VERY GOOD”, “GOOD” or “BAD”.

$$\text{PHP Level} = \sum_{i=0}^n \frac{n^{\text{Hits}}}{n^{\text{Alerts}}} \times 100\% \quad [1]$$

Where:

PHP - refers to the Prefecture Hit Probability

Nr. of HITs - refers to the number of the prefectures exposed to the respective level of risk affected by fires.

Nr. of Alerts - refers to the number of alerts of the respective level of risk.

**Table 2.** Shreasholds of PHP used for categorising the Wildfire Forecast Performance

	PHP	WFP	PHP	WFP	PHP	WFP
<b>High Risk</b>	70% - 100%	<b>VERY GOOD</b>	50 % -70 %	<b>GOOD</b>	>50 %	<b>BAD</b>
<b>Moderate Risk</b>	50% - 70%		40 % – 50 %		>40 %	
<b>Low Risk</b>	20% - 40%		70 % - 80 %		<80%	
<b>Very Low Risk</b>	0 – 10%		10 % - 20 %		< 50%	
			40 % – 50 %		< 20%	
			10 % - 20 %			

Additionally, the Average quantity of Fires per Hits (AFH) was calculated per each Level of risk, in order to better understand the fire occurrence, taking into account that in many cases more than one Fire per Hit Occurred. All evaluations were conducted for each Prefecture, in a month duration basis.

### **3. RESULTS**

The results are shown in two subsections, the first one, containing the basic findings of the study, and the second one, containing additional information with data on number of forecast alerts issued by level, number of fires occurred by level, and number of HITS by level.

#### **3.1. Wildfire Forecast Performance**

##### **3.1.1. June**

Wildfire Forecast Performance of “High Risk Level” forecasts, during June, was rated as “VERY GOOD” due to considerably high value of Prefecture Hit Probability (PHP 70%). The average quantity of fires occurring per prefecture (Average Fires per Hit) appeared considerably high as well with an average value of 1.5 Fires per Hit, showing as such, a good relationship with the respective level (see table 3).

The “Moderate Risk Level” forecasts appeared to have a “BAD” Wildfire Forecast Performance given the low values of Prefecture Hit Probability (PHP 14%). The average number of Fires per Hit was 1.18, a value that was in line with the level of forecast.

The “Low Risk Level” and the “Very Low Risk Level” forecasts indicated respectively “GOOD” and “VERY GOOD” Wildfire Forecast Performance. The respective values of PHP were 10% and 4%, revealing that 90% and 96% of the alerted prefectures in respectively “Low Risk Level” and “Very Low Risk Level” reported no fires. In all cases, only one fire per hit was reported, on average, which was in line with forecast levels.

##### **3.1.2. July**

During July, Wildfire Forecast Performance of “High Risk Level” forecasts was ranked as “VERY GOOD” with a considerably high value of Prefecture Hit Probability (PHP 70%). The average quantity of fires occurring per prefecture (Average Fires per Hit) appeared significantly high (1.72 fires/hit) which was in accordance with the level of forecast.

“Moderate Risk Level” forecasts appeared to have a “VERY GOOD” Wildfire Forecast Performance due to a moderate value of Prefecture Hit Probability (42%). Even though, the number of fires per Hit, in average terms, appeared significantly high (1.66 fires/hit), which should preferably be lower in this level of risk.

The Wildfire Forecast Performance of “Low Risk Level” and “Very Low Risk Level” forecasts were ranked as “VERY GOOD” and “GOOD” owing to low PHP values (respectively 27% and 20%). The PHP value of “Very Low Risk Level” forecasts were reported somehow high which caused WFP to step from “VERY GOOD” to “GOOD” level. The fires occurrence was high in both levels, specifically in “Very Low Risk Level” (2.7fires/hit), which was actually inconsistent with respective level.

##### **3.1.3. August**

Wildfire Forecast Performance of “High Risk Level” forecasts, during August, was rated as “GOOD” with a slightly higher Prefecture Hit Probability, much lower as compared to the previous months (PHP 55%). The average quantity of fires occurring per prefecture (Average Fires per Hit) was high in accordance with respective level (1.56 fires/hit).

“Moderate Risk Level” forecasts appeared as “GOOD” with a slightly low Prefecture Hit Probability (45%). The quantity of fires per prefecture was moderate in line with respective level (AHF, 1.35 fires/hit).

Wildfire Forecast Performance of “Low Risk Level” and “Very Low Risk Level” forecasts appeared as “GOOD” and “VERY GOOD” respectively, with Prefecture Hit Probability values of 10% and 0%. In all cases, only one fire per hit was reported, in line with the respective level.

#### **3.2. Distribution of Forecast alerts and Fires by Level**

A total of 360 forecast alerts were delivered during June, of which, a share of 53.6% indicated “High Risk Level” or “Moderate Risk Level” with the highest percentage indicating “Moderate Risk Level” (52%). On the other side, a total of 44 fires were registered over the country, of which, a share

of 75% occurred in “High Risk Level” and “Moderate Risk Level” prefectures according to the forecast alerts; while most of them (59%) occurred in “Moderate Risk Level” ones (see table 4 and graph 1).

**Table 3.** Prefecture Hit Probability, Wildfire Forecast Performance and Average Fires per HIT

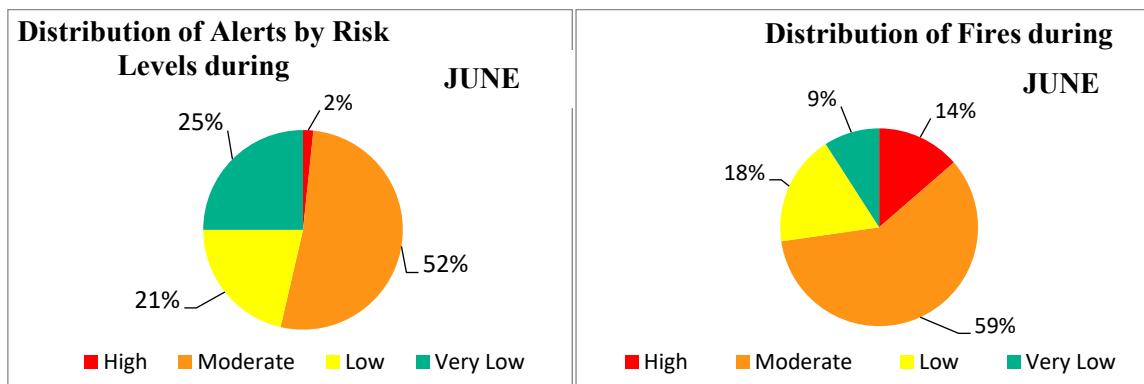
	J U N E			J U L Y			A U G U S T		
	PHP	WFP	AFH	PHP	WFP	AFH	PHP	WFP	AFH
<b>High Risk</b>	<b>70%</b>	Very good	1.50	<b>70%</b>	Very good	1.72	<b>55%</b>	Good	1.56
<b>Moderate Risk</b>	<b>14%</b>	Bad	1.18	<b>42%</b>	Good	1.66	<b>45%</b>	Good	1.35
<b>Low Risk</b>	<b>10%</b>	Good	1.00	<b>27%</b>	Very good	1.83	<b>10%</b>	Good	1.00
<b>Very Low Risk</b>	<b>4%</b>	Very good	1.00	<b>20%</b>	Good	2.67	<b>0%</b>	Very good	-

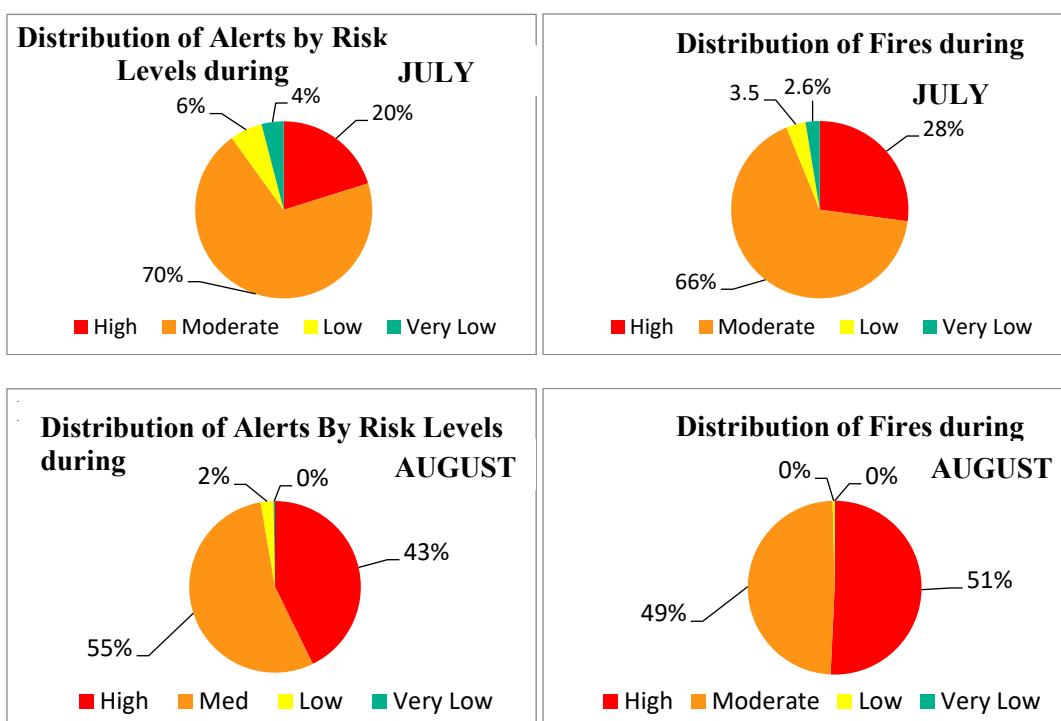
**Table 4.** Number of forecasts issued for each level of Risk, Fires occurrence, registered HITS

		JUNE	JULY	AUGUST
<b>High Risk</b>	Alerts	6	75	159
	Fires	6	86	137
	Hits	4	50	88
<b>Moderate Risk</b>	Alerts	187	260	203
	Fires	26	207	132
	Hits	22	125	98
<b>Low Risk</b>	Alerts	77	22	9
	Fires	8	11	1
	Hits	8	6	1
<b>Very Low Risk</b>	Alerts	90	15	1
	Fires	4	8	0
	Hits	4	3	0
<b>TOTAL</b>	Alerts	360	372	372
	Fires	44	312	270

A total of 372 forecast alerts were issued during July, of which, a share of 90% indicated “High Risk Level” and “Moderate Risk Level” with the highest percentage indicating “Moderate Risk Level” (70%). Meanwhile, a total of 312 fires were registered countrywide, of which, a share of 94% occurred in “High Risk Level” and “Moderate Risk Level” prefectures; while most of them (66%) occurred in “Moderate Risk Level” prefectures (see table 4 and graph 1).

During August, a total of 372 alerts were issued. A share of 97% of forecast alerts indicated “High Risk Level” and “Moderate Risk Level” with almost the same percentage amongst these two levels (respectively 43% and 55%). A total of 270 fires were registered, of which, a share of 51% occurred in “High Risk Level” prefectures and a share of 49% in “Moderate Risk Level” prefectures (see table 4 and graph 1).





**Graph 1.** The distribution of alerts by forecast risk levels and distribution of fire occurrence on monthly basis

#### 4. CONCLUSIONS

- A high accuracy for the alerts of “**High Risk Level**” has been observed during the three months the study was conducted, with Prefecture Hit Probability, peaking in June and July to 70% and with Wildfire Forecast Performance rating as “**VERY GOOD**” for those months but “**GOOD**” for August. The number of the prefectures exposed to the “**High Risk Level**” consisted a normal share to the total. It was very low in June, significantly high in July and very high in August.
- A significantly varying accuracy for the “**Moderate Risk Level**” forecasts has been observed, with Prefecture Hit Probability varying from very low in June to low in July and August and Wildfire Forecast Performance rating as “**BAD**” for June and “**GOOD**” for July and August. The number of the prefectures exposed to this level of risk was very high, peaking in July with a share of 70% to the total of forecast alerts.
- A varying accuracy for the “**Low Risk Level**” forecasts has been observed with Prefecture Hit Probability varying from 10% in June and August to 27% in July and Wildfire Forecast Performance rating as “**GOOD**” for June and August and “**VERY GOOD**” for July. The quantity of the prefectures exposed to this level of risk was significantly low during all the season, exceptionally during July and August.
- A very high accuracy for the “**Very Low Risk Level**” forecasts has been observed, explicitly during June and August, with Prefecture Hit Probability of 4% and 0% respectively to 20% in July and Wildfire Forecast Performance rating as “**VERY GOOD**” for June and August and “**GOOD**” for July. The number of the prefectures exposed to this risk level consisted a normal share to the total. It was significantly high in June, low in July and almost null in August.

#### 5. RECOMMENDATIONS

A great number of prefectures exposed to Moderate level of risk should not be considered as satisfactory. Another study should be conducted aiming to define better levels of risk thresholds. Furthermore, an improved risk level division is expected to bring a more balanced exposure by risk level as well as a revised accuracy for forecasts related to “**Moderate Risk Level**” and “**Low Risk Level**”.

Even though the affected area does not show significant correlation with FWI Index, according to literature, other studies on this topic should include an analysis on the relationship between forecast alerts and areas that have literally caught fire.

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## O 2. A COMPARATIVE STUDY TO ENHANCE THE PHOTOCATALYTIC ACTIVITY OF PICKERING EMULSIONS STABILIZED WITH DIFFERENT SURFACE-MODIFIED TITANIUM DIOXIDES VIA MEMBRANE EMULSIFICATION WAY

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**ABSTRACT:** This study is based on the application of surface-modified TiO<sub>2</sub> to stabilize Pickering emulsions (PE) and then to be used in photocatalytic system for degradation of indigo carmine dye. Number of the reactive sites on the TiO<sub>2</sub> surface plays an important role on the performance of photocatalytic degradation. Due to this theory, the aim must be to increase the amount of TiO<sub>2</sub> nanoparticles adsorbed on the water/oil interface thereby creating stabilization of PE. In this regard, TiO<sub>2</sub> were modified using various types of organic acids such as salicylic, benzoic, and citric acids to investigate their effects on photocatalytic reaction efficiency and kinetics. Instead of conventional emulsification technologies, membrane emulsification method was used to prepare PE which enables the homogeneous particle size distribution. The bonding structure and surface properties of the particles along with the degradation efficiency of indigo carmine dye were investigated to assess the effect of the surface modification of TiO<sub>2</sub> on the photocatalytic activity of the PE-based system in terms of types of oil phase and organic acid. Additionally, the efficiencies of PE and bare surface-modified TiO<sub>2</sub> were compared to understand the advantage of PE. Characterization of surface modified TiO<sub>2</sub> was performed using TGA, BET, DSC, FTIR, XRD, and SEM analyses. It is found that surface modified particles help to achieve better degradation percentages rather than bare TiO<sub>2</sub>. According to the results, olive oil based composite particles stabilized with salicylic acid-TiO<sub>2</sub> provided the best promising result as a 78% dye removal.

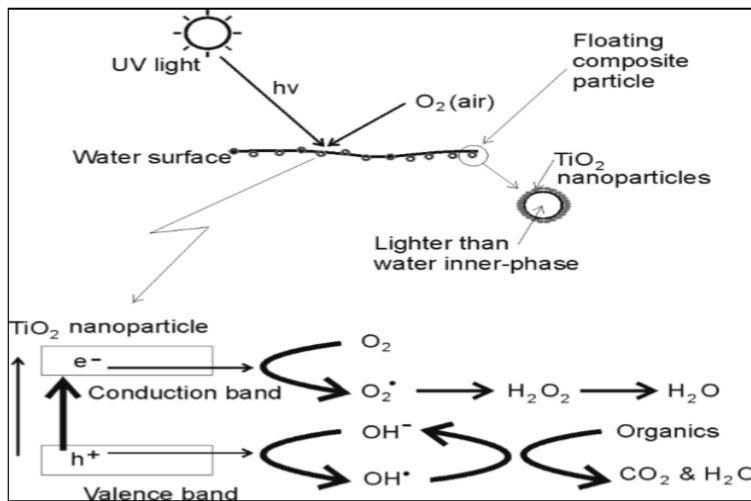
**Keywords:** *Pickering Emulsion, Surface Modification, Dye Decolorization, Water Treatment, Photocatalytic Degradation.*

### 1. INTRODUCTION

Decrement in water resources and increase in the amount of wastewater generated by various industrial activities have become an environmental problem that has become very important in recent years. The accumulation of the textile dyes is increasing day by day with the industrial growth in the last century. It has significance to treat wastewater containing harmful substances for human health like carcinogenicity, toxicity and bioaccumulation. Especially textile industry causes the accumulation of some of major contaminants as polycyclic aromatic hydrocarbons. There are many treatment methods for decolorization of wastewater. Among these methods, photocatalytic degradation makes possible the dye to be discolored by sunlight or UV light. Indigo Carmine (IC) Dye is one of used textile azo dye in the industry which has serious environmental concern. Up to 30% of the used dye is released in wastewater effluents, and a large portion of the consumed dyes are azo dyes which are generally as a highly toxic class of IC (Harrache, et al., 2019).

TiO<sub>2</sub> has ability to degrade the organic and inorganic pollutants from water by photodegradation. The properties of TiO<sub>2</sub> which make it an attractive and effective photocatalyst are non-toxicity, desirable thermal and chemical stability, chemical and biological inertness, high photosensitivity, and relatively low cost production (Chattopadhyay et al., 2012; Mekprasart et al., 2012; Atar et al., 2014; Nawaz et al., 2017). Large surface area of TiO<sub>2</sub> causes increment in adsorption-desorption sites of catalyst which enables effective transport channels for reactant molecules. Furthermore, crystallinity, provides generation of electron hole pairs in the bulk and surface of TiO<sub>2</sub>. That is why, it can be concluded that, crystal nanostructure which has large surface area is wanted combination for the process (Nawaz et al., 2017). Photocatalytic degradation using TiO<sub>2</sub> is used to degrade organic contaminants due to the leading extremely active reactive oxygen types as photo-generated hole (h<sup>+</sup>) and hydroxyl radicals (·OH) under irradiation of solar light as demonstrated in Figure 1. Photocatalytic degradation owns a lot of benefits counted as minimum cost, straightforward operation, superior catalytic yield, full oxidation

performance, low energy consumption, and no secondary contaminants formation after degradation (Ding et al., 2016; Katsumata et al., 2013).



**Figure 1.** Schematic of composite  $\text{TiO}_2$  forming free radicals to decompose organic matter (Holdich et al., 2012).

In this study, Pickering emulsions which are stabilized using fine solid particles were produced applying membrane emulsification method. This technique is a relatively new technique attempting to improve on traditional emulsification methods by producing each droplet singly, as required. There are lots of advantages which are required less energy, no necessary any additional chemical materials, high effectiveness of separation, enlarging easily and constant operation. By using the membrane emulsification method, emulsions of the desired size are achieved by passing the dispersed phase through the pores of a microporous membrane into the continuous phase with the aid of pressure (Drioli and Giorno, 2009). Stabilization of interface between two immiscible phases by solid colloidal particles, such as  $\text{TiO}_2$  decreases and eliminates synthetically surfactants (Kasiri & Fathi, 2018).

The purpose of this study was to stabilize the surface of the oil droplets by surface modified  $\text{TiO}_2$  nanoparticles. To achieve this adsorption at the surface,  $\text{TiO}_2$  nanoparticles were modified using salicylic, benzoic, citric acids. The resulting nanoparticles were applied to generate Pickering emulsions by membrane emulsification. The photocatalytic assessment of those composite particles was investigated as a function of weak acid and oil types.

## 2. MATERIAL AND METHOD

### 2.1 Materials

The anatase  $\text{TiO}_2$  powder (Degussa P25) was obtained from Sigma-Aldrich, that owns mean particle size of 21 nm, more than 99.5% purity on trace metal basis,  $50 \text{ m}^2/\text{g}$  surface area. Olive oil (Local Market; Migros) and safflower oil (Feliz) were bought from local markets. Oleic acid was purchased from Sigma Aldrich ( $>99\%$  purity GC). Surface Modification of  $\text{TiO}_2$  was carried out using salicylic acid (SA) (Merck), benzoic acid (BA) (Merck), and citric acid (CA) (Merck  $\geq 99.5\%$ ). indigo carmine dye (Sigma Aldrich), acetone (Merck, analysis grade), and ethanol (Merck, analysis grade) were also used for the tests.

### 2.2 Surface Modification of $\text{TiO}_2$

The procedure explained by Nawaz et al., 2017 was followed for the surface modification of  $\text{TiO}_2$ . The obtained solution was filtered through a filter paper. After that filter cake was washed with water repeatedly until pH reaches to 5.5-6.5 and then heat-treated at  $105^\circ\text{C}$  for 30 min.

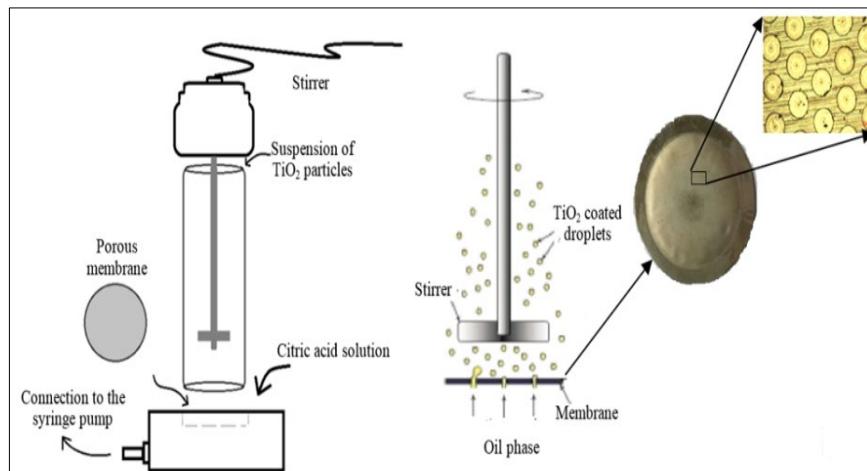
### 2.3 Characterization of Surface Modified $\text{TiO}_2$ Nano Particles

The morphologies of nanoparticles were investigated by scanning electron microscopy (SEM) (Jeol 6510, Japan). The BET surface areas were obtained using Quantachrome Autosorb IQ2 instrument

(Quantochrome, USA). X-Ray diffraction (XRD) was utilized to determine the crystallinity of the pure TiO<sub>2</sub> and BA-TiO<sub>2</sub> composite nanoparticles using Rigaku Smart lab, Japan with Cu K $\beta$  radiation and a scanning range of 10-80°.

## 2.4 Preparation of Pickering Emulsion

The floating photocatalytic composite particles stabilized with SA-TiO<sub>2</sub>, BA-TiO<sub>2</sub> and CA-TiO<sub>2</sub> were prepared by membrane emulsification and Pickering emulsion methods in a stirring cell equipped with the membrane. This system as shown in Figure 2 involves a mechanical stirrer, a glass reservoir with a volume of 150 mL, and a hydrophilic flat nickel porous membrane with a diameter of 3.4 cm and a pore size of 14 $\mu$ m supplied from Micropore Technologies Ltd. (Loughborough, U.K.).



**Figure 2.** Dispersion cell and nickel porous membrane (Gasparini et al., 2008)

A dispersed phase is injected through a microporous flat membrane by using a syringe pump into a continuous phase, aqueous phase, to obtain floating Pickering. Oil phase which is dispersed as olive oil, oleic acid and safflower oil into the microporous membrane and continuous phase which consist of surface modified TiO<sub>2</sub> particles to able to stabilize the core phase. 10 mL of oil phase were injected at a rate of 5 mL/min through the membrane through the base of the cell using syringe pump. At the second stage, the droplets were conditioned by mixing for 30 min at 2 V to avoid any agglomeration. Finally, Pickering emulsions were left to be settle down for several hours so that three phases were observed as the layer of floating composite particles, aqueous phase, and surface modified TiO<sub>2</sub> nanoparticles.

## 2.5 Characterization of Pickering Emulsions

To figure out the amount of TiO<sub>2</sub> that was effectively coated on oil droplets, ash test was performed by a stepwise heat treatment in a muffle furnace (Mikrotek). Droplet size measurements of Pickering emulsions were conducted by using a Nikon Eclipse LV150N Optical Microscope.

## Photocatalytic Degradation Tests

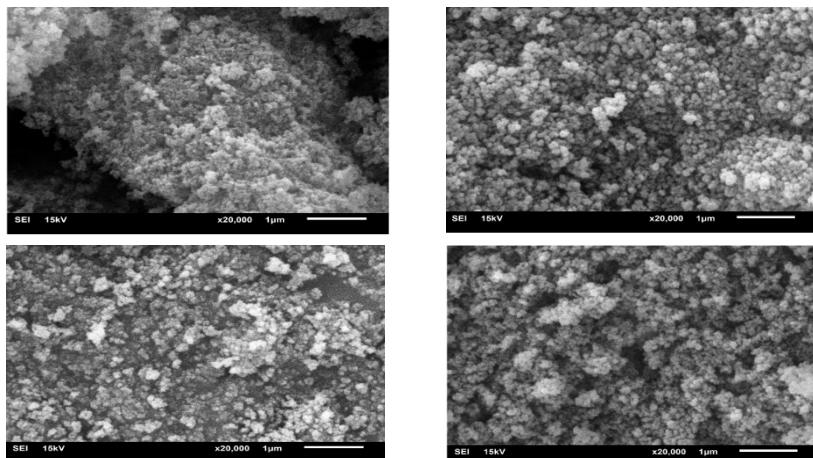
For each experiment, two duplicates of 200 mL indigo carmine dye solution were located uncovered beneath a tubular “black light blue” source (Philips 18 W/08 BLB ISL), emitting at 365 nm, in order to benefit effectively from the tubular UV. Each experiment was carried out for 180 minutes at room temperature. Samples were filtered through 0.2 mM cellulose filter. Once the photocatalytic degradation experiments were completed, concentration of the samples were determined by a spectrophotometer (Shimadzu, UV 1800 model) at a maximum wavelength of 610 nm.

## 3. RESEARCH FINDINGS

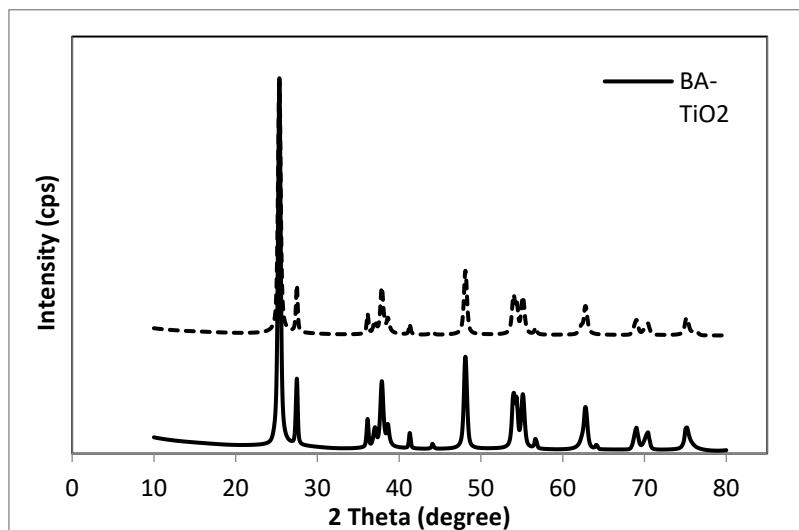
### 3.1. Characterization of Composite Particles

The SEM images of BA, SA and CA have showed no difference in morphology. However, SA-TiO<sub>2</sub> and CA-TiO<sub>2</sub> particles were observed bigger comparing to TiO<sub>2</sub> and BA-TiO<sub>2</sub> as illustrated in Figure 3. The BET surface areas, which were obtained using the BJH adsorption-desorption method of BA-TiO<sub>2</sub> and TiO<sub>2</sub>

were found as  $35.98 \text{ m}^2/\text{g}$  and  $53.2 \text{ m}^2/\text{g}$  (Holdich et al., 2012) respectively as it is expected. The pore size and pore volume of BA-TiO<sub>2</sub> were found to be  $188.64 \text{ \AA}^\circ$  and  $0.34 \text{ cm}^3/\text{g}$ , respectively. Modification of TiO<sub>2</sub> with BA did not affect the crystallinity of TiO<sub>2</sub>, and the characteristics peaks for the anatase phase were preserved (Figure 4).



**Figure 3.** SEM images of (A) BA-TiO<sub>2</sub>, (B) SA-TiO<sub>2</sub>, (C) CA-TiO<sub>2</sub> and (D) pure TiO<sub>2</sub>



**Figure 4.** X-Ray diffraction pattern of TiO<sub>2</sub>

### 3.2 Evaluation of Pickering Emulsions

Floating composite particles were generated using membrane emulsification and Pickering emulsions ways to obtain the droplets with homogeneous size distribution. The highest amount of TiO<sub>2</sub> adsorbed on TiO<sub>2</sub> surface was achieved using oleic acid due to the highest amount of oleic acid among the other oils.

**Table 1.** Properties of surface modified TiO<sub>2</sub> coated composite particles

Core Phase	Continuous Phase	Composite Particle Median Diameter ( $\mu\text{m}$ )	TiO <sub>2</sub> Coated (mg/g)
Oleic Acid	0.5 g BA-TiO <sub>2</sub> - 2 g CA	77	13.43
Safflower Oil	0.5 g BA-TiO <sub>2</sub> - 2 g CA	126	11.05
Olive Oil	0.5 g BA-TiO <sub>2</sub> - 2 g CA	126	5.69

### 3.3 Assessment of Photocatalytic Degradation

To observe the effect of weak acid type SA, BA, and CA were used for surface modification of  $\text{TiO}_2$ . Figure 5 illustrates all weak acid types enable dye removal percentage as 78 % and 65 % for SA and BA, respectively. It can be said that, due to having more coated  $\text{TiO}_2$  SA provided higher percentage compared to others.

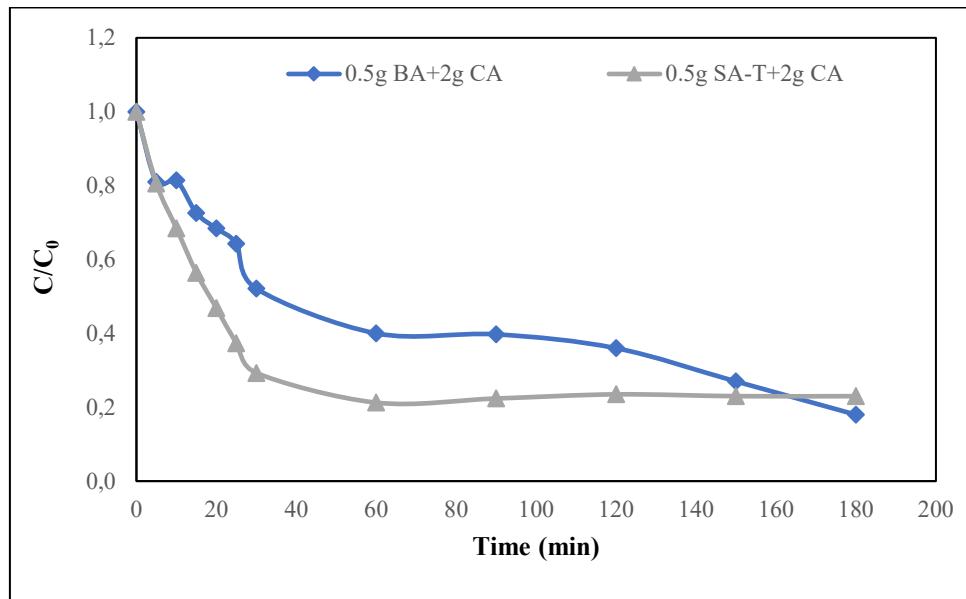


Figure 5. Effect of modifying agents (Dispersed phase: olive oil)

The effect of particle cores on photocatalytic degradation of IC is illustrated in Figure 6. According to the results, the maximum degradation of dye was reached with the safflower oil /BA- $\text{TiO}_2$  composite particle due to the high amount of  $\text{TiO}_2$  coated. The less degradation was obtained for oleic acid. It is expected that, amount of higher coated  $\text{TiO}_2$  results greater degradation results as observed for safflower oil.

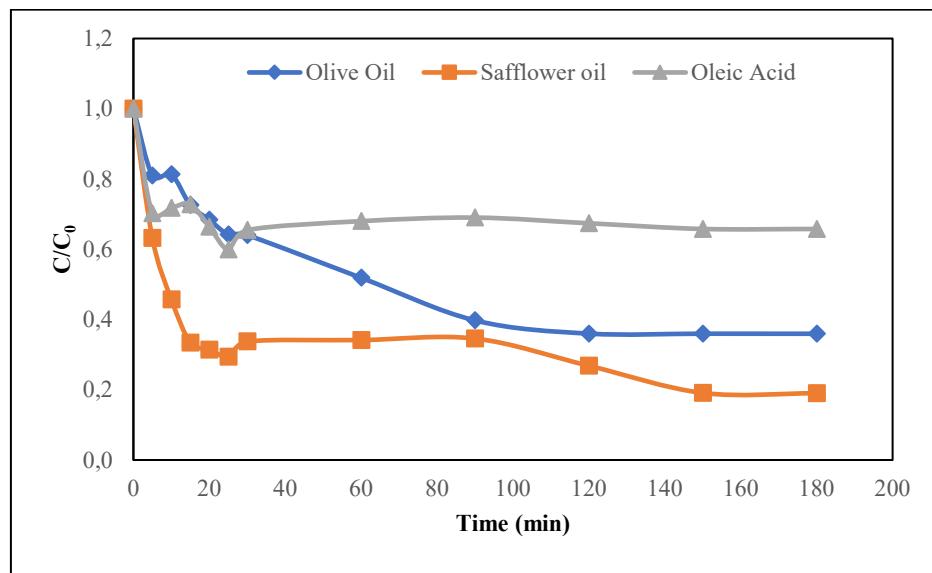


Figure 7. Effect of oil type (Conditions: 0.5 BA- $\text{TiO}_2$  + 2g CA)

## 4. CONCLUSIONS AND DISCUSSION

Surface modification of  $\text{TiO}_2$  leads increment of the photocatalytic efficiency of composite nanoparticles. The amount of  $\text{TiO}_2$  getting higher leads the degradation of IC dye improvement. It is proved that surface modification leads greater amount of coated  $\text{TiO}_2$ . Best dye removal was obtained

for 0.5 g SA-TiO<sub>2</sub>+ 2g CA as 78 %. Regarding results and acids characteristics, higher OH numbers leads higher coated TiO<sub>2</sub> amount and this enables greater dye removal percentage.

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### O 3. SUCCESSION OF SOIL MICROBIAL COMMUNITIES IN TERRESTRIAL ECOSYSTEMS

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**ABSTRACT:** Microbial community dynamics in soil play a key role in the sustainable development of ecosystems. Conceptual models of exogenous and endogenous successions in soil microbiome of natural and transformed ecosystems were proposed. Heterotrophic successions were divided into exogenous and endogenous categories where exogenous succession is fueled by continuous external inputs of organic carbon, while the majority of organic carbon supplies in endogenous succession are derived from a single initial input contained within the substrate itself. These two categories are also differentiated by the degree to which the developing communities modify and influence the quantity and quality of available carbon supplies. During endogenous succession, microbial community structure and the nature of the organic carbon substrates available in the environment are inextricably linked and will change together as succession progresses. The general regularities of changes in the functional and taxonomic structure of soil microbial communities at different stages of the succession process have been established. It is noted that soil biomass and phylogenetic diversity are markers of succession processes in the soil microbiome. On the basis of long-term monitoring according to the concept, five main categories of succession are purposed.

**Keywords:** Succession, Marker, Microorganism, Soil, Ecosystem.

#### 1. INTRODUCTION

Soil microorganisms are responsible for most biological transformations and drive the development of stable and labile pools of carbon, nitrogen and other nutrients, which facilitate the subsequent establishment of plant communities (Banning N.C., et all 2011; Symochko L., 2018). Over half a century ago, Odum identified mechanistic linkages between the successional dynamics of natural communities and the functioning of natural ecosystems (Odum E. P., 1969). Ecologists have documented the process of plant succession for centuries, yet the successional patterns exhibited by microbial communities have received relatively little attention. Specifically, as communities progress through succession, diversity is expected to increase and nutrients will become ‘locked-up’ in the biota, with consequences for the build-up of soil organic matter and closure of the mineral cycles. More recently, the interplay between aboveground and belowground biodiversity has emerged as a prominent determinant of the successional dynamics in biological communities. However, little is known about how changes in the soil biota contribute to the associated changes in ecosystem functioning. In the complex and dynamic plant root interaction with the microbiome, both biotic and abiotic factors play critical roles for microbiome composition, richness, and diversity. Biotic factors, such as host genotypes, developmental stages and abiotic factors, such as temperature, soil pH, seasonal variation, and the presence of rhizospheric deposits, act as chemical signals for microbes and influence the microbiome community structure and function (Walker L.R. 2007; Rout ME., Southworth D., 2013; Minz D., Ofek M., Hadar Y., 2013). However, the extent to which both abiotic and biotic factors contribute to microbial communities is not fully understood (Turner TR., James EK., Poole PS., 2013; Zolla G., et al 2013). Forests represent one of the largest and most important ecosystems on Earth, covering more than 40 million km<sup>2</sup> and representing 30% of the total global land area (Keenan RJ, Reams GA, Achard F, et el, 2015). Primeval forests are ideal ecosystems to study the interaction of bacteria, fungi and archaea with their abiotic environment (Grayston S.J., Rennenberg H., 2006). Virgin forests are essential for the conservation of biological and genetic diversity. They reserve the relict and endemic species of flora and fauna. The study of primeval forest is a unique opportunity to explore the natural structure, diversity and genetic structure of unmodified forest and ecosystem dynamical processes and relationships that occur in them

under the influence of ecological factors. Despite of the intensive exploitation of forests in the last ten centuries, its area decreased by 3.5 times, and virgin forest ecosystems which have special value remained only in the Carpathian Mountains. Moreover, since most European forest stands have been managed for centuries, very little is known about the diversity, ecology, and distribution of soil microorganisms in natural, undisturbed forest ecosystems in Europe (Bengtsson, J., Nilsson S., 2000; Symochko L., 2015). Soil microorganisms have been largely ignored by conservation efforts. However, their role in biogeochemical processes, their diversity and abundance, and their potential as repositories of valuable genetic information and metabolic products make them as important as animals and plants to the biosphere and human welfare. Study of authentic soil microbiota creates the necessary prerequisites for the conservation of microbial diversity and forming the base of the eco-microbiological monitoring (Patyka V., Symochko L., 2013).

Main idea of this work is to study soil microbiome and its diversity, activity, functional and structural successions in natural ecosystems. As a model ecosystem was investigated virgin forests of Shyrokoluzhansky massif of the Carpathian Biosphere Reserve. The primeval forests as etalon ecosystems better combine above resistance and stability with high productivity biomass (Symochko L. Hamuda H.B., 2015). In the Transcarpathian region of Ukraine the Carpathian Biosphere Reserve offers a unique opportunity for studying the biodiversity and natural processes of primeval forest ecosystems, i.e. forests that have never been significantly modified by human activity.

## **2. MATERIALS AND METHODS**

Materials of research were soil samples, which had been collected from natural ecosystems: virgin forests of Shyrokoluzhansky massif of the Carpathian Biosphere Reserve at the deep 0-25cm. CBR (Carpathian Biosphere Reserve) offers a unique opportunity for studying the biodiversity and natural processes of virgin or primeval forest ecosystems. The region covers an area of about 53,650 ha and became part of the World Network of Biospheres Reserves of UNESCO in 1992. The total area of the Shyrokoluzhansky massif is about 15,033 ha. The massif consists of two contiguous areas (foresteres): Uholka and Shyrokyi Lug. It lies within the Krasnyansky physical-geographic area of the Middle mountain-Polonyn region and Uholka physical-geographic area of the Low mountain-Rocky region. It is located between the rivers Tereblya and Teresva. The massif is separated by the mountain range Krasna from the Mokryanka river valley and lies within the Duklyanska, Prokuletska, Rakhiv and Maramorosh tectonic zones. The soils are very stony, mostly midloamy with good water and air penetration ability. Climate conditions change from mild-warm to cold. The massif belongs to three different climatic zones with annual average temperatures ranging from 0 to +7 °C and annual average precipitation varying between 1,000 mm and 1,500 mm. The temperature in July elevates from +17 °C to +12 °C, and in January from -3 °C to -10 °C. The sum of active temperatures changes with the altitude from 2,300 °C to 800 °C. Researches were conducted from 2008 to 2018 years. Sampling was carried out in depth of 0-25 cm at different altitudes from 500 m to 1,100 meters. Studies of soils were carried out at the Scientific Research and Educational Center of Molecular Microbiology and the Immunology of Mucous Membranes (Uzhhorod National University), Research Laboratory Monitoring of Water and Terrestrial Ecosystems of department entomology and biodiversity conservation (Uzhhorod National University) and in Laboratory of Microbial Ecology (Institute of Agroecology and Environmental Management, Kyiv Agrarian Academy of Sciences of Ukraine). The research was carried out within the framework of the complex theme „Eco-microbiological monitoring of various types ecosystems of the Carpathian region” №0116U003331 (state registration number), following the standard protocol (Tepper, 2004; Shyrobokov, 2011; Goldman, Green, 2015) All soil samples were analyzed within 24 hours. Microbiological study of soil was performed in sterile conditions. The method of serial dilution was used to obtain the suspension where microorganisms titre were 10<sup>-3</sup> CFU/ml. - 10<sup>-5</sup> CFU/ml. 100 µl (CFU-Colony Forming Units) of the soil suspension was evenly distributed on the surface of the medium with a sterile spatula. For the study we used the following media: Endos agar, Meat peptone agar, Strepto agar and Entero agar, Agar-Agar, Eshbi agar, Soil agar, Chapek agar, Starch agar, Fedorova Agar, Vinogradsky Agar, Ashbys agar in 4 repetitions. Petri dishes with study material were incubated in the thermostat at 37°C for 48 hours in aerobic and anaerobic (Wilson-Blair Agar, Vinogradsky Agar) conditions. Petri dishes with Czapek agar were incubated in the thermostat at 28°C for 96 hours. All isolated microorganisms were identified by applying of appropriate biochemical test-systems

LACHEMA according to the instructions. Biodiversity of soil microbiome was calculated according to the Shannon index (Magurran, 1988).

Shannon's diversity index ( $H$ ):  $H = -\sum P_i \ln (P_i)$

$P_i$  – is the proportion of individuals belonging to species  $i$ .

The results of the experimental studies were statistically analyzed using the Microsoft Excel program package. Results were expressed as means ( $\pm$ ) standard deviation (SD) and (SSD05) smallest significant differences of experiments conducted in quadruplicating. The level of significance selected for the study was  $P < 0.05$  (Bailey, 1995).

### 3. RESULTS

Soil microbiome as a part of forest ecosystems plays an important role in sustainable development of forestry. Forest ecosystems provide a broad range of habitats for bacteria, including soil and plant tissues and surfaces, streams, and rocks, among others, but bacteria seem to be especially abundant on the forest floor, in soil and litter (Hardoim et al., 2015). Usually five phyla, *Acidobacteria*, *Actinobacteria*, *Proteobacteria*, *Bacteroidetes*, and *Firmicutes*, appear to be abundant in most soils. In addition to pH, which seems to be the most important driver of the bacterial community composition in soils, organic matter content, nutrient availability, climate conditions, and biotic interactions (especially the effect of vegetation) affect the composition of bacterial communities (Lauber et al, 2009). The spatial variation of these parameters is responsible for the presence of hot spots of microbial activity with increased abundance and activity in the soil, such as in and on plant debris, including litter and deadwood, or on and around plant roots (Kuzyakov & Blagodatskaya, 2015). Each of these niches has specific properties and, consequently, a specific bacterial community. Biocenotic relations of trophic and topical types are decisive in edaphotope shaping of different type of ecosystems. Due to this fact, the purpose of the research was to determine structure and functions of soil microbiome. Studies of the soil were taken from primeval ecosystems revealed general regularities of distribution of main ecological-functional groups of microorganisms, their population dynamics in different habitats. The most favourable conditions for the development and functioning of microorganisms were in an edaphotops which were located at an altitude of 500-700 meters above sea level. It is highly connected to local temperature and water regime, as well as reserves of nutrients (organic origin) in the soil (Table 2).

The number of ammonifiers at an altitude of 500 m was 6.56 million CFU/gr.ab.d.s., and at altitude of 1100 m – 1.15 million CFU/gr.d.s., which indicate a significant enrichment of soil by organic matter. The content of oligotrophic microbiota significantly increased, practically in twice at altitude 1000-1100 meters above sea level, the same as sporeforming bacteria (2.65-5.76. million CFU/gr.d.s.). Process of nitrogen fixation was more active in edaphotops at altitude 500-600m.a.s.l. Percentage of content in the soil aerobic nitrogen fixing bacteria was 79.30%-72.00 %.

It should be noted that at altitudes of 700-800 meters above sea level, significant changes occur in the structure of microbial community. The content of anaerobic microbiota, pedotrophs and oligotrophs in the soil increases.

The number of micromycetes and actinomyces is increasing. Instead, the number of ammonifiers, aerobic nitrogen fixing bacteria is decreasing. The changes in the structure of soil microbiome indicate the realization of structural and functional successions and the presence of hot spots at these altitudes. For linking of the presence of bacteria or their activity to soil properties, it is important that soil is a complex of microniches with heterogeneous physicochemical properties on various scales. Because bacteria inhabit small niches, the properties of their immediate environment rather than the mean soil properties affect the local bacterial community. This spatial heterogeneity has been shown to result in the heterogeneity of bacterial communities on small scales. Furthermore, local dispersal limitations can also remarkably influence the bacterial community composition (O'Brien et al., 2016). Considering the high level of spatial variation of forest C stocks on the same scale, the occurrence of individual taxa in forest soil may actually be highly variable on a small scale and may differ among activity hot spots (Martiny et al, 2011; Kuzyakov & Blagodatskaya, 2015).

**Table 2.** Soil microbiome of primeval forest ecosystems (2008) (CFU/gr.d.s.)

Nº	Biotopes, altitude above sl, m	Ammonifiers*10 <sup>6</sup>	Spore forming bacteria *10 <sup>6</sup>	Micromycetes*10 <sup>3</sup>	Actinomyces*10 <sup>3</sup>	Bacteria which are using mineral forms of nitrogen *10 <sup>4</sup>	Anaerobic bacteria*10 <sup>3</sup>	Aerobic nitrogen fixing bacteria, %	Anaerobic bacteria *10 <sup>3</sup>	Oligotrophic bacteria *10 <sup>6</sup>	Oligonitrophic bacteria*10 <sup>4</sup>	Pedotrophic bacteria*10 <sup>6</sup>
1	500	6.56	2.65	26.22	12.80	4.89	30.20	79.30	5.89	2.59	4.50	1.74
2	600	4.20	2.88	30.30	12.94	4.09	33.42	72.00	7.45	2.78	4.00	2.01
3	700	3.12	3.25	33.60	16.97	3.95	40.67	69.20	7.90	2.87	3.81	2.35
4	800	2.77	4.89	35.72	30.90	3.45	96.34	51.50	14.50	3.53	3.43	2.78
5	900	1.56	5.35	45.70	40.24	2.54	97.18	42.00	15.56	3.91	1.43	3.23
6	1000	1.44	5.60	50.78	42.30	2.31	113.60	40.60	22.76	4.10	1.31	3.60
7	1100	1.15	5.76	53.21	44.00	2.12	120.56	40.00	23.10	4.45	1.12	4.68

Note: the data are statistically significant,  $P < 0.05$ ,  $x \pm SD$ ,  $n = 4$ .

The same dynamic of different functional and trophic groups of soil microorganisms were saved for 10 years. In 2018 were fixed hot spots at the same altitudes (Table 3).

**Table 3.** Soil microbiome of primeval forest ecosystems (2018) (CFU/gr.d.s.)

Nº	Biotopes, altitude above sl, m	Ammonifiers*10 <sup>6</sup>	Spore forming bacteria *10 <sup>6</sup>	Micromycetes*10 <sup>3</sup>	Actinomyces*10 <sup>3</sup>	Bacteria which are using mineral forms of nitrogen *10 <sup>4</sup>	Anaerobic bacteria*10 <sup>3</sup>	Aerobic nitrogen fixing bacteria, %	Anaerobic bacteria *10 <sup>3</sup>	Oligotrophic bacteria *10 <sup>6</sup>	Oligonitrophic bacteria*10 <sup>4</sup>	Pedotrophic bacteria*10 <sup>6</sup>
1	500	7.32	4.67	40.77	25.89	5.66	50.02	60.30	7.90	4.45	4.34	3.23
2	600	4.90	5.00	45.30	28.14	4.12	55.57	55.53	8.40	4.90	3.80	3.87
3	700	3.67	5.31	46.80	32.91	4.00	70.56	53.00	8.96	5.02	3.72	4.56
4	800	2.90	7.70	70.23	60.80	3.04	100.40	42.40	20.34	6.72	2.07	6.03
5	900	1.65	7.45	78.45	80.42	2.90	110.12	40.60	25.66	6.97	1.43	6.12
6	1000	1.30	8.01	87.76	90.67	2.67	156.22	33.50	30.12	7.89	1.22	6.89
7	1100	1.22	8.12	89.22	90.45	2.34	160.34	32.00	30.52	8.32	1.15	7.33

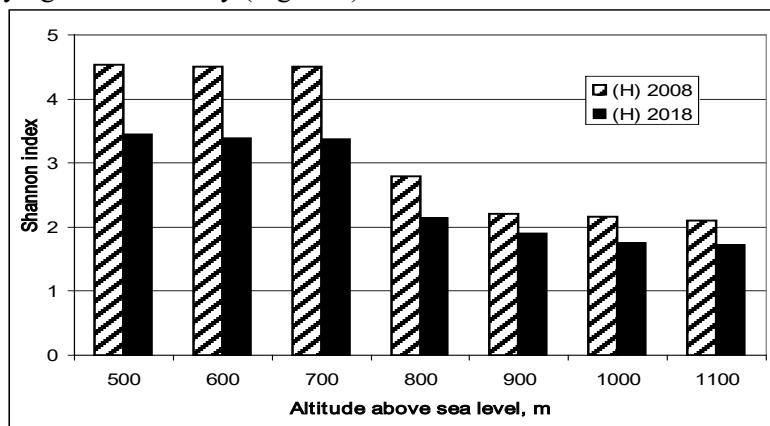
Note: the data are statistically significant,  $P < 0.05$ ,  $x \pm SD$ ,  $n = 4$ .

Long term investigations showed significant changes in the structure of soil microbiome, increased in twice the quantity of oligotrophic and pedotrophic bacteria, micromycetes and actinomyces. Number of ammonifiers wasn't changed significantly, the quantity of aerobic nitrogen-fixing bacteria decreased by 17%-22%. Changes in the structure of soil microbiome can be caused by two reasons: the influence of external factors and the availability of resources.

Resource availability is also likely to be a fundamental driver of microbial succession, but the limiting resources and environmental factors regulating succession will be more complex given the far greater

physiological diversity contained within microbial communities and the breadth of environments in which succession can occur. In autotrophic succession, nutrients and light (or the availability of inorganic electron donors) are likely to be the primary resources limiting biomass accumulation. However, in the earliest stages of autotrophic succession, heterotrophs may also be in relatively high abundance, utilizing trace levels of available carbon (Okabe et al., 2007; Roeselers et al., 2007).

During endogenous heterotrophic succession, labile substrates will be consumed first, supporting copiotrophic microbial taxa that are later replaced by more oligotrophic taxa that metabolize the remaining, more recalcitrant, organic C pools in the later stages of succession (Rui et al., 2009). Endogenous heterotrophic succession cause increasing biomass of oligotrophic bacteria and decreasing phylogenetic diversity (Figure 1).



Diversity is indicating, how changed microbial communities during succession. After 10 years, fluctuation of microbial diversity at different altitudes was the same. But it should be noted that in 2008 the Shannon index fluctuated within (4.54-2.10), after 10 years the values of this index decreased by an average of 15% and ranged from 3.45 (at altitude 500 m.a.s.l) to 1.72 (at altitude 1100 m.a.s.l).

#### 4. CONCLUSION

Soil microbial community diversity changed along successional time, but it showed significant difference at altitude 700-800 meters above sea level, which indicate hot spots in edophotopes at this altitude. This fact also was confirmed by the quantity of soil microorganism and they functional activity. Endogenous heterotrophic succession caused increasing biomass of oligotrophic and pedotrophic bacteria and decreasing microbial diversity. Diversity indicates, how changed microbial communities during succession. After 10 years, fluctuations of microbial diversity at different altitudes were the same. Multiparametric indices are recommended for environmental impact assessment of soils and monitoring study. Long term monitoring allowed determining hot spots in structural successions of soil microbiome. Monitoring study database has both theoretical and practical value and can be used for creation of necessary measures to preserve authentic microbial communities and to implement environmental principles of sustainable forestry.

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## O 4. TECTONIC MODEL OF THE KRESHPAN - VERBAS REGION AND OIL RESERVOIR RELATED WITH IT

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**ABSTRACT:** The study region is located in the Kurveleshi belt part of the Ionian tectonic zone (Outer Albanides). Kurveleshi belt (subzone) is characterized by anticlinal structures with different dimensions and tectonic model with northwest to southeast direction. The Kreshpan – Verbas anticlinal structure is the northernmost structure of the Kurveleshi belt (subzone). Based on the seismic works and drilled wells in this region, will be given some consideration of the tectonic model of this structure. The anticline structures of Kreshpan - Verbas is characterized by two tectonic floor. The lower floor is formed by carbonate and flysch deposits that build the core and limbs of the Kreshpan - Verbas anticlinal structure, which is folded before Burdigalian age. The upper floor is formed by Miocene molasses deposits that are placed transgressively on the top of lower structural floor. The hinge of the Kreshpan-Verbas anticlinal structure is eroded up to the level of Jurassic deposits. The eroded limestone of this structure have served as source rocks and has formed oil reservoir in the sandy deposits of Messinian.

**Keywords:** Anticlinal, Kreshpan – Verbas, Tectonic model.

### 1. INTRODUCTION

The Ionian tectonic zone begins outside the Albanian territory, from the Peloponnese and continues towards the northwest in Albanian territory until the transverse tectonic faults Vlora-Elbasan. (Xhomo et al, 2002). To the east the Ionian tectonic zone is bordered with Kruja tectonic zone and in the southwest its contacts tectonically with the Sazan tectonic zone. Ionian tectonic zone overlap to the west and completely hide some structural units. From the south towards the north within the Albanian territory, the Ionian tectonic zone gradually reduces its width (Roure, et al., 2004) as a result of the interruption of structural units and the subzones and their overlapping toward the west (Fig.1). The north and northeast boundary of the Ionian zone coincides with the orogeny border overlapping to the Southern Adriatic zone. The Ionian zone is divided in three main structural subzones as follows from West to East:

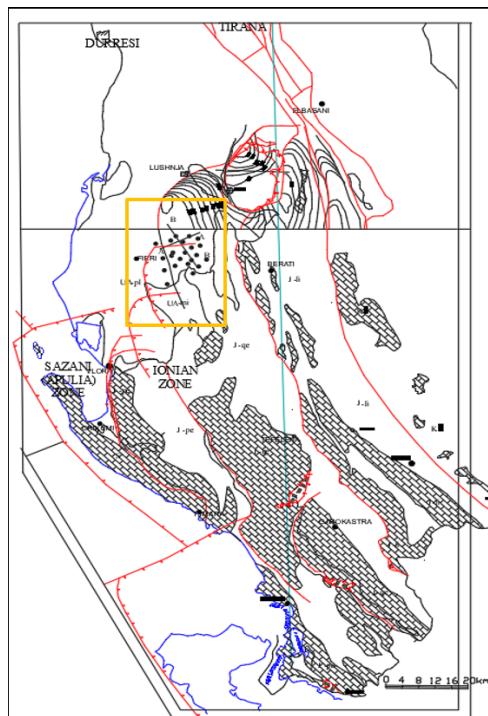
- The western subzone of Çika
- The central subzone of Kurveleshi
- The eastern subzone of Berati (Xhomo A. et al, 2002).

In the Ionian tectonic zone are the main oil and fields in Albania, especially in the Kurveleshi subzone where are dicoverd several oil field. In this subzone also are made a large number of geological studies, seismic works and considerable number of drilled wells. All these studies are taken into consideration to give the tectonic model of the Kreshpan – Verbas anticlinal structures that is the most northern structures of the Kurveleshi subzone (belt) (Velaj T., 2015). Also with this structure are related the Patos- Marinza oil field in Messinian deposits (Fig.1). The Patos- Marinza oil field is located in the north - eastern part of Fier city in southern Albania.

### 2. GEOLOGICAL SETTINGS

In Ionian tectonic zone and in Kurveleshi subzone are distinguished three main sedimentary formation. The Permo- Triassic evaporites, Upper Triassic to Eocene carbonate and terrigenous formation from Eocene to Quaternar. The evaporitic formation in Kurveleshi subzone are associated with deep tectonic faults of the anticline structures. The largest outcorp of this formation is in the Dumrea diapire with an area of about 210 km<sup>2</sup> in the north part of the study region. These formation generally are represented by gypsum, anhydrite, dolomite, potassium salt limestone and multicolored clay (Velaj et al., 1999). The geological data obtained from deep wells (Dumre, Paper, Grekan, Bogaz, Butrint, Delvine, Picar) (Xhomo et al, 2002) and seismic data show that these deposits in all cases have tectonic contact with surrounding rocks. The carbonate formation in Ionian zone is divided in two large megasequences (Roure et al., 2004) (Fig.2).

- The megasequence before rift of Permo-Triassic age to the Lower and Middle Liassic, which are considered as deposits of neritic facies.
- The megasequences of the post-rift deposits of Toarian to Paleocene in age. These post-rift deposits are interpreted as pelagic facies.



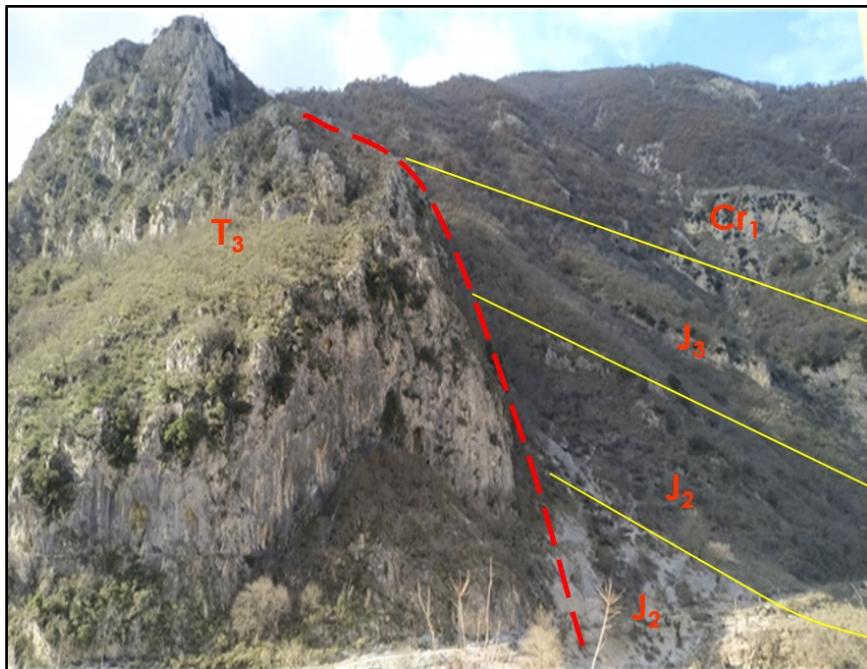
**Figure 1.** Geological-tectonic map of southern Albania (Study location) Xhomo et al, 2002)

The deposits of the both these megasequences belong to the passive edge of the Adria tectonic microplate. The neritic facies are lithologically represented by dolomite and limestone (Rahimi Q, et al., 1987). The pelagic facies within Ionian tectonic zone and Kurveleshi subzone are lithologically represented by “schists with Posidonia”, “Ammonitico rosso” which are transgressively placed on the horst tectonic blocks. This kind of sedimentation of the pelagic facies continued until the end of Paleocene - Eocene. The big changes in thickness and facies variations, which are documented for the Triassic- Liassic deposits of Ionian zone, can be well explained with the presence of the big bended platformic carbonate or dolomitic blocks of the pre-rifting megasequence.

The terrigenous formation in Kurveleshi subzone lithologically are represented by turbidite limestone and biomicritic and micritic limestone in the lower part of the stratigraphic columns (Korrovoshi et al., 1981). The transition from Eocene limestone deposits to flysch of Oligocene deposits is done through a transitional marl package. Flysch deposits are represented by claystone-sandstone layers mainly of medium rhythm with micritic, biomicritic and turbiditic limestone layers (Bakia H, et al., 1998). Neogene deposits are represented by those of the Miocene and Pliocene (Bandilli L, et al 1976). The Aquitanian, Burdigalian and Serravalian deposits lithologically are represented by marls, lithothamnic limestone and sandstone. The deposits from Tortonian, Messinian and the Pliocene are lithologically represented by sandstone, siltstone and claystone (Myftari S, et al 1995). Messinian deposits are most prevalent and lithologically from bottom to the upper part of the stratigraphic columns are represented by the formations Bubullima and Gurët e Zesë, Marinza, Driza, Gorani, Kucova and Polovina as follow (Gjoka M, et al., 1986). The Bubullima formation is placed transgressively on the oldest deposits and is represented by lithothamnic limestone which at the base have large grain sandstone and conglomerates. In the plan these deposits have several lithological changes, passing from carbonate gravelly sandstones with lithotamnia and limestone sandstones with lithotamnia in the east to siltstones in the west. In the area of Kallm

- Kolonjë this formation have 20 layers which in the west and in the northwest direction passing into claystone. This formation have thickness that varies from 20 to 200m (Fig.3) (Gjoka M, et al., 1988). The Guret e zezë formation are lithologically represented by massive claystone with siltstones. The

claystone are blue-gray with reddish-yellow spots and many macrofauna. The thickness of this formation increases from southeast to northwest direction and varies from intervals 0 – 700 up to 1100m (Fig.3).The Marinza formation in the western part lies normally above the Bubullima formation and with discordance with the eroded surface in the east and south part of the Patos – Marinza monoclinal structure. Lithologically it is represented by massive layers of sandstones that contain carbonate sandstone concretions. Sandstones are interbedded with claystone with carbonate concretions. The thickness of this formation varies in an interval from 30 - 120m from south to the north direction. (Gjoka M, et al., 1988)



**Figure 2.** The main tectonic event T<sub>3</sub>-J<sub>1</sub> (Lower & Middle Liassic)/Middle-Upper Jurassic – Eocene (Ionian tectonic zone) (Photo Bence Village Albania).

The Driza formation have widespread in Patos - Marinëz - Kolonjë monoclinal structure and deposits of this formation have also been documented in the Gorishove - Kreshpan monoclinal structure. It is placed transgressively on the oldest deposits and builds the bay of Patos - Marinza. This formation in the plan undergoes in significant lithological changes, in the region of Patos is claystone - sandstone layers, while in Marinza and Kolonjë it is sandstone –claystone layers. The thickness is about 60 - 120 m (Fig. 3) from south to the north of the region (Gjoka M, et al., 1988). In the outcrop of the Driza formation are easily distinguished the oil signs and fossilized wood in the sandstone formation (Fig. 4).

The Gorani formation is normally placed above the Driza formation and has the same spread. In the Zharrza eroded uplift (Fig. 7), Gorani formations is placed transgressively on carbonate deposits, especially the Go<sub>5</sub> and Go<sub>6</sub> layers. In Patos - Marinza is represented by the combination of not well cemented sandstones till gravel with claystone and carbonate siltstone. The thickness of this formation from south to north goes from 100 - 160m. The Kucova formation is widespread throughout the Patos - Marinza monoclinal structure and is placed transgressively on the Gorani formation. While on the Kuman - Jagodina structural scale it is placed transgressively on the flysch and carbonate oldest deposits. Lithologically it is represented by the combination of sandstone - claystone layer with conglomerate lenses. The thickness of the Kucova formation varies from 160 - 330m. The Polovina formation is widespread in Patos-Marinza monoclinal structure and is normally placed on the deposits of the Kucova formation while in the eastern part of the Marinza region it is eroded. Lithologically, it is represented by a combination of claystone with not well cemented sandstones, while in the western part Picar-Buzmadh, Kreshpan – 1 and Frakull further in the west, are documented gypsum interlayerd with claystone. The thickness of this formation from Patos to Këmishtaj is from 200 - 300m and in the west direction increases even more. (Gjoka M, et al., 1988)

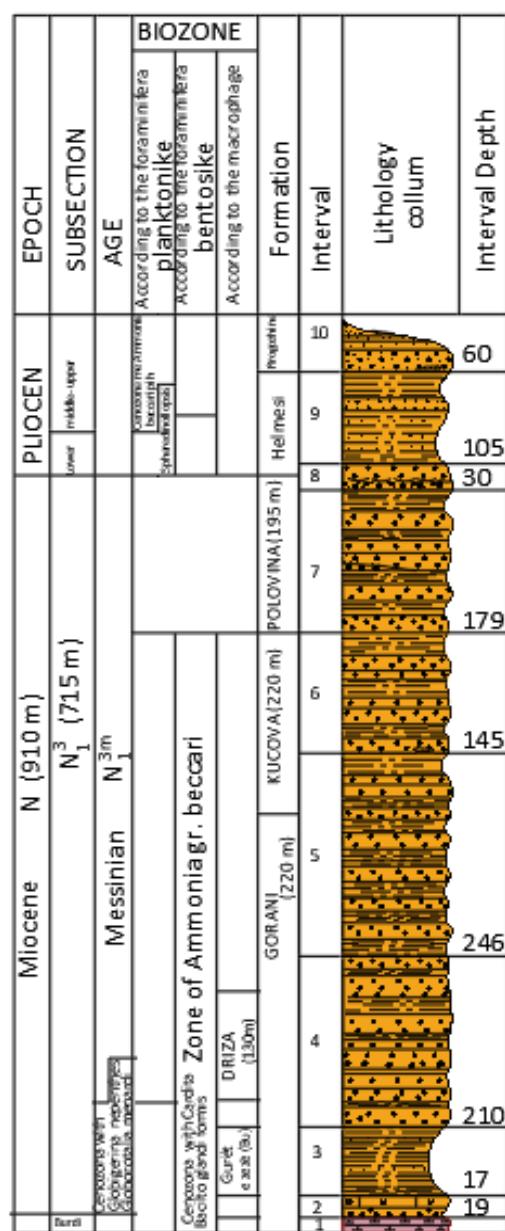


Figure 3. Gur  t e z  ze lithological column

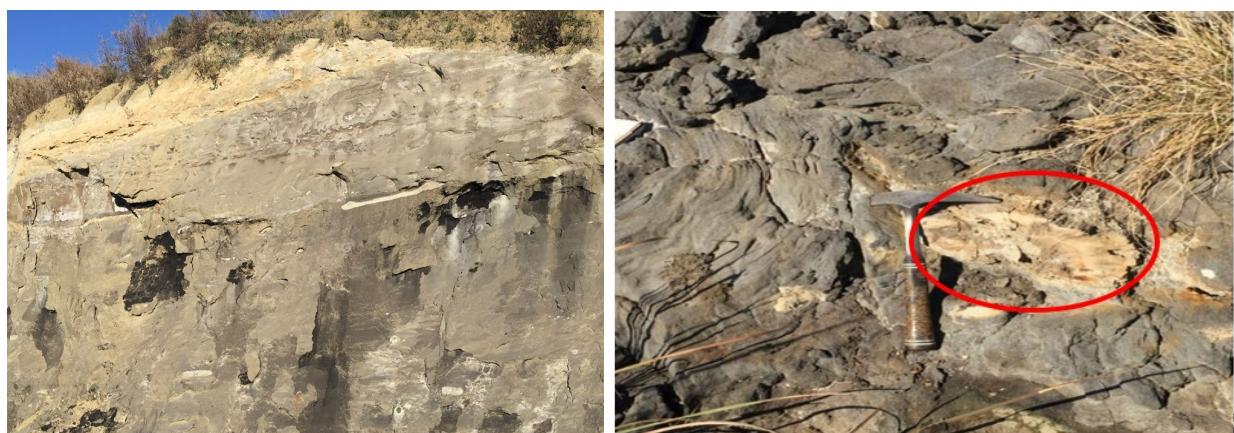


Figure 4. The outcrop of Driza Formation in the south part of the study region (the oil sings are easily distinguished in the sandstone formation and the fossilized wood)

### Tectonic Model

From the geological works, seismic profiles and of the drilled wells have been obtained necessary data to give the tectonic model of the Kreshpan - Verbas region. Messinian transgression is clearly visible on the surface in the Gurêt e zezë outcrop where Messinian deposits are placed transgressively over the Burdigalian deposits. (Fig. 5). There are also data on transgressive of the Burdigalian deposits east of the Ballsh anticline and partly on the western flank of the structure and in the southern part of Visoka structure, while in Cakran they have normal contact with the Akutanian deposits, so they are placed successfully(Bakia H, et al 1985) Mehillka L, et al 1988).

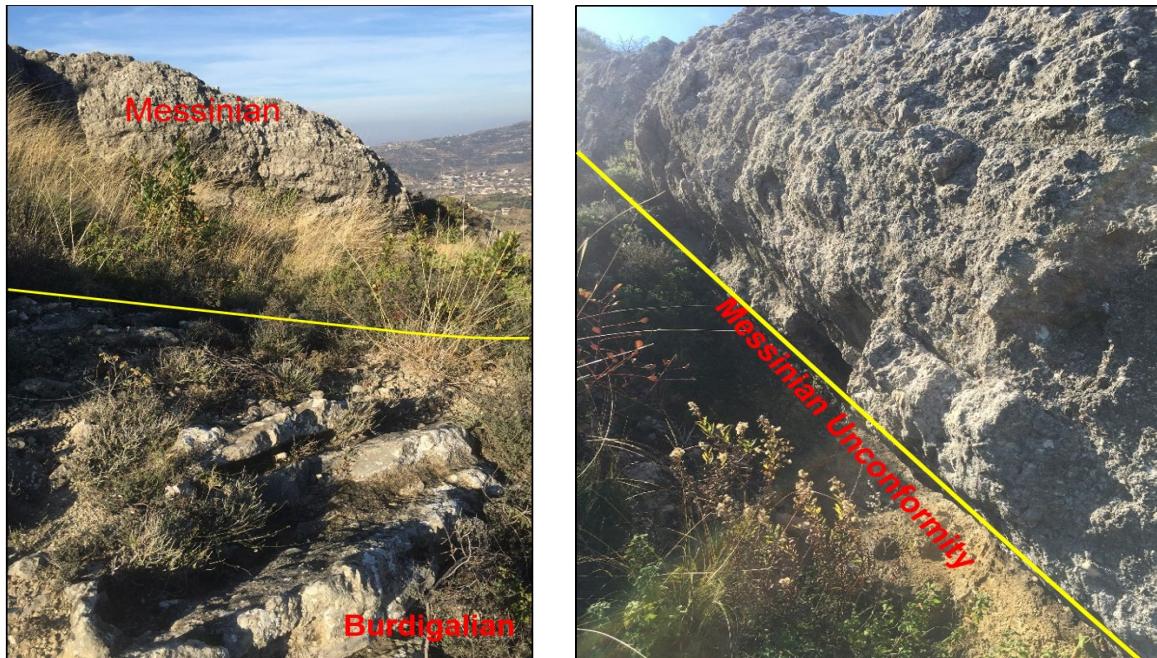
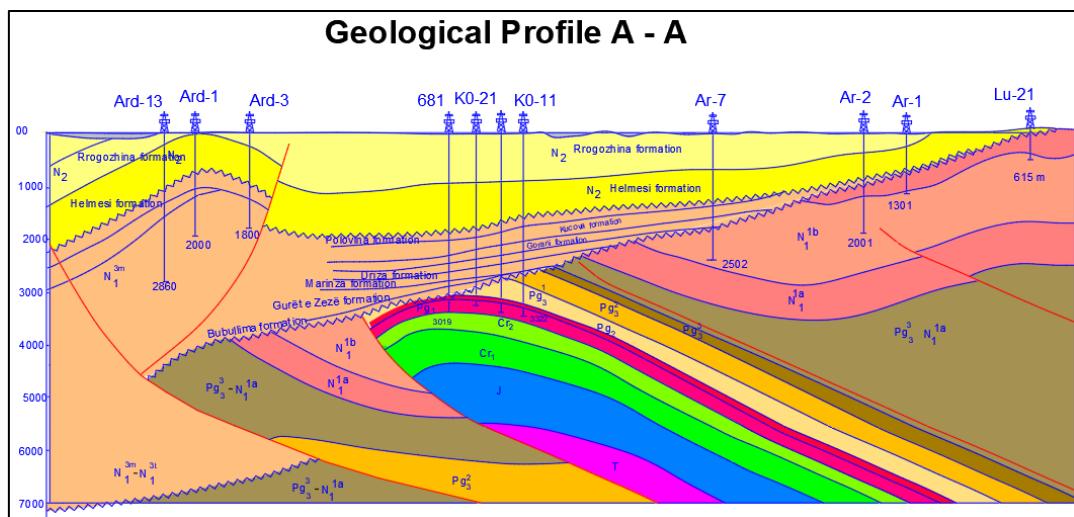


Figure 5. Messinian Unconformity (Gurêt e zezë outcrop) northern part of the study region.

### Lower Structural Floor

Lower structural floor deposits on the surface emerge only south of the study region at the Ballsh and Cakran anticlinal structure. In the other part of the region these deposits are covered by upper tectonic floor deposits (Fig.6). The data obtained from geological works and drilled wells in this area have provided considerable information for the construction of the lower structural floor. It should be noted that in this region is a very large number of seismic works and drilled wells. The most important structures in this region are the brahanticlinal structure of Patos - Verbas and to its west the anticlinal structure of Kreshpan. The brahanticlinal structure of Patos - Verbas has a northwestern direction (Sadiku Y, et al 1990). At the core this anticlinal structure is built from old Triassic and Jurassic deposits but the presence of evaporites is not excluded (Fig.6). The hinge of the structure is eroded up to the levels of Lower Jurassic deposits. At the same time, the Cretaceous deposits up to the Paleocene-Eocene are eroded and Messinian deposits are placed placed with angular and azimuthal unconformity (Fig.6). Its periclinals are extended and the northern part is more eroded, indicating that the Patos - Verbas anticlinal structure has been most elevated to the north, the southern periclinal is shallow forming favorable structural conditions for the formation of oil reservoir layers. In this area of the structure is formed the Visoka oil field which is a hydrodynamic oil reservoir.



**Figure 6.** Transversal geological profile modified from (Gjoka M, et al. 1988).

The eastern flank of the Patos-Verbas anticlinal structure is relatively less steep and constructed by Cretaceous, Paleocene - Eocene deposits and successively by the terrigenous flysch and molasses deposits and dips eastward with angles  $20^{\circ}$ - $30^{\circ}$  (Fig. 6). The western flank is steeper confirmed by drilled wells and geological works and tectonically faulted, so the wells V-3, 695, 655 have documented this tectonic fault. Where the first one from the Triassic carbonate deposits has passed to those of the Hatian-Akutanian and the other two wells from flysch deposits of the Middle Oligocene with those of the Burdigalian and Akutanian deposits. The western tectonic fault of the Patos - Verbas anticlinal structure puts carbonate deposits in contact on the east side, with the Burdigalian deposits in the west (Fig. 6). This fault in northward direction takes a northeast turn and interrupt the Patos - Verbas anticlinal structure for carbonate levels in the northern part of the study region (Sadiku Y, et al 1990). This tectonic fault is a structural fault and coincides with the trace of the transeval fault Vlora – Elbasan. Characteristic of this structure is the presence of interflysch tectonic faults with eastern dips angle of  $35^{\circ}$  -  $40^{\circ}$ , formed after the Messinian and Pliocene (Fig. 6). Towards the north this faults places on the deposits of the Burdigalian and Messinian the oldest deposits of the Oligocene age. This tectonic fault is not the same with the old limestone fault of the Patos - Verbas anticlinal structure. It is thought that the tectonic fault of the western flank of the Ballshi anticlinal structure is the same with the fault of the western flank of Patos – Verbas anticlinal structure (Sadiku Y, et al 1990). In the central and northern part of the Patos – Verbas anticlinal structure the fault also affects the Burdigalian deposits so is post-Burdigalian age. The anticlinal structure of Kreshpan is located directly in the northern continuation of the anticline of Cakran and in the west of the brahianticline of Patos - Verbas. Geological works and drilled wells, indicate the existence of anticlinal structure in the north - northwest of Cakran for the carbonate levels and is called Kreshpan anticlinal structure. The Kreshpan anticlinal structure is proven by some wells that have been drilled in the region and has produced very little oil. Geological works show that the Kreshpan anticlinal structure on the surface is constructed from Oligocene flysch deposits, which in the northern part are covered transgressively by Burdigalian deposits and newer deposits. Due to the effect of the flysch movement to the west direction as a result of the overlapping of the eastern structures the roof of the carbonate deposits has a displacement to the east direction. As a result of this phenomenon are caused the faults that occur in the western flank of the structure and are interformational faults. (Sadiku Y, et al 1990). The roofs of these structures are eroded for different stratigraphic levels.

### The Upper Structural Floor

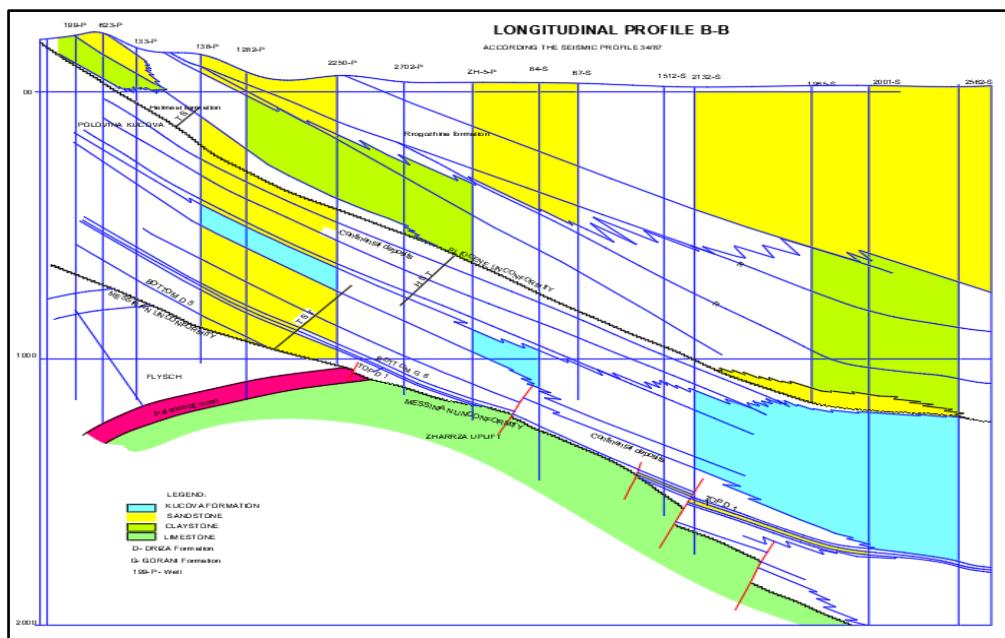
Previous seismic works and in the recent years also the drilled wells have further clarified the structural construction of the upper structural floor. This structural floor forms the monoclinal structure of Patos – Marinza and extends southeast to northwest direction and dips in the north- western direction. This monoclinal structure is built from several formation (Fig. 3). The geological profile show that the upper structural floor is less tectonically folded and is placed with angular and azimuthal unconformity on the carbonate and in the flysch deposits of the Patos – Verbas eroded anticlinal structure (Fig.6).

This deposits from west to east wedge stratigraphically on the uplift of Zharrza and the Kuman- Jogodine scale (Fig.7). Also partially the Gorani formation and newer deposits pass the erosive uplift of Zharrza and are placed transgressively on the deposits of Roskoveci synclinal structure. In the north of Marinza village pass the uplift of Zharrza also the Driza formation (Fig.7) (Gjoka M, et al. 1988). Aslo another transgression is between Pliocene deposits and Messinian deposits (Fig.6). Throughout the region the Messinian deposits is eroded in varies levels. In the eastern part of this monoclinal the erosion of the Messinian deposits from the Pliocene goes up to the levels of the Gorani and Driza formations while in the west the erosion goes up to the levels of the Kucova and Polovina formations(Gjoka M, et al. 1988). In the geological profiles it is obvious that the area with the highest erosion is Zharrza area (Fig.7). In the Patos-Marinza monoclinal structure is characteristic that the contours of the lithological-stratigraphic wedge of the oil reservoir layers are not in accordance with the isolines of the structural maps that have gradual and continuous dipping in the south-west direction (Gjoka M, et al. 1988). This comes as a result of the change of the structural plan of Messinian deposits, during the time of the Pliocene. At the levels of the Driza formation, is documented a ripple structure from west to east direction forming synclinal structure of Lalës. At the synclinal structure of Lalës, near the eroded surface are observed the wedges of Tortonian deposits in a west to east direction while in the north - south direction are observed more. Also reductions of thickness of this deposits are observed. The width of the Lalës synclinal reaches 2 - 3 km and with an extension north - west up to 7 km. To the north of the well Kr - 5 is seem that the synclinal structure of Lalës is unified with other structural units. The Neogene deposits in the west of the Lalës synclinal structure bends with relatively is less steep eastern flank and forming the Neogene "structural nose" of Krapsi (reference). This is conditioned by new neotectonic movements. Based on this and according to the surface geology, the Neogene "structural nose" of Kraps seems to have its origin directly in the northern periclinal of Cakran structure (Janopulli V, et al., 1980). As a result of this, it is not excluded that the Neogene deposits of Kraps have previously been united in a single fold with the Neogene deposits (Tortonian and newer one) of the western flank of the Cakrani structure. This "structural nose" extends northwest until the well Fieri - 2, and further to the north does not continue, but the anticlinal structure of the Ardenica is formed. The eastern flank Krapsi structure dips with angles of 10° - 15°, while the western flank with angles 75° - 80° and is tectonically faulted, on the surface has a small amplitude (emerges within the Pliocene deposits) but at the base of eroded surface in the east and west this amplitude increases. This fault plan have east direction with small angle but in the vicinity of the eroded surface and in the depth direction the angle should increase. Although in the east of the eroded surface apparently remains static to the folds of the upper structural floor. Analyzing the equal thicknesses of the Tortonian deposits on both sides of the fault, it is concluded that in the west the eroded surface must have been inclined, as well as the western flank of the Neogene uplift. The transgressive contact of the upper tectonic floor is clearly visible at the beginning of the structural nose of the Krapsi (Janopulli V, et al., 1980). This surface has been confirmed by the wells drilled in this area, where from deposits of Tortonian has passed to those of Hatian - Akutanian. In the Kreshpani region in the west of Cakran area the Neogene deposits of the upper structural floor have the form of a monoclinal near the tectonic fault and further to the west they fill the Selisht - Cakran synclinal structure. To the northwest direction the Neogene deposits of upper tectonic floor take full synclinal form with continuous decreasing trend. The eroded surface dips to the north, so do the upper structural floor deposits, especially those of Messinian. The continuation of the eroded surface to the west of the Krapsi tectonic fault is drawn on the basis of direct well data and with the help of seismic and geological profiles (Janopulli et al., 1980).

### **Oil Reservoir Related With the Anticlinal Structure**

All studies conducted for oil and gas exploration in the study area have shown that in the Patos - Marinza oil field the oil is secondary and genetically related to the eroded limestone (Barbullushi R., 2013) of the anticlinal structure of Patos - Verbas. The oil field in Patos - Marinza is the largest oil field onshore discovered in Albania. The geological works in the Patos-Marinza oil field indicate that the oil field have reservoir in different oil conditions phase. Three are the main oil reservoir formation in Patos – Marinza Gorani, Driza and Marinza (Çobo L., 2002).The deposits of the Bubullima formation in the sedimentation bays of Kolonjë and Kallmi, are represented by the combination of gascondensate reservoir with the oil (layers from B<sub>1</sub> to B<sub>14</sub>). This oil reservoir have limited spread near the eroded surface and are placed vertically one after the other and displaced in the horizontal plane, thus forming

a transgressive series. Oil and gas reservoir thicknesses that are associated with deposits of Marinza formations, include mainly oil with gas cap reservoirs. Oil reservoir are found all over the Patos-Marinza-Kallm area, including formations from Driza to Kucova of the transgressive-regressive series. Bituminous thicknesses include the bituminous sand of pure natural bitumen and bituminous gravel. The bituminous thickness of the sandstones is widespread in the Patos oil field. The bituminous thicknesses are related to the Driza formation layer D<sub>4</sub> - D<sub>5</sub> and the Marinza formations layers M<sub>0</sub>, M<sub>1</sub>, M<sub>2</sub>.



**Figure 7.** Longitudinal geological profile in the Patos Marinza Oil field

Geological works in the Patos - Marinza oil field indicate that the hydrocarbon generation in carbonate rocks have continued throughout all the geological time after the source rocks have entered in the main stage of oil generation. In the all oil fields of Neogene and carbonate deposits, the phenomenon of the association of biodegraded oils with normal oils is observed. This is observed also in Patos – Marinza oil field. The oil in Patos - Marinza oil field belong to the early generation phase (Driza formation). The oil that belong to the late generation phase are found in the Marinza and Bubullima formations. The the oil formation of Patos - Marinza are found in Messinian molasses deposits that are placed transgressively on the eroded limestones of the Patos - Verbas anticlinal structure (Gjoka M, et al. 1988). This indicates that the main routes of hydrocarbon migration for the accumulation of the oil in molasses deposits are the transgressive contacts with eroded limestones which serve as hydrocarbon migration path (fig 7). Oil reservoir thicknesses that contact with limestone favor the migration of hydrocarbons vertically, also favor the formation of deposits even at those thicknesses that do not have transgressive contacts with the eroded limestone. In these cases, migration is also favored by the presence of tectonic faults. Migration through the tectonic faults is observed in several layers of the Gorani formation in the eastern part of the Marinza village and in the Kucova formation (Fig. 7). The direction and distance of the migration of hydrocarbons in the Patos - Marinza oil field depends on the contact of the source rocks and accumulation formation that during the geological development is not always the same throughout the oil field. In Patos - Marinza - Kolonjë area the eroded surface has a very large surface on which are placed the deposits of the formations Bubullima, Marinza, Driza and Gorani (Gjoka M, et al. 1988). While in Cakran - Kreshpan area the features of the source rock and the accumulation zone also depend on the conditions of oil migration. The oil reservoir layers of the Bubullima, Marinza, Driza and Gorani formations in the southern part (Patos) and in the south-western part (Kreshpan) where they outcrops in the surface have many oil marks. This indicates that oil has migrated in the horizontal direction from the eroded uplift of Zharrza located further to the north (Fig.7). So we can say that horizontal migration has been made in relatively large distances. For the Driza formation in the Marinza village, horizontal migration of the oil has been made also in the northern

part of the eroded uplift of Zharrze until Kallm village where these deposits dips (Fig.7). The vertical migration has in Patos – Marinza been less intense, thus conditioning the small number of oil reservoir in the Gorani formation. The Patos and Cakran-Kreshpan monoclinals structure from the paleotectonic point of view have been a unique unit with the same deposits and for this the oil reservoir of the Kreshpan region are related to the Bubullima formation (Janopulli V, et al., 1980). For this reason it is accepted that the source rock are related to the anticlinal structure of Patos – Verbas (Gjoka M, et al. 1988). The oil reservoir thickness of the upper Messinian deposits are found displaced further in the west in relation to its initial position. The upper part has been displaced by at least 10 km to the west in relation to its initial position, taking into consideration the Neogene depsts outcrop at Gegaj and Bishqethëm villages. The eastern and north - eastern parts of the Neogene deposits are thought to be almost in the initial sedimentation position. This variant is also supported by the fact that the oil reservoir and the oil mark in the geological log are mainly concentrated in the upper part of the geological log until 1000 - 1200 m deep.

### 3. CONCLUSION

1. The study region has two structural floor model, where the lower floor deposits are constructed of carbonate formations and partly terrigenous formation, covered with angular and azimuthal unconformity by the molasses deposits of the upper structural floor mainly those of the Messinian age.
2. The lower structural floor has anticlinal structures which on the western side are tectonically faulted and overlapped towards the west, sometimes masking the northern structures.
3. The transverse tectonic faults Vlore - Elbasan has interrupted in the north the anticlinal structure of Patos - Verbas. This fault is a combination of longitudinal faults with transverse faults.
4. The deposits of upper structural floor are transgressively placed on older deposits of the lower structural floor and they form the monoclinal structures of Patos - Verbas and Cakran - Kreshpan.
5. The Messinian transgression based on geological data and drilled wells is not interrupted by structural faults. So this shows that the orogenesis of the Pliocene floor is displaced further to the west and the movement of the structures is done according to a plan with a smaller and deeper angle, compared to the structural faults.
6. The oil Patos - Marinza field is secondary, genetically is related to the eroded limestone of the anticlinal structure of Patos – Verbas and found in Messinian deposits. These deposits are transgressively placed on the eroded limestones of the Patos-Verbas anticline structure. The eroded surface has served as the main path of hydrocarbon migration from limestone reservoir to the Messinian deposits.
7. Most important oil reservoir in the Patos - Marinza oil field from the depth are:  
Bubullima formation  
Marinza formation  
Driza formaconi

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## O 5. REMOVAL OF DIMETHYL PHTHALATE BY MACRONET ADSORBENT

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**ABSTRACT:** The macroporous polymeric adsorbent, Purolite MN100, was used for the removal of dimethyl phthalate from aqueous solution. The effect of various experimental conditions such as adsorbent dose, initial solution pH, temperature, and contact time on the removal of dimethyl phthalate was tested. Sorption of dimethyl phthalate onto MN100 adsorbent obeyed the pseudo-second-order kinetic model and reached equilibrium in 300 minutes. Also, experimental data showed a good fit with Langmuir adsorption isotherm models and maximum sorption capacity ( $Q_0$ ) found as 463.37 mg/g-adsorbent. Moreover, the sorption of dimethyl phthalate is pH depended and it was decreased at alkaline pH. Additionally, the presence of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Mn}^{2+}$  has a relatively low effect on dimethyl phthalate removal. Furthermore, the thermodynamic parameters demonstrated that the adsorption of DMP onto polymeric adsorbent is endothermic and spontaneous. On top of that, the exhausted adsorbent can be regenerated with 96% ethanol.

**Keywords:** Adsorption, Dimethyl phthalate, MN100, Phthalate esters, Water Treatment.

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## O 6. MANTA RAY OPTIMIZATION ALGORITHM FOR SOLVING DEFINITE INTEGRALS

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**ABSTRACT:** This study proposes a newly emerged bio-inspired metaheuristic problem-solving method called Manta-ray optimization algorithm for solving definite integral problems. Inspired from the foraging behavior of intelligent manta rays, the proposed method emulates three intrinsic food search mechanisms of manta rays which include chain foraging, cyclone foraging, and somersault foraging. Collective application of these three foraging mechanisms forms a unique problem-solving strategy to overcome hard-to-solve real-world optimization problems. The optimization performance of the proposed method is evaluated on four real world engineering optimization problems which are efficient testbeds for assessing the diversification and exploitation capacity of any optimization algorithm. Furthermore, numerical results retrieved from Manta-Ray algorithm is benchmarked against some of the literature famous optimization methods of Particle Swarm Optimization, Differential Evolution, and Crow Search Algorithm. The superiority of the Manta Ray Optimization is so evident that it surpasses the compared optimization algorithms in each test problem with regard to solution efficiency and accuracy. Finally, the proposed method is applied to five different definite integral problems and corresponding numerical results show that the algorithm offers a plausible and efficient way to solve integral problems with higher accuracy and robustness.

**Keywords:** Definite integrals, Manta Ray Optimization Algorithm, Metaheuristics.

## O 7. TRANSPORT CAPACITY ASSESSMENT FOR TRAINS USING SIMULATION TECHNIQUE

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**ABSTRACT:** Trains are employed for efficient and economic freight and passenger transport between freight centers and station such a dry port, logistic villages, seaports and cities. The preliminary step of planning a railway transport network is the capacity assessment of the transport system for the freight and passenger throughput. Unfortunately, this step requires a detailed study of the underlying transport network and infrastructure. In this study, a novel microscopic simulation model is introduced to evaluate the transport capacity of train services using the discrete event microsimulation (DES) paradigms. A hypothetical railway section, infrastructural and operational constraints are considered in the scope of different train interarrival scenarios. With the microscopic simulation model, the variation of the freight transport capacity is investigated for a set of model variables and operational constraints. The results of the study indicate that, while the hourly train output remains same, the stochastic and constant train arrival patterns may disturb the line capacity differently. This study demonstrates the applicability of the microsimulation models for railway capacity assessment considering delays and number of train stops.

**Keywords:** Railway, microsimulation, capacity, transport, throughput

### 1. INTRODUCTION

With the emergence of intermodal transport, increase of the trade throughput and passenger numbers, the issue of how to evaluate the capacity of railway transport systems has been gaining intensive attention. To evaluate the railway transport capacity, it is necessary to develop a systematic capacity evaluation tool. The capacity evaluation for the transport systems generally relies on analytical methods, mathematical models or the computer simulation approaches (Pouryousef and Lautala, 2015). The problem of capacity evaluation especially rises from the complexity of the underlying system. Because of this high complexity and unpredictability involved in railway operations, it is often technically problematic to implement the analytical and mathematical models to evaluate the capacity. Therefore, simulation methodology has been generally used to evaluate the railway capacity for microscopic and macroscopic levels.

The main objective of this study is to propose a comprehensive discrete-event microsimulation (DES) model that can be used for evaluating the railway transport capacity of a specific corridor and also conduct a hypothetical what-if scenarios to test the efficiency and reliability of the model. A summary of the literature required for the study and the purpose of the study are in Introduction section. In the existing literature, both theoretical and practical capacity concepts are used. The latter one is especially calculated with the realistic measures such as operational quality and reliability (Abril et al., 2008). In the scope of the analytical models, the railway environment is modelled using the mathematical expressions and relations. Unfortunately, the analytical models represent the system roughly and theoretical capacity assumptions are reached using these tools. The UIC compression method, developed by the International Union of Railways is a well-known technique which uses the train timetable compression to calculate a theoretical operational capacity (UIC, 2013).

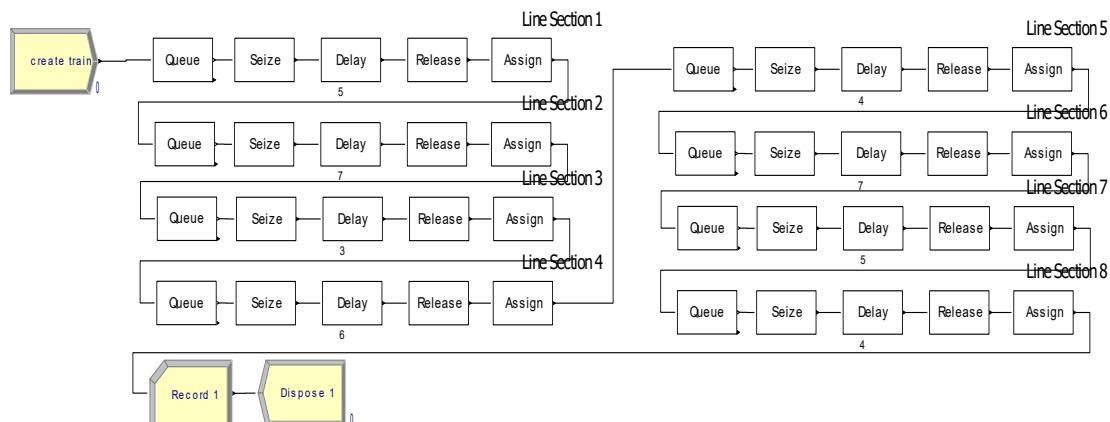
Beside the pure analytical models, the optimization methods are also utilized to solve the railway capacity problems with focusing on the train timetable. Among them, Szpigiel (1972) firstly implemented to a branch-and-bound algorithm for train scheduling considering a single railway track using the train departure times. The optimization problems are also handled using the mixed integer linear programming (Jovanović and Harker, 1991; Zhang and Li, 2019) and heuristics (Carey and Lockwood, 1995; Mu and Dessouky, 2011; Cacchiani et al., 2012). During the last decade, with the advances of the computer capabilities, simulation methods are emerged as an alternative way of evaluating the railway capacity (Lu et al., 2004). Several examples of the railway simulation modelling are conducted to calculate the system performance and capacity of the urban railway systems (Wales

and Marinov, 2015), evaluation of the timetable for the capacity and economy (Warg and Bohlin, 2016), train timetable and conflict evaluation (Högdahl et al., 2019) and rail freight capacity evaluation (Cacchiani et al., 2010).

## 2. MATERIAL AND METHOD

A computer simulation is an attempt to model a real-life or hypothetical system on a computer to study how the system works (Yıldırım et al., 2020). Computer simulation is generally used as a substitute for an underlying system without simple analytic solutions. DES is often used which manages the events at discrete time moments. In the concept of the DES, the simulation engine upholds a list of scheduled events synchronized by the simulation engine clock. The simulation engine reads the queue and triggers synchronized events. In the scope of the DES methodology, system state modifications and decision makings only took place at the discrete times. Simulation models can also handle the stochastic behavior and randomness of the underlying systems. Stochastic simulation engine generates stochastic numbers with using a specialized random number generator for seeding the random variables. Specific stochastic distributions are also used to represent the stochastic characteristics of the underlying system.

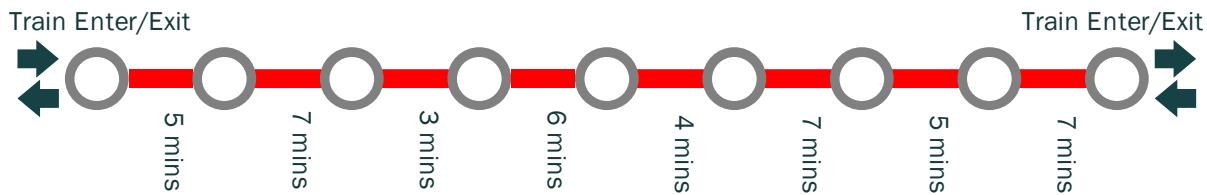
To simplify the railway operations in a specific railway corridor, several simplifications are made following the conceptual planning stage. The most important assumption is that, there is no overtaking for the trains. The no-overtaking assumptions significantly simplifies the railway operations and priority problems associated with the seizing of the railway line track resources. Moreover, the operated trains are assumed to cruise the same average speeds within same railway line segments. The simulation model primarily based on the synchronized allocation of the railway track resources, routing delays and release of the associated resources. During this procedure, following trains try to seize the track resources prior to the track release and the railway operations is performed with successive railway track modules. In this study, Arena software is used as the simulation modelling framework. The utilized Arena modules are shown in Figure 1.



**Figure 1.** Arena module for a single railway track operation

In the Figure 1, the queue block is used for train waiting for the seize of the next railway track resource, seize block is used to seize the railway track resource and release block is used to release the already seized railway track resource. The delay block is issued for representing the train routing delay through a line track section. Each train is generated from the create block with a predetermined interarrival time and it routes through the successive connected block as a moving system entity. The assign block is used for recording the operational statistics of the trains as the waiting delay (minutes) for seizing the next resource and the total number of train stops through the operation. The cumulative train statistics are used for calculating the average train delay (minutes) at the queue and average number of train stops for evaluating the scenario performances.

The hypothetical railway corridor consists of 8 line track sections with a total routing time of 44 minutes. The routing time of the line track sections are considered same for the trains. Each line track section is designed as bi-directional. The train routing times of the sections are 5,7,3,6,4,7,5 and 7 minutes from the first to the last section. The conceptual drawing of the railway line sections is shown in Figure 2.



**Figure 2.** Conceptual drawing of the railway line sections and train routing times

### 3. RESEARCH FINDINGS

The simulation model is executed for different train interarrival scenarios. The execution time was 24 hours corresponding a daily schedule. For evaluating the train operational disruptions, also another stochastic train arrival scenario is prepared for assuming that train interarrivals suits with the exponential distribution. In fact, this scenario is not realistic because the trains usually operate with a specific train timetable and predetermined train schedules and any disruptions need to be corrected as soon as possible. The stochastic arrival scenario is executed for 50 replications and the average values of the performance measures are taken with the associated confidence intervals. The execution results of the constant and stochastic train arrival scenarios are given in Table 1.

**Table 2.** Scenario execution outputs for the constant and stochastic train arrival scenarios

Train Interarrival Time	Constant Interarrival RN=1			Stochastic Interarrival RN=100		
	Number of Generated Trains	Avg. Train Waiting Delay (min.)	Number of Train Stops	Number of Generated Trains	Avg. Train Waiting Delay (min.)	Number of Train Stops
4 hr.	12	0	0	14.02 ( $\pm 1.13$ )*	0	0
2 hr.	24	1.8	8	25.76 ( $\pm 1.31$ )	2.34	11.2 ( $\pm 6.4$ )
1 hr.	48	3.1	14	48.92 ( $\pm 1.96$ )	3.86	16.7 ( $\pm 8.12$ )
30 min.	96	8.4	39	97.7 ( $\pm 3.14$ )	11.21	44.16 ( $\pm 9.2$ )
15 min.	192	21.54	138	191.02 ( $\pm 4.14$ )	19.27	198.31 ( $\pm 18.11$ )

Note=RN shows replication number: \*95% confidence interval on expected values

According to the results in Table 1, the following conclusions can be made. If the train interarrival times decrease, the average train waiting delays and number of train stops are increased as expected. However, for the 4 hours of train interarrival time, no congestion issue is observed for the constant and stochastic interarrival scenarios. For the stochastic interarrival scenario, increased average waiting delays and number of train stops were observed. Additionally, the confidence intervals are larger for the stochastic interarrival scenarios because of higher variability of the train interarrivals and more frequent train conflicts. With the direct examination of the model execution, we can conclude that the stochastic generation of the trains also disturbs the train routing operation. Also, it can be found that several distinct times cause a decrease in train interarrival samples between successive trains and it results larger train blockages and delays.

### 4. CONCLUSION AND DISCUSSION

In this study, a discrete event simulation methodology is demonstrated for evaluating the operational capacity of a railway corridor. The railway network is modelled using a DES model resources. The entity delay blocks are used for resource allocation using a systematic approach. It is obtained from the analysis results that the developed methodology can be used for evaluating the railway capacity of a hypothetical railway corridor with double railway track segments and various train interarrival distributions. Study findings can be a good example for train transport capacity assessment for freight trains. Hence, planners can be used the suggested method in the study for planning process.

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## O 8. GENETIC RELATIONSHIPS AMONG PRUNUS SP IN EX SITU COLLECTION IN ALBANIA

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**ABSTRACT:** The genus *Prunus* consist of fruit tree species of high economic value, well known for their edible fruits. Its germplasm is represented by a large number of cultivars, breeding selections and rootstocks. The present study considers genetic diversity and relationships among four different *Prunus* species used for breeding new cultivars and rootstocks. Fifty-five accessions of *Prunus domestica*, *P. armeniaca*, *P. avium* and *P. persica* from *ex situ* collection in Albania were analysed using RAPD molecular markers. *Prunus* accessions were grouped into three clades, according to the unweighted pair group method with arithmetic mean (UPGMA) dendrogram constructed based on molecular data, with a mean similarity of 43%. The obtained results were supported by principal coordinate analysis (PCoA) which clearly differentiated *Prunus* sp. into three similar groups. The results demonstrated that *P. domestica* and *P. armeniaca* were more closely related among analysed species, their accessions were clustered in the same clade. The understanding of genetic relationships among *Prunus* sp. contribute significantly to breeding and effective utilisation of *Prunus* germplasm resources held in the *ex situ* collection.

**Keywords:** *Prunus* sp., Genetic relationships, RAPD, Albania

### 1. INTRODUCTION

The genus *Prunus* belong to Rosaceae family and comprises around 400 species of tree and shrubs (Bouhoudida et al. 2007). It includes fruit tree species of high economic value, well known for their edible fruits, such as peaches, apricots, plums, cherries, etc. Albania is considered a heartland of many cultivars belonging to *Prunus* in the South-East of the Balkans. This rich diversity of cultivars and biotypes is spread out over the country and many of the cultivars are particularly well adapted to local ecological conditions (Cakalli et al. 2007).

The number of planted trees was increased over years while increased the interest on cultivating cultivars of favourable traits and the demand of their products. *Prunus* germplasm in Albania is represented by a large number of cultivars, selections and rootstocks as well their hybrids, mainly distributed in the Central region. It is maintained in the collections that aims the selection and breeding new *plum* cultivars, one of them is the Agricultural Technologies Transfer Centre (ATTC) in Vlora. However, the data on molecular diversity of the *Prunus* species within these collections are missing. The lack of this genetic background affects the output and costs of breeding programs.

Classification within the genus *Prunus* was based on morphologic traits, mainly considering the fruit characteristics (Aradhya et al. 2004). The development and the use of DNA based techniques had overcome the drawbacks related to the application of morphological characters, such as their availability and being influenced by environmental conditions, for genetic diversity and phylogenetic relationship studies among plant species.

Randomly amplified polymorphic DNA(RAPD) markers have been extensively used in the investigation of genetic diversity and evaluation of genetic relationships within different *Prunus* species, *P. armeniaca* (Mariniello et al. 2002; Ercisli et al. 2008), *P. avium* (Di Vaio et al. 2015; Berindean et al. 2016; Antic et al. 2020), *P. persica* (Zheng, 2007; Melgoza et al. 2009; Dervishi et al. 2019), *P. domestica* (Shimada et al. 2004) as well as among them (Liu et al. 2006; Athanasiadis et al. 2013). Although advanced molecular techniques were developed, RAPD is still in use for estimation of genetic variability of different plant species, due to their low cost and efficiency compared with other methods (Antic et al. 2020).

The characterisation of *Prunus* sp. is the prerequisite for the development of effective breeding strategies (Athanasiadis *et al.* 2013). The present study aims the molecular characterisation and evaluation of genetic relationships among most important *Prunus* species used for breeding new cultivars and rootstocks held in *ex situ* collection of ATTC in Vlore in Albania. Increasing our knowledge on genetic diversity and relationships of these fruit species might be useful for germplasm utilization in the breeding programmes.

## 2. MATERIAL AND METHOD

The plant material was provided by the ex-situ collection of the ATTC (Agricultural Technologies Transfer Centre). Fresh leaves were collected from a total of 55 accessions from four important *plum* species; *Prunus persica* (20), *Prunus armeniaca* (9), *Prunus avium* (16), and *Prunus domestica* (10). The list of analysed *Prunus* sp. genotypes is given in table 1.

The genomic DNA isolation was done using 120 mg fresh leaves following CTAB (cetyltrimethylammonium bromide) protocol as described by Kump and Javornik, (1996). The DNA quantity and quality was assessed using UV spectrophotometric method and by 0.8 % agarose gel. The DNA was adjusted to 4 ng/ $\mu$ l concentrations and stored to -4°C.

**Table 1.** List of analysed *plum* genotypes

Species	No	Cultivar name	Species	No	Cultivar name
<i>Prunuspersica</i>	1	Cardinal	<i>Prunusavium</i>	31	E Zeze
	2	Coronet		32	Roze
	3	Dixired		33	Italiane
	4	Fairhaven		34	Napolonbishteshkurter
	5	Nay Crest		35	Napolonbishtegjate
	6	Nemaguard		36	Vishnje
	7	Redtop		37	Bukje
	8	Rubira		38	Carzy Star
	9	Springcrest		39	Celeste
	10	Andross		40	New Star
	11	Baby Gold 6		41	Burlat
	12	Baby Gold 7		42	Sweet Early
	13	Percoco di Turi		43	Moro di casano
	14	Percoco di Novembre		44	Sciena
	15	Maria Serena		45	Big Star
	16	PercocoPrecoce		46	Uknown
<i>Prunusdomestica</i>	17	Vivian	<i>Prunusarmeniaca</i>	47	Tsunami
	18	Nektarina		48	Sankastres
	19	Arm King		49	Magicot
	20	Fantasia		50	Bulida
	21	Black Diamont		51	Prima
	22	Tcsan		52	Antonio Errani
	23	Black-Amber		53	Rubistar
	24	Sugar		54	Bora
	25	Stanley		55	Spink Blush
	26	V1.1			
	27	V2.1			
	28	V3.1			
	29	V1.2			
	30	V2.2			

The 55 plum genotypes were amplified by a total of six random decamer RAPD markers (OPA 07, OPA 17 OPB 01, OPAG 04, OPJ 04, OPJ 12). The RAPD markers specific sequences are given in table 2. The amplification was carried out in a final volume reaction of 15 µl, containing 20ng DNA template, 1xPCR buffer, 2mM MgCl<sub>2</sub>, 0.2mM dNTPs, 0.2µl primer (Operon Technologies) and 0.3U of Taq polymerase. The amplifications were performed in the PCR conditions as follow, initial denaturation at 94°C for 1.5 min, then 36 cycles of 30s at 94°C denaturation, 45s at 36°C annealing, polymerisation for 1 min at 72°C and the final elongation step on 72°C for 5 min. RAPD-PCR products were analyzed on agarose gel 1.5% in 1xTAE buffer at 8V cm<sup>-1</sup>, stained in ethidium bromide and visualized with transilluminator under UV light.

The amplified bands sizes were determined against a DNA standard of 100bp and scored as present (1) or absent (0). The provided data were used to construct a binary matrix, on which Dice's similarity coefficient (Dice, 1945) were calculated. The genetic relationships among four *Prunus* species under study were evaluated and visualized in a dendrogram constructed by applying UPGMA (unweighted pair group method using arithmetic average) method using NTSYS v.2.2 software (Rohlf, 2000). PCoA analysis was performed using GenAlEx software.

The efficiency of RAPD markers in our analysis was assessed based on the total number of bands (TNB), the number of polymorphic bands (NPB), and the percentage of polymorphic bands (PPB).

### 3. RESEARCH FINDINGS

A total of 56 fragments were scored among all plum genotypes for the six selected RAPD markers and were used to estimate genetic relationships among them. The fragments size ranged from 300-2000bp, the mean number of polymorphic fragments per primer resulted 9.3 ranging from 8 to 11 in OPAG04, OPB01 and OPA07, respectively (Table 2).

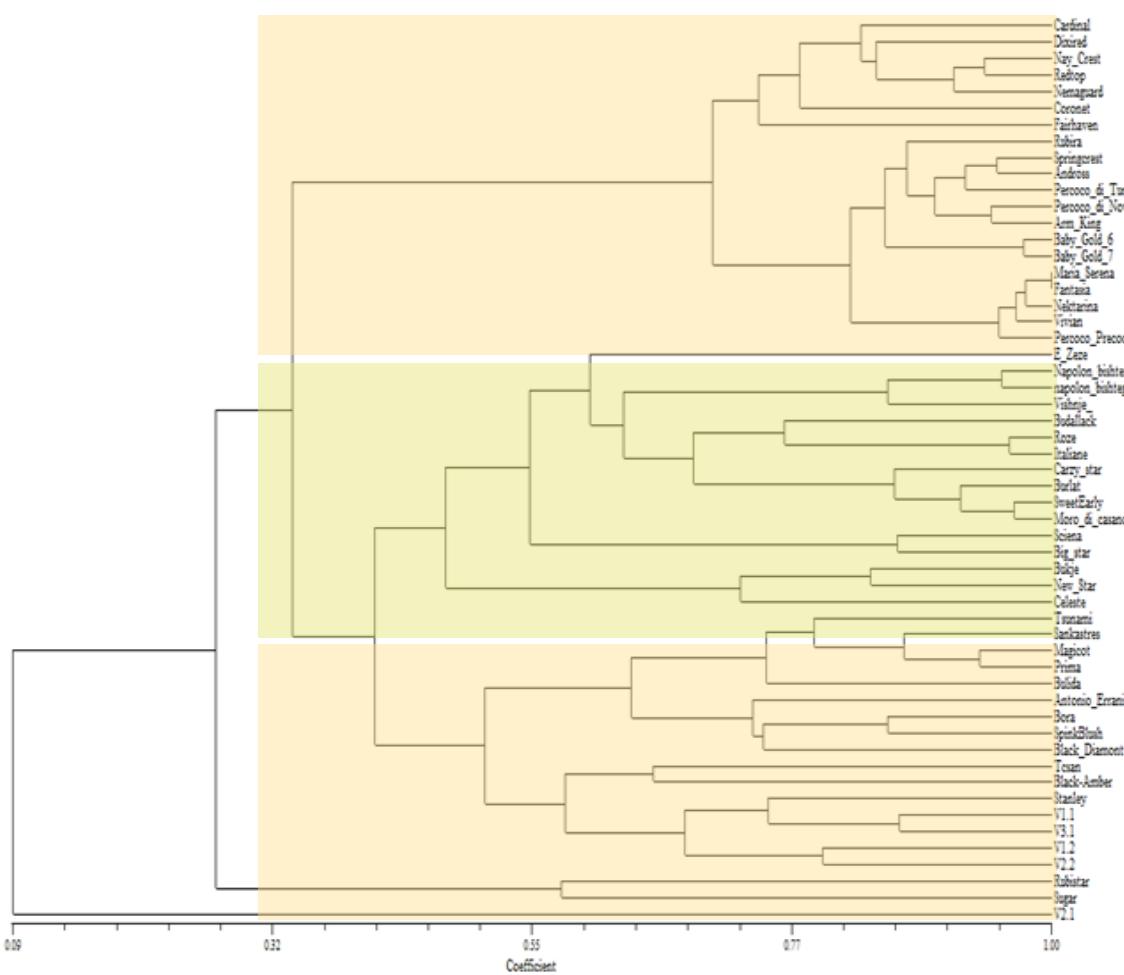
**Table 2.** Approximate range of amplified fragments and RAPD polymorphism data

Locus	TBN	PBN	Fragment size (bp)
OPB01	8	8	1500-400
OPAG04	8	8	2000-400
OPJ04	10	10	2000-300
OPJ12	10	10	2000-300
OPA17	9	9	2000-300
OPA07	11	11	1500-300
<b>Mean</b>	<b>9.33</b>	<b>9.33</b>	-

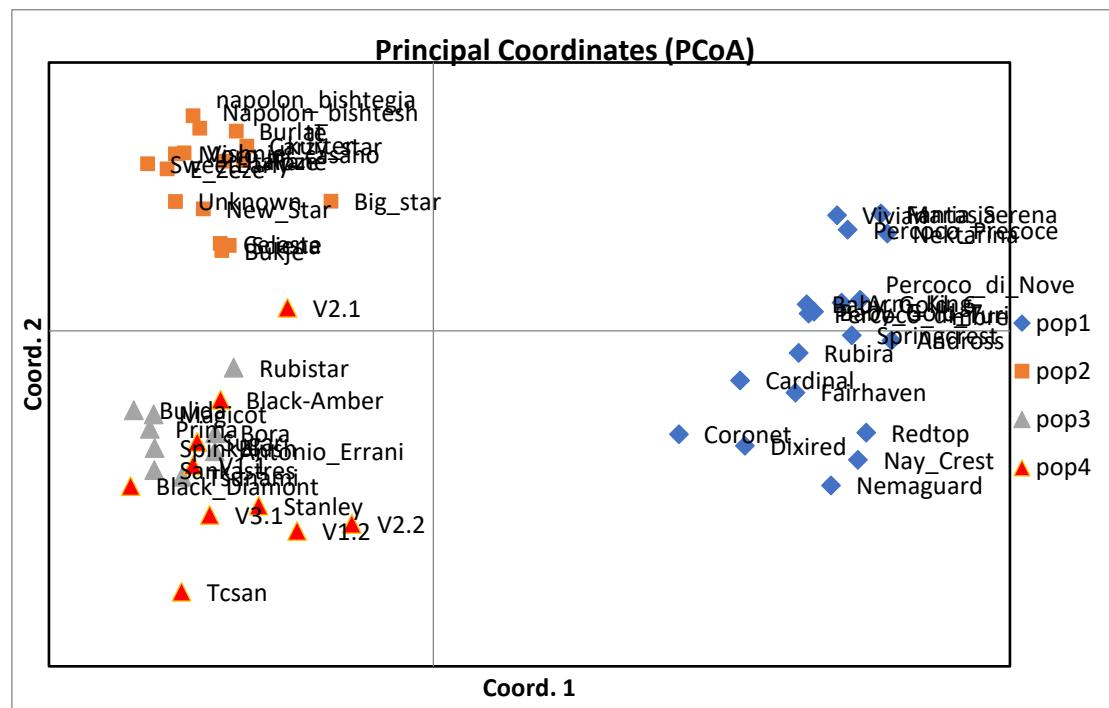
Genetic similarities between pairs of accessions were calculated according to Dice's coefficient. The mean genetic similarity among analysed genotypes was 43%, ranging from 9 - 97%. The present study revealed remarkable genetic diversity among the analysed *Prunus* sp genotypes.

Based on the provided RAPD profiles the analysis of genetic relatedness analysis among plum genotypes was performed by applying Dice's similarity coefficients and UPGMA method of clustering. Fifty five plum genotypes were grouped in three main clades in the dendrogram constructed in cluster analysis (Figure 1). The most distant were three genotypes; one genotype of *P. armeniaca* 'Rubistar' and two of *P. domestica* 'Sugar' and V2.1 which are clustered together. The first group comprised all genotypes (20) of *P. persica*, the second group comprises *P. avium* genotypes (16), and the third group comprises the genotypes of species *P. armeniaca* (8) and *P. domestica* (8) divided in two subgroups within this second group. Genotypes of *P. persica* showed to be more distant among all species under study.

To obtain a better understanding of the genotypes relationship, principal coordinate analysis (PCoA) was conducted. (Figure 2). The PCoA analysis revealed a total of 51.3% of variation. The first and the second principal coordinates account for 31.9 % and 12.3 % of the total variation, respectively. The genotypes of different species were clearly grouped in accordance with UPGMA clustering, into three groups.



**Figure 1.** Dendrogram representing genetic relationships among 55 *Prunus* sp genotypes based on RAPD data



**Figure 2.** Principal coordinate analysis (PcoA0 of 55 *Prunus* sp genotypes Pop 1- *P. persica*; Pop 2-*P. avium*; Pop 3-*P. armeniaca*; Pop 4- *P. domestica*

#### 4. CONCLUSION AND DISCUSSION

In the current study, RAPD markers were used to evaluate genetic diversity and relationships among four important *Prunus* species used for breeding new cultivars and rootstocks in the *ex situ* collection of ATTC, Vlore, Albania. The RAPD technique proved to be efficient and a practical approach for the evaluation of genetic diversity and relationships among different *Prunus* species, in congruence with previous studies (Athanasiadis et al. 2013).

The present study revealed remarkable genetic diversity among *Prunus* sp genotypes, the mean similarity of 43% among genotypes suggests their potential usefulness in breeding programs aimed by the collection institution. The genotypes of *P. armeniaca* and *P. domestica* were more closely related among analysed species.

The UPGMA cluster analysis which was supported also by PCoA analysis showed that the distribution of genotypes across groups mostly represented botanical classification within the genus *Prunus*. The genotypes of the species *P. armeniaca* and *P. domestica* were more closely related among analysed species. The understanding of genetic relationships among *Prunus* sp. will help significantly in breeding and effective utilisation of *Prunus* germplasm resources held in the *ex situ* collection.

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## O 9. PERIPHERYTON DIATOM DIVERSITY AND WATER QUALITY EVALUATION IN POJSKA TRANSECT, (OHRID LAKE)

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**ABSTRACT:** Aim of this paper is analysis of the composition for the periphyton communities on Macrophyte species (*Chara*) in Pojska transect (Ohrid Lake). The lake has underwater resources, which contribute to the creation of endemic species-specific habitats as they supply oxygen, nutrients, and create conditions for the development and growth of endemic species. Changes in diatom community structures suggest a change in environmental conditions such as, for example the deterioration of trophic status observed in Ohrid lakes. Estimation of diatom species based on two standards: EN 13946:2003 and EN 14407:2004, we calculate biodiversity variations (Shannon index) between different depths. The Saprobiac Index fluctuated from oligosabrob to oligo- β-mesosabrob but Trophic Diatom Index (TIDIA) fluctuated from mesotroph to meso-eutroph. The structures of the diatom communities reflect real environmental changes.

**Keywords:** Periphyton diatom diversity, trophic status, Pojska transects, Ohrid Lake.

### 1. INTRODUCTION

Watershed of Ohrid lake extends to an area of 966 km<sup>2</sup> where only 273 km<sup>2</sup> lie within the Albanian territory; the rest lies on the territory of Northern Macedonia. The total area of the Lake is 358 km<sup>2</sup>, with 111.4 km<sup>2</sup> located within Albania. This lake is the deepest in the Balkans, with an average depth of 138 m (maximum 295 m). The lake has a relatively regular ellipsoid shape and forms a shoreline of 87 km and only 32 km is in the Albanian territory. 63 of this shoreline are generally rocky, high and steep; whereas the rest are flat, low shores of limnogenic and potamogenic origin (Pano, 2015), extending mainly in the northern part near the town of Ohrid, and in the southern part, near the town of Pogradec. The origin of the lake is tectonic, where karstic processes also operate (Qirjazi, 2019; Kabo, 1900-1991). In the watershed of Lake Pogradec, starting from northwest to south-east, chrome (Pojske), iron-nickel and coal mines (Gur i Kuq) have been active. These mines worked at full capacity until the early 1990, which in the past have affected the disruption of the ecological balance of the lake water discharging into the lake and the disruption of the tourist landscape of the area. Despite their closure, their several years' previous activity has affected the lake's aquatic environment. Lake Ohrid has a tectonic origin and has rich biodiversity in flora and fauna. A considerable space is occupied by macrophytes, which form several vegetation belts by depth, namely: *Cladophora*, *Phragmites*, *Potamogeton*, *Chara* (Talevska & Talevski, 2015; Osmani et al., 2012; Krog & Keçi, 2013). The high presence of macrophytes in the lake is associated with the influence of streams or rivers, but also by the slope of the shores; on the lower shores, the amount of deposited matter is higher and the chance of developing aquatic vegetation is better. But also, the relatively high amount of nutrients (nitrates, phosphates, etc.) leads to the development of macrophytes and diatoms, as well as the development of an entire food chain in the aquatic ecosystem.

Aim of this study was to identify silicate algae (diatoms) in perifiton communities at Pojska transects, at different depths from the lake shore, and to assess nutritional status based on the use of contemporary biomonitoring methods (EN13946: 2003; EN14407: 2004) which are implemented by many European countries. Microscopic algae (Diatoms) are used for assessing the nutritional status and quality of waters (Fott, 1971; Sladacek, 1986; Kelly & Whitton, 1995; John, 2002; Bellinger & Sigee, 2010; Miho, 2011). Biological monitoring (diatoms) has many advantages over chemicals, since it summarizes large-scale contamination biota data over time (Calow & Petts, 1994; John, 2002).

### 2. MATERIAL AND METHODS

Samples were collected as perifiton in macrophytes (*Chara*) at Pojska transect, at different depths from the lake shore (2 m; 3 m; 4.5 m; 6 m; 8 m; 11 m; 13 m; 15 m; 17 m; 18 m; 19 m), during July 2011.

These samples were collected with the help of a scraper fitted with a rope, which was released several times from the boat, at each depth. This is a rocky area near the Pojska Mine. All samples were conserved in 3-4% formaldehyde (Lenzi-Grillini, 1978; Sournia, 1986).

The cleaning of diatom frustules was done by boiling the material, first with HClcc and then, after washing, boiling them again with H<sub>2</sub>SO<sub>4</sub>cc, adding during the last procedure some crystals of KNO<sub>3</sub>, as described by Krammer & Lange-Bertalot 2001; Kupe, 2006.

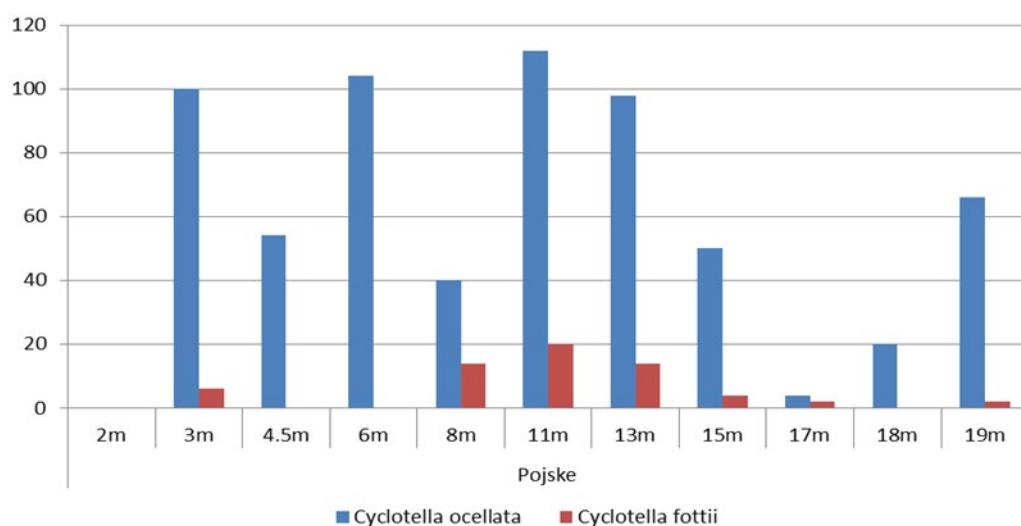
The diatoms were identified using standart literature: mainly the volumes of the Central European Freshwater Flora series (Süßwasserflora von Mitteleuropa; Krammer & Lange-Bertalot, 1986-2001), as well as the publication of Levkov et al. (2007). Scientific names have been consistently consulted with websites, especially AlgaeBase (Guiry & Guiry, 2020) and DiatomBase (Kociolek et al., 2020).

About 500 valves per slide were counted using 100 oil immersions; the calculated value in% of species is error ± 10, with 95% reliability (Lund et al., 1958; Kupe, 2006).

We calculate the Diversity Index (H'), (Shannon & Weaver, 1949); Trophic and Saprobic indices may be used to make a rought estimate of lake's condition and to determinate a water quality. For this purpose, we calculated TI DIA and SI using the formula of Zelinka & Marvan (1961) by Root et al., 1999 and 1997.

### 3. RESULTS AND DISCUSSION

In this paper we focused on identifying microscopic algae (diatoms) as well as assessing the trophic state of the water at Pojska transect, near which the chrome mine was operational prior to the 1990, which although not functioning today, again has its effects on the waters of this lake and precisely at the Pojska transect. The influence of nutrients affects the structure of the biodiversity. About 11 diatoms have been identified in the Pojska transect in 11 samples, 2 diatoms belong central diatoms represented by *Cyclotella ocellata* (TW = 1.5 which indicates oligo-mesotrophic states) and *C. fotti* with a limited distribution and 100 diatom species, belong order pennate, which was classified as the most dominant species in eight samples.



**Figure 1.** Distribution of centric diatom in Pojska transect

We have identified many endemic species. Underwater resources contribute to the creation of endemic species-specific habitats as they supply oxygen, nutrients, and create conditions for the development and growth of endemic species in Lake Ohrid (Stankovic, 1960; Matzinger et al., 2007; Albrecht & Wilke, 2008; Hauffe et al., 2010; Trajanovski et al., 2010).

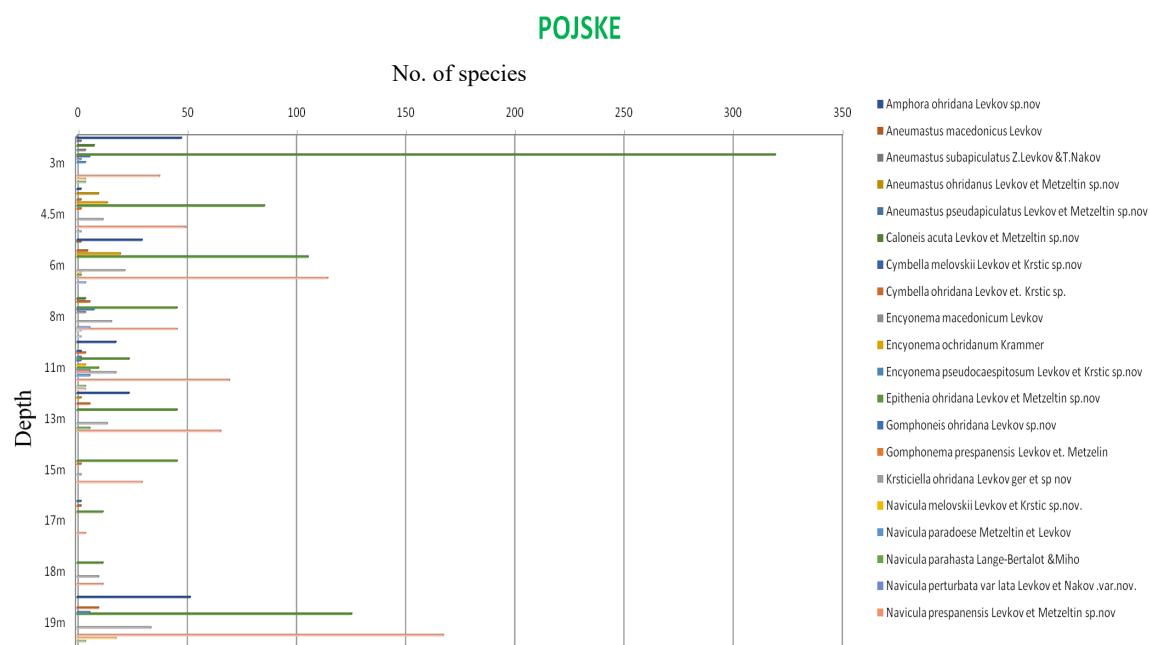
*Cyclotella ocellata* is widespread in all depth of Pojska transect (especially 2m depth) approximately 91% of frequency the maximum valves number of *Cyclotella ocellata* were counted in 11m, 6m, 3m, 13m (Tab.1).

Among the pennate species (Tab. 1, Fig. 2) are the most widespread and abundant in the Pojska transect: *Amphora ohridana* (endemic species), *Cocconeis placentula* var. *lineata* (TW = 2.6 (eutroph);

$S = 1.8$  ( $\alpha$ -mesotroph), *Cocconeis robusta* (endemic species), *Epithemia ohridana* (endemic species), *Gomphonema pumilum* (TW= 1.1 (Oligotroph);  $S = 1.6$  (oligo – $\alpha$ - mesotroph), *Navicula cryptotanella* (TW = 2.3 (eutroph);  $S = 1.5$  (oligo – $\alpha$ - mesotroph), *N. subalpine*, *Denticula tenuis* etj. In Ohrid lake more diatom species may be considered rare, endemic, or tertiary relicts, such as, *Epithemia goeppertiana*, *Navicula oligotraphenta*, *N. mediocostata*, *N. praeterita* etc.

Also, the diatom communities are good indicators to respond changes in nutrient and to evaluation long-term changes in ecosystem. The climate has influence in community of diatoms and is normal to evaluate the status of Lake one/year.

The number of species in the Pojska transect fluctuates from 8 at 2 m depth to 41 species at 11 m depth (Tab. 1; Fig. 2), which coincides with the maximum found at this station. As the depth increases, the number of species found increases except for depths of 15 m to 18 m; perhaps this is due to the low concentration of nutrients, or by the greater development of macrophytes.



**Figure 2:** Distribution of pennate diatom in Pojska transect

**Table 1.** Check list of diatoms in Pojska transect, Ohrid Lake

Name of species / Depth, m	2	3	4.5	6	8	11	13	15	17	18	19	Frequency, %
<b>Centricae</b>												
<i>Cyclotella fotii</i> Hustedt		0.2			2.1	1.9	1.5	0.6	1.0		0.1	64
<i>Cyclotella ocellata</i> Pantocsek		4.0	7.3	9.7	6.1	10.9	10.3	8.1	2.0	6.6	3.0	91
<b>Pennatae</b>												
<i>Achnanthes minutissima</i> Kützing agg.						0.2						9
<i>Amphora ohridana</i> Levkov		1.9	0.3	2.8		1.8		1.6	2.0			55
<i>Amphora pediculus</i> (Kützing) Grunow					2.8		1.1	0.6				27
<i>Amphora</i> sp.	0.4											9
<i>Aneumastus macedonicus</i> Levkov				0.2								9
<i>Aneumastus ohridanus</i> Levkov et Metzeltin			1.4				0.2					18
<i>Aneumastus subapiculatus</i> Levkov & Nakov		0.1										9
<i>Aneumastus pseudapiculatus</i> Levkov & Metzeltin									1.0			9
<i>Caloneis acuta</i> Levkov & Metzeltin		0.3			0.6							18
<i>Caloneis tenuis</i> (W.Gregory) Krammer			0.3	0.2								18

Name of species / Depth, m	2	3	4.5	6	8	11	13	15	17	18	19	Frequency, %
<i>Caloneis sp.</i>			0.5									9
<i>Campylodiscus levanderi</i> Hustedt											0.1	9
<i>Campylodiscus marginatus var.tenuis</i> Jurilj				0.6								9
<i>Cavinula scutelloides</i> (W.Smith) Lange-Bertalot											0.1	9
<i>Coccneis placentula</i> var. <i>lineata</i> (Ehrenberg) Van Heurck	76.2	18.0	10.8	9.1	2.8	25.8	6.3	12.3	3.1	26.5	9.5	100
<i>Coccneis placentula</i> Ehrenberg agg.						1.9	1.3					18
<i>Coccneis pseudolineata</i> (Geitler) Lange-Bertalot						0.4						9
<i>Coccneis robusta</i> Jurilj		3.0	2.7	1.9	7.1	9.7	6.9	7.5	7.1		2.8	82
<i>Craticula cuspidata</i> (Kützing ) D.G Mann										0.4		9
<i>Cymatopleura solea</i> (Brebisson) W. Smith										0.1		9
<i>Cymbella exigua</i> Krammer					0.6	0.2						
<i>Cymbella lange-bertalotti</i> Krammer		1.6	2.2	1.9	0.3	0.2	1.9	0.6			0.5	73
<i>Cymbella melovskii</i> Levkov et Krstic sp.nov						0.2						9
<i>Cymbella ohridana</i> Levkov et. Krstic sp.			0.3	0.5	0.9	0.4	0.6		1.0		0.5	64
<i>Cymbella tumida</i> (Brebisson) Van Heurck		0.6	0.3	0.2								27
<i>Denticula tenuis</i> Agarth		13.8	14.6	11.2	9.8	0.8	4.4	6.5	5.1	9.9	6.9	91
<i>Diatoma densicostata</i> Levkov		0.1										9
<i>Diatoma tenuis</i> Agardh		0.1	0.3									18
<i>Diploneis elliptica</i> (Kützing) Cleve			0.3			0.4						18
<i>Encyonema minutum</i> (Hilse) D.G.Mann		0.4			1.2	6.0	2.9	3.9	2.0	1.3	1.3	73
<i>Encyonema macedonicum</i> Levkov		0.2										9
<i>Encyonema ohridanum</i> Krammer			1.9	1.9								18
<i>Encyonema Lange-Bertalotii</i>		0.5	0.8	1.9	0.6	2.1	1.7	1.9		2.6		73
<i>Encyonema pseudocaespitosum</i> Levkov et Krstic sp.nov						0.2					0.3	18
<i>Epithemia lunata</i> Jurilj		1.3	0.5	0.7			0.2			0.7		45
<i>Epithemia goeppertiana</i> Hilse		0.1		0.4								18
<i>Epithemia adnata</i> (Kutziing) Brebisson		1.6	0.3	0.4						0.1		36
<i>Epithemia sorex</i> Kützing		0.1										9
<i>Epithemia ohridana</i> Levkov		12.8	11.7	9.9	7.1	2.3	4.8	7.5	6.1	4.0	5.7	91
<i>Fragilaria acus</i> Kützing								0.3				9
<i>Gomphoneis ohridana</i> Levkov		0.2			1.2	0.2						27
<i>Gomphonema angustum</i> Agardh	4.8											9
<i>Gomphonema clavatum</i> Ehrenberg		0.3	3.3	0.2			0.2					36
<i>Gomphonema irroratum</i> Hustedt		0.1										9
<i>Gomphonema olivaceum</i> (Hornemann) Brebisson gr.			2.6	3.5	5.2	3.1	2.3	5.3	1.9	3.1	0.7	91
<i>Gomphonema olivaceolacuum</i> Lange-Bertalot								0.2				9
<i>Gomphonema olivaceum</i> var. <i>calcareum</i> Cleve			0.5							1.0		18
<i>Gomphonema parvulum</i> Kützing agg.	9.5			0.0			0.1					27
<i>Gomphonema pratense</i> Lange-Bertalot		1.2	0.8		2.1					2.6	1.2	45
<i>Gomphonema prespanensis</i>			0.3					0.3				18

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Name of species / Depth, m	2	3	4.5	6	8	11	13	15	17	18	19	Frequency, %	
<i>Gomphonema pseudotenellum</i> Lange-Bertalot					0.3							9	
<i>Gomphonema pumilum</i> (Grunow) Reichardt & Lange-Bertalot	9.5	26.0	22.8	14.6	27.3	11.9	28.4	23.1	56.1	23.2	40.2	100	
<i>Gomphonema subclavatum</i> (Grunow) Grunow								0.6				9	
<i>Gyrosigma sciotoense</i> (Sullivant et Wormley) Cleve					0.3						0.1	18	
<i>Hippodonta costulaiformis</i> Lange-Bertalot				0.2		0.8					0.6	27	
<i>Hippodonta lueneburgensis</i> Lange-Bertalotii												0	
<i>Krsticiella ohridana</i> Levkov					0.6							9	
<i>Meridion circulaire</i> (Greville) Agardh				4.3								9	
<i>Meridion circulaire</i> (Greville) var <i>constrictum</i>					3.7	1.9	1.7	5.2		5.3	7.5	55	
<i>Navicula ambigua</i> Ehrenberg							0.2			2.0		18	
<i>Navicula capitatoradiata</i> Germain					1.5	0.9	0.4	5.8	7.1	5.1	2.6	0.5	73
<i>Navicula cari</i> Ehrenberg					0.6		0.2					18	
<i>Navicula caterva</i> Hohn & Hellerman		0.1										9	
<i>Navicula cuspidata</i> Kützing			0.5									9	
<i>Navicula cryptocephala</i> Kützing					0.6						0.7	18	
<i>Navicula cryptotenella</i> Lange-Bertalot		2.4	2.7	7.3	7.4	3.9	6.3	3.2	3.1	4.6	5.2	91	
<i>Navicula cryptotenelloides</i> Lange-Bertalot						0.4						9	
<i>Navicula cf. antonii</i> Lange -Bertalot						0.2						9	
<i>Navicula melovskii</i> Levkov & Krstic						0.4						9	
<i>Navicula paraobesa</i> Metzeltin & Levkov		0.2										9	
<i>Navicula parahastata</i> Lange-Bertalot & Miho						1.0						9	
<i>Navicula perturbata</i> Jurilj						0.6						9	
<i>Navicula prespanensis</i> Levkov et Metzeltin						0.6						9	
<i>Navicula radiosa</i> Kützing			1.6	2.0	2.5	1.8	1.5	0.3		3.3	1.5	73	
<i>Navicula rakowskae</i> Lange-Bertalot				0.2								9	
<i>Navicula sancti-naumii</i> Levkov & Metzeltin						0.6						9	
<i>Navicula stankovicci</i> Hustedt					0.9							9	
<i>Navicula subalpina</i> Reichardt		1.5	6.8	10.7	7.1	6.8	6.9	4.9	2.0	4.0	7.6	91	
<i>Navicula saprophila</i> Lange-Bertalot			0.3					1.0				18	
<i>Navicula tripunctata</i> (O. F. Müller) Bory				0.4		0.6		0.3		0.2		36	
<i>Neidium binodis</i> (Ehrenberg) Hustedt			0.3									9	
<i>Neidium dubium</i> var. <i>constricta</i> Hustedt		0.1										9	
<i>Neidium majus</i> (Jurilj) Levkov					0.6							9	
<i>Nitzschia angustata</i> (W. Smith) Grunow										0.1		9	
<i>Nitzschia communis</i> Rabenhorst										0.3		9	
<i>Nitzschia denticula</i> Grunow		4.3										9	
<i>Nitzschia sigmoidea</i> (Nitzsch) W. Smith						0.4						9	
<i>Pinnularia viridis</i> (Nitzsch) Ehrenberg		0.1			0.3	0.2						27	
<i>Placoneis gastrum</i> (Ehrenberg) Mereschkowsky						1.2						9	
<i>Placoneis tumidula</i> Levkov			0.3	0.4								18	

Name of species / Depth, m	2	3	4.5	6	8	11	13	15	17	18	19	Frequency, %
<i>Placoneis macedonica</i> Levkov					0.3							9
<i>Placoneis ohridana</i> Levkov et Metzeltin		0.2										9
<i>Planothidium dubium</i> (Grunow) Round & Bukhtiyarova						0.2	0.2					18
<i>Planothidium lanceolatum</i> (Brebsson) Lange-Bertalot							0.2					9
<i>Roicosphaenia abbreviata</i> (Agarth) Lange-Bertalot					0.3	0.2		1.0				27
<i>Rhoicosphaenia macedoniva</i> Levkov		0.2				0.4				0.2		27
<i>Sellaphora macedonica</i> Levkov & Metzeltin					0.3							9
<i>Sellaphora ohridana</i> Levkov & Krstic						0.4						9
<i>Staurosira sp.L</i>										0.3		9
<i>Staurosiriella pinnata</i> Ehrenberg				0.2	0.3	0.2		0.3			0.6	45
<i>Staurosirella sp.</i>		0.1		0.4		0.2						27

**Table 2.** Diversity Index ( $H'$ ); number of species (N); Trophic Index of Diatom, TIDIA), trophic classes, Trophic saprobic (SI), Saprobiic classes in Pojska transect

Name of station	Pojska										
	2	3	4.5	6	8	11	13	15	17	18	19
Depth (m)											
Number of species, N:	4	34	31	30	31	39	27	23	15	16	28
Diversity Index (Shannon Index), $H'$ :	1.15	3.41	3.69	3.89	3.85	3.85	3.67	3.50	2.55	3.26	3.19
Trophic Diatom Index, TIDIA:	2.2	1.8	1.9	2.1	1.9	2.3	2.2	2.2	1.8	2.0	1.7
Trophic classes	Meso-eutroph	Mesotroph	Mesotroph	Mesotroph	Meso-eutroph	Mesotroph	Meso-eutroph	Meso-eutroph	Mesotroph	Mesotroph	Mesotroph
Saprobic Index, SI	1.6	1.5	1.4	1.4	1.5	1.4	1.6	1.6	1.6	1.4	1.5
Saprobic classes	Oligo-β-mesosprob	Oligosprob	Oligosprob	Oligosprob	Oligosprob	Oligosprob	Oligo-β-mesosprob	Oligo-β-mesosprob	Oligo-β-mesosprob	Oligosprob	Oligosprob

To determine the waters ecology near this transect, depending on the types of diatoms and their numbers, we calculated the ecological values of the nutrient indicator (which is closely related to the inorganic matter accumulated in macrophytes and in water) and the saprobic indicator (which is related to the presence of organic matter). According to Shannon & Weaver 1949, the variability index fluctuates from 1.15 (2 m) to 3.89 (6 m). Almost all other  $H'$  depths fluctuate around the value of 3, (Tab. 2). Based on inorganic matter in water, responsible index is TIDIA, which oscillated from mesotroph (1.7) in 19m depth to meso-eutroph (2.3) in other depths.

About the presence of organic matter in water, SI oscillated from oligosprob (1.4) to Oligo-β-mesosprob (1.6). As we show, the presence of organic matter is in the moderate value (grade II quality) compare with inorganic matter. Eutrophic habitats dominated Diatom species, in conditions by *Amphora pediculus*, *Cocconeis placentula* var. *lineata*, *Encyonema minutum*, *Navicula cryptotenella*, *Nitzschia dissipata* etc.

#### 4. CONCLUSION

The diatom communities are good indicators to respond changes in nutrient and to evaluation long-term changes in ecosystem. *Cyclotella ocellata* as centric diatom is more widespread in all depth of

Pojška transect because centric diatoms float in water and the sampling is conducted from macrophyte. Most of pennate diatoms are present in all depth of sampling sites like epiphyte in macrophytes. Diatom communities in the Ohrid Lake were characterized by a high diversity, which is in accordance with other studies carried out in tectonic Ohrid Lake. The relative abundance is reflected in the water quality. Most of the species in Pojška transect are endemic like: *Amphora ohridana Levkovsp.nov*; *Encyonema macedonicum Levkov*; *Encyonema ochridanum Krammer*; *Encyonema pseudocaespitosum Levkov et Krsticsp. nov*; *Gomphoneis ohridana Levkov sp. nov*; etc., Endemic species are evaluated only on taxonomic aspects because until now don't have ecological status. The trophic classes oscillated from mesotroph (1.7) to meso-eutroph (2.3). Saprobic classes oscillated from oligosaprob (1.4) to Oligo- $\beta$ -mesosaprob (1.6).

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## O 10. ENDEMIC AND SUBENDEMATIC PLANT SPECIES IN MT TREBESHINA IN SOUTHERN ALBANIA; THEIR STATUS AND THREATS

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**ABSTRACT:** The Trebeshina Mt is part of a very important Albanian mountain range Trebeshine-Dhembel-Nemercke, known for its biodiversity richness, situated in Southern Albania. Trebeshina Mt is one of the main source of livelihood for the surrounding communities, which have long benefited from the utilisation of its natural resources, mainly in harvesting of medicinal plants, grazing livestock and extensive use of woody ecosystems. The sustainable utilisation of mountain biodiversity, especially the conservation of subendemic and endemic vascular plant species that falls under the threatened IUCN categories is of great importance. In the present study we investigated the status of plant species grown in Trebeshina Mt and their threats factors this plants are facing. In total, we identified 15 endemic vascular plant taxa, from which 4% were endemic of Albania and 10% were subendemic. Based on IUCN categories, 50% of endemic plant taxa found in Trebeshina Mt are listed in the Albanian Red List and classified as threatened. The major threats affecting the status of endangered species were due to anthropogenic activity, habitat fragmentation and uncontrolled harvesting of medicinal plants. This study, as an approach of plant conservation, provides the first baseline for future research towards the protection of the endemic and subendemic plant species of this mountain in order to prevent future plant extinction and loss of biodiversity.

**Keywords:** Trebeshina Mt., Endemic and Subendemic species, IUCN, Albania

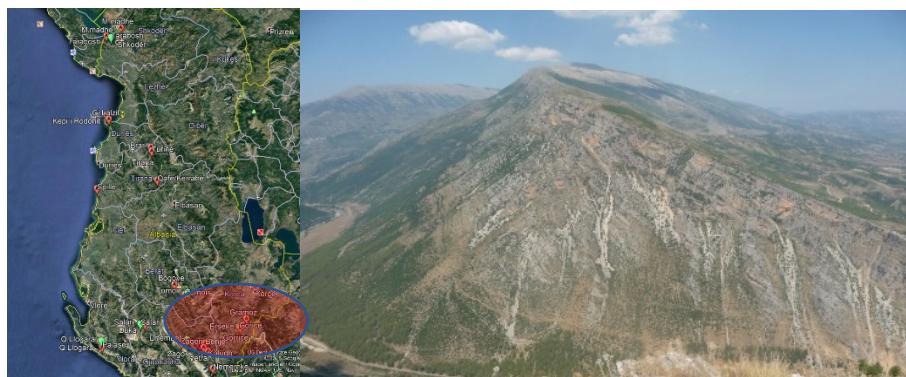
### 1. INTRODUCTION

The Albanian flora comprises more than 3629 plant species, which belong to 960 genera and 175 families, they constitute approximately 30% of the European flora. (Vangjeli et al. 1997; Vangjeli, 2015). According to Paparisto et al. (1988), around 160 of these plant species share the distribution area with neighboring countries, such as, Kosovo, Macedonia Montenegro and Greece and are considered as subendemic species. This considerable species richness is attributable to the country's geographical position, geological composition, relief as well as large altitudinal and climatic conditions range. The Red list of Albania includes 420 vascular plant species, which represent around 9.3 % of Albanian Flora. The conservation of rare and threatened species in Albania is focused mainly on the high mountains. Based on the statement of Mayers et al (2000), Trebeshine-Dhembel-Nemercke mount range, situated in Southern Albania, is considered as a biodiversity hotspot area, featuring exceptional concentrations of endemic species as well as experiencing extreme loss of habitats. Trebeshina Mt, as a part of this mount range, contributes to the endemism degree of it. In addition, the surrounding communities have long benefited from ecosystem services that its area provides by harvesting of medicinal plants, grazing livestock and extensive use of forest ecosystems and quarries. Several studies provide data on flora of the Nemercka Mountain, which is part of the same mount range (Balacci. 1896, 1897, 1900; Mitrushi, 1955, Mahmutaj et al. 2015; Peci et al. 2016), and a very few studies consider the distribution and the status of endemic plant species, in mountain areas in the Southern Albania (Peci et al. 2016; Mahmutaj et al., 2015).

Identifying areas of endemisms is an essential part of planning conservation management (Noroozi et al. 2018). The sustainable utilisation of mountain biodiversity, especially the conservation of subendemic and endemic vascular plant species that falls under the threatened IUCN categories is of great importance. The aim of the present study was the identification of the endemic and subendemic plant species grown in the Trebeshina Mt. the evaluation of their habitat conditions and the investigation of threats they are facing. In addition, this study yields pertinent information and the first data on the degree of endemisms and its conservation status in Trebeshina Mt, which will serve its conservation and sustainable use programs.

## 2. MATERIAL AND METHOD

Trebeshina Mt. is situated in Southern Albania, it is part of a very important Albanian Mountain Range Trebeshine-Dhembel-Nemercke. It is extended about 20 km from South East to North East in the geographical positions of N  $40^{\circ} 17' 55.9''$ ; E  $20^{\circ} 10' 09.73''$  (Kelcyra Gorge) to the N  $40^{\circ} 25' 09.75''$ ; E  $20^{\circ} 06' 28.55''$  (Kicoku Pas). The altitude ranges from 170 m asl in Kelcyra Gorge to 1923 m asl in the Dean Peak and it has a total area of 35.06km<sup>2</sup>. The figure 1 gives the map of geographical location and a peak view of Trebeshina Mt. The area is characterized by Mediterranean climate, and three types of soil compositions; silt, greyish brown and calcareous.



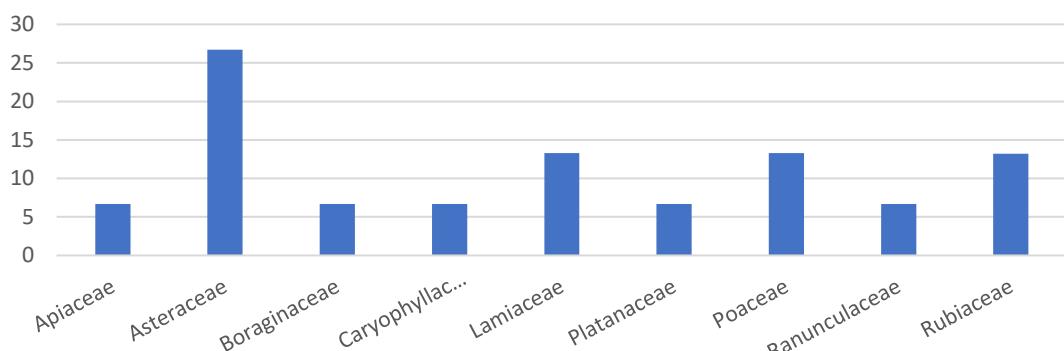
**Figure 1.** Geographical position and a view of the Trebeshina Mountain

Field investigations have been carried out for two successive years. Vegetation samples (2m x 2m) have been taken in the entire mountain and presence-frequency tables have been recorded using Braun-Blanquet method. All identified vascular plants species have been registered and a voucher of them is deposited in the National Herbarium. In addition, a list of data including information on the existing status of plant populations, habitat and ecological characteristics, the observed threats, was compiled. Careful observation have been carried out in the area in order to identify any sign of human activity in the habitat of species. Plant conservation status was assessed based on IUCN criteria.

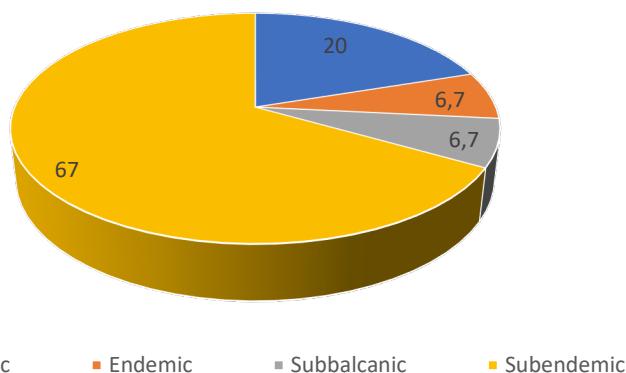
## 3. RESEARCH FINDINGS

A list of all plant taxa found in the Trebeshina Mt was compiled during field surveys in two years, from which there were identified in total 15 endemic plant species, from which 4 % were endemic of Albania and 10% subendemic of Balkan. These endemic and subendemic plant species belong to nine families; the majority of them, 26 % belong to Asteraceae family, around 13% belong to each of Lamiaceae, Poaceae and Rubiaceae families while the other families were represented by less than 6.7 % (Figure 2, and Table 1).

The chorological spectrum of endemic vascular plant species of Trebeshina Mt. shows three elements, most representative is the subendemic element with 67%, while balcanic and subbalcanic elements were represented by 20% and 6.7 %, respectively (figure 3).



**Figure 2.** Family composition of endemic plants found in Trebeshine Mt.



**Figure 3.** Chorological element of endemic vascular plant species in Trebeshina Mt.

**Table 1.** List of endemic and subendemic plant species found in Trebeshina Mt., Red List status and their threats

No	Family	Species	Chorological element	IUCN categories	Threats
1	Poaceae	<i>Achilleafrasii</i>	Balc	CR	Habitat destruction
2	Apiaceae	<i>Bupleurumbaldense</i>	Subende	NT	Not on Red List
3	Asteraceae	<i>Cirsiumtymphaeum</i>	Subende	EN	Overgrazing
4	Rubiaceae	<i>Asperulascutellaris</i>	Subende	NT	Not on Red List
5	Asteraceae	<i>Carduusmicropterus</i>	Subende	EN	Fire occurrences
6	Rubiaceae	<i>Galiumpseudaristatum</i>	Subende	NT	Not on Red List
7	Ranunculaceae	<i>Helleborusmultifidus</i>	Subende	NT	Not on Red List
8	Asteraceae	<i>Helichrysumplicatum</i>	Balc	EN	Overharvesting
9	Caryophyllaceae	<i>Herniariaparnassica</i>	Subende	NT	Not on Red List
10	Platanaceae	<i>Platanusorientalis</i>	Subbalc	VU	Habitat destruction
11	Lamiaceae	<i>Scutellariarubicunda</i>	Subende	NT	Not on Red List
12	Poaceae	<i>Sesleriaautumnalis</i>	Subende	NT	Not on Red List
13	Lamiaceae	<i>Sideritisraeseri</i>	Balc	EN	Overharvesting
14	Boraginaceae	<i>Alkannasandwithii</i>	Ende	CR	Deforestation
15	Asteraceae	<i>Centaureazuccariniana</i>	Subende	VU	Habitat destruction

Based on IUCN criteria the endemic and subendemic plant taxa found in Trebeshina Mt. were assigned to different categories of extinction, 50 % of them were also listed in the Albanian Red List and classified as threatened, from which 50 % were endangered, 25 % fall under vulnerable and 25% in the category critically endangered (Table 1). This data suggests that the endemic species in this mountain are facing risk of extinction.

During the study habitat conditions of endemic and subendemic species were visually inspected and major threats that species were facing were identified. The most prominent threats found in endemic species of Trebeshine Mt. were habitat destruction and harvesting of individual species, which over years had become more intensive posing a increased risk and damages to the mount ecosystems, leading to the degradation of habitats mainly the pastures and shrublands. The main human activities with negative impact were deforestation, overgrazing and medicinal and aromatic plant bad practices of harvesting

#### 4. CONCLUSION AND DISSCUSION

The study aims at identification of endemisms in the Trebeshina Mountain, the investigation of factors and threats affecting their distribution and conservation status. The floristic analysis of endemic plant species in Trebeshina Mt. represents an important contribution to the knowledge in the Mountain

Range it belongs to. Asteraceae family is more represented in the endemic plants recorded. However, a list of 15 Albanian endemic and subendemic species was identified and registered, suggesting that this mountain is moderately rich of endemic plants increasing its habitat conservation importance. Among the main threats species were facing was habitat destruction and long overexploitation, along with uncontrolled harvesting especially true for the medicinal plants. The fragmentation and loss of habitats due to the urbanisation was observed as well. Despite of the anthropogenic activity a negative effect on the species conservation status and their habitat health had also the climate change, increased temperatures and decreased of rainfalls. These threats were also identified as the main reason of species vulnerability in Southern mountain areas in Albania (Mahmutaj et al. 2014; 2015). There is the need to develop plan strategies and to control the threats, especially human activity on endemic species in order to preserve them. This study, as an approach of plant conservation, provides the first baseline for future research towards the protection of the endemic and subendemic plant species of this mountain, in order to prevent future plant extinction and loss of biodiversity. We recommend the development of strategies to control threats especially those related to human activity as restriction of ecosystem use for a certain period of time.

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## O 11. EVALUATION OF ORGANOCHLORINE POLLUTANTS IN RIVER ESTUARIES OF VJOSA, SEMANI AND SHKUMBINI (ALBANIAN RIVERS)

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**ABSTRACT:** Purpose of this study was evaluation of levels for some organochlorine pesticides (DDTs, HCHs, Heptachlors, Aldrins and Endosulfanes) and polychlorinated biphenyls (PCB) in water samples of Vjosa, Semani and Shkumbini rivers. These rivers have a catchment area that collect waters from large agricultural areas includes Myzeqeja Field. Many industrial wastes finished in these rivers because of elevated industrial activity near these rivers. All these rivers flow into Adriatic Sea, so it is important to evaluate the pollutant levels in their estuaries. Water samples were taken two times per year in a three years period from March 2017 to December 2019. Liquid-liquid extraction was used to isolate chlorinated pollutants and a florasil column was used for clean-up procedure. Analysis of organochlorinated pesticides (according to Method EPA 8081) and polychlorinated biphenyls (7 PCB markers) were realized by using gas chromatography technique equipped with electron capture detector and RTX-5 capillary column. Organochlorinated pollutants were detected for all stations, for each sampling periods because of agricultural and industrial impact in water rivers. The highest levels were found in Semani and Shkumbini rivermouths due to higher agricultural areas near these rivers. New arrivals from water irrigation and discharges of industrial wastes influence in found levels. Degradation products of pesticides and volatile PCBs were found in higher levels for all analyzed samples. The levels of organochlorine pollutants were higher than EU and Albanian norms for Semani and Shkumbini rivers.

**Keywords:** Organochlorine pesticides; PCBs; PAH; Water analyzes; GC/ECD

### 1. INTRODUCTION

Albania is country rich in marine and surface waters. It is facing the Adriatic Sea and the Ionian Sea. The major water resource is surface water presented by lakes and rivers. Three main lakes of Albania are Shkodra Lake, Ohrid Lake and Prespa Lake. The most important rivers are: Drini, Mati, Ishmi, Erzeni, Shkumbini, Semani, Osumi, Vjosa, Bistrica and Buna (Cullaj et al, 2005). The main rivers of Albania discharge into the Adriatic Sea. In this study were evaluated concentrations of some organochlorine pollutants in water samples of river estuaries for Vjosa, Semani and Shkumbini.

Vjosa River is 270 kilometer long. It lies between Greece (first 80 km) and Albania territory (from Permeti to Vlora). Along its entire course it is untamed and free flowing and characterized by beautiful canyons, braided river sections, islands and meandering stretches. The meandering lower part opens up into a valley with extensive wetlands, providing habitats for spawning fish, migratory birds and others. Finally, it drains into the sea just north of the Narta lagoon – one of the biggest and ecologically richest lagoons of Albanian. The Vjosa is draining a total area of 6,700 km<sup>2</sup> in Albania and Greece and discharges an average of 204 m<sup>3</sup>/s into the Adriatic Sea. In the first part, the river lies in a mountainous area that is mainly clean due to the greater slope and faster flow. In the second part because of plain part the river moves more slowly and is more polluted due to the influence of the agricultural areas of the Myzeqeja Field (Nuro et al, 2018).

The Semani River lies in western Albania. It is formed by join together of Osumi and Devollı rivers near Kucova. These rivers begin in South-East Albania (Erseka and Devollı respectively) and pass in Korca, Gramshi, Skrapari and Berati areas. Osumi River is considering a clear river because of mountainous areas where it is lies but Devollı River lies through Korca Field that is second agricultural area in Albania. Semani is 85 km long (281 km including its longest source river Devoll) and its drainage basin is 5,649 km<sup>2</sup> (include two main effluents). It flows in Fieri territory into the Adriatic Sea (near Topoja) with an average discharge of 95.7 m<sup>3</sup>/s. Semani River is considered one of the most polluted rivers in Albania because it is directly influenced from extracting and processing oil industry (Patos-Marinza area and refineries of Fieri and Ballshi) and in the same time it is affected from waters that came from Myzeqeja field which is the main agricultural area in Albania. Gjanica River that joins with Semani some kilometers from Fieri brings a considerable pollution from oil industry.

Shkumbini River originates from Valmara Mountains (Pogradeci) in Southeastern Albania. After descending from the Valamara's, it flows in Pogradeci and Librazhdi territories in many deep gorges and canyons. A significant inflow comes from Gur i Kamjës in southwest of Pogradec. Over the course, it flows between the Mokra and Shebenik Mountains in the east and the Polis Mountains in the west. Close to Librazhdi the river joins the Rapun stream. It passes in Elbasani, Peqini and in the end the river cross the Myzeqeja field. Before reaching the Adriatic Sea it forms a small delta in Karavasta Lagoon. It is 181 km long and its drainage basin is 2,444 km<sup>2</sup>. Its average discharge is 61.5 m<sup>3</sup>/s. Also, Shkumbini River is affected from elevated industrial and agricultural activity especially in its second part where the flow is slower and the activity is higher (Como et al 2013, Murtaj et al 2013).

Before 90' organochlorinated pesticides (OCP) were used widely in Albania for agricultural purposes. The main agricultural areas were in the western of the country but almost every were in the country had been developed different directions of agricultural (fruits, corns, vegetables, etc). This study considers water samples of estuaries for three main rivers that pass through Myzeqeja Field which is the main agricultural areas of Albania. It lies in the South-West of central Albania. The fields that lie in these areas are very fertile, especially for cereals, fruits and vegetables. The main parts of these fields are covered by the Shkumbini, Vjosa and Semani rivers and their branches. It is known for elevated agricultural activity after Second War until now. In the past the main parts of Myzeqeja field have been a wetland. Firstly, DDT and other organochlorine pesticides (Lindane, HCB, Aldrins, Endosulfanes and Heptachlors) were used in this area against malaria vector and after that for agricultural purposes. The use of pesticides in Albania after the 1990 decreased rapidly due to migration and/or immigration of population. PCBs were not in use in Albania until 90'. They can be found only in some electrical transformers that were used in early 1990 but they were reported in many ecosystems because of atmospheric depositions. Organochlorine pollutants (OCP and PCB) have high stability, high bioaccumulation capacity and the ability to spread out of the application site. Generally these compounds are difficult to degrade. Runoff affects the movement of pollutants in water over a sloping surface. The amount of pollutants runoff depends on: the slope, the texture of the soil, the soil moisture content, rainfall, and the type of pesticide used (Corsi et al, 2010; Nuro et al, 2012).

## **2. MATERIALS AND METHOD**

### **Chemicals**

Hexane and Dichloromethane for pesticide residue grade were purchased from Sigma Aldrich. Anhydrous sodium sulfate (Na<sub>2</sub>SO<sub>4</sub>), Florisil ( $\geq$  400 Mesh ASTM) and silica gel (60-100 Mesh ASTM) were purchased also from Sigma Aldrich. H<sub>2</sub>SO<sub>4</sub> with 95-97% purity for GC analyses was purchased by Merck. The sodium sulfate, florisil and silica gel were pre-extracted and rinsed with Hexane/Dichloromethane (4/1) just before utilization. EPA 8081 pesticide (17 compounds of organochlorine pesticides) and 7 PCB markers mix standard were purchased from Sigma Aldrich. Standard solutions for all pollutants were prepared by dissolving their stock solutions in Hexane in different concentrations and storing them in refrigerator. All glassware was rigorously cleaned with detergent followed by pyrolysis at 220°C. Procedural of blanks were regularly performed and all results presented are corrected for blank levels.

### **Study areas**

The study areas were river estuaries of Vjosa, Semani and Shkumbini (Adriatic Sea, Albania). Water samples were taken two times per year in a three years period from March 2017 to December 2019. The sampling stations are presented in Figure 1. 2 L of water were taken from each station in Teflon bottles. The sampling method was based on UNEP/MED Wg. 128/2, 1997. Water samples were transported and conserved at +4°C prior to their analyze.

### **Treatment of water samples for organochlorine pesticides and PCBs analyze**

1 L of water and 40 mL n-Hexane (extracting solvent) were added in a separatory funnel. Liquid-liquid extraction was used for the simultaneously extraction of 15 organochlorine pesticide and PCB markers from water samples. The organic phase after separation was dried with 5 g Na<sub>2</sub>SO<sub>4</sub> anhydrous, for water removing. A Florisil column was used for the sample clean-up. After the concentration to 1 ml using a thermal block, the samples were injected in GC/ECD (Nuro et al, 2012; Kostandinou et al, 2006; Wells and Hess, 2000).



**Figure 1.** Sampling stations of water samples in river estuaries of Vjosa, Semani and Shkumbini

### Apparatus and chromatography

Chromatographic analyse were realized in a Varian GC 450 model. GC was equipped with split/splitless injector, Rtx-5 capillary column ( $30\text{ m} \times 0.33\text{ mm} \times 0.25\text{ }\mu\text{m}$ ) and electron capture detector. Nitrogen was used as carrier gas ( $1\text{ ml/min}$ ) and make-up gas ( $25\text{ ml/min}$ ). Injector and ECD temperature was hold respectively  $280^\circ\text{C}$  and  $300^\circ\text{C}$ . Quantification of organochlorine pesticides and their residues was performed in external standard. Five concentrations of pesticides and PCB mixture ( $5, 10, 25, 50$  and  $100\text{ ng/ml}$ ) were used for calibration (Lekkas et al, 2004; Vryzas et al, 2009; Nuro et al, 2012). Organochlorine pesticides were: Lindane and its isomers (alfa-HCH, beta-HCH, gama-HCH or Lindane and delta-HCH); Heptachlor's (Heptachlor and Heptachlorepoxyde); Aldrin's (Aldrine, Dieldrine and Endrin); DDTs (4,4-DDE; 4,4-DDD and 4,4-DDT) and Endosulfanes (Endosulfan alfa, Endosulfan beta and Endosulfan sulfat) while PCB markers were (PCB 28, PCB 52, PCB 101, PCB 118, PCB 153, PCB 138 and PCB 180).

### 3. RESULTS AND DISCUSSION

Water samples from river estuaries of Vjosa, Semani and Shkumbini were analyzed for two times per year in a three years period (2017-2019). These rivers flow in Adriatic Sea, in West (central) Albania. These rivers cover a large catchment area and pass through Myzeqeja Field which is the main agricultural areas of Albania. DDT, Lindane, HCB, Aldrins, Endosulfanes and Heptachlors were used in this area for against malaria vector and for agricultural purposes. Also, industrial activities and atmospheric deposition of pollutants can influence water of Vjosa, Semani and Shkumbini rivers. All these rivers flow in Adriatic Sea and this was the reason that we thought to analyze water samples in

their estuaries to see also their impact in the sea. Organochlorine pesticides, their degradation products and PCB markers were analyzed in a total of 27 water samples. Average data on organochlorine pesticides and their classes was shown in Table 1.

Figure 2 shows total of organochlorine pesticides (average concentrations) found in water samples of river estuaries for Vjosa, Semani and Shkumbini. Higher level of organochlorine pesticides were found for Semani River (146.0 ng/l) and Shkumbini River (131.7 ng/l). The main factor of higher concentrations of OCPs in these two water rivers can be their previous uses for agricultural purposes. Rivers furnished continuously with new inputs from rainfall and water irrigation. Punctual sources or recent use of pesticides can impact on differences between rivers. The lower level was found in water samples of Vjosa River (23.8 ng/l).

Figure 3 shown distributions of organochlorine pesticides in three river estuaries. There are noted similarities in all samples because the same pollution origin. For Semani and Shkumbini rivers were noted the presence of individual pesticides in higher levels than others. This could be connected with punctual sources or a momentum value.

Total for the pesticide groups of HCHs, Heptachlors, Aldrins, DDTs and Endosulfanes was shown in Figure 4. Endosulfanes were found in higher concentrations for three rivers. May be, this pesticide could be in use recent years near Myzeqeja area. After that, Aldrins and Heptachlors were found in Vjosa River; HCHs, Aldrins, Heptachlors and DDTs in Semani River and Heptachlors, Aldrins, DDTs and HCHs in Shkumbini River. These differences could be because of punctual sources near these rivers and chemical-physical characteristics of individual pesticides. Pesticide concentrations for each classes in water samples of Vjosa, Semani and Shkumbini rivers were in the same levels with reported data on previous studies for the same stations (Murtaj et al 2014; Como et al 2013, Nuro et al 2017).

Concentrations of Lindane and its isomers (alpha-, beta-, gama- and delta-hexachlorocyclohexanes-HCHs) were shown in Figure 5. Their total was respectively: Semani River (26.4 ng/l) > Shkumbini River (12.5 ng/l) > Vjosa River 1.8 (ng/l). It was noted that Lindane concentration wasn't the higher than other HCHs. It was found only in 60% of all analyzed samples. beta-HCH were found the primary isomer for all three rivers. Its origin could be because of their presence as impurity in Lindane formulations or because of Lindane chemistry. This is valid for all Lindane isomers. HCHs could be also products of degradation of other pesticides or because of impact of urban waste especially in rivers water. For all stations, total of HCHs were lower than permitted level of 0.04 ug/l conform EU Directive 2013/39 and Albanian norms for surface waters.

Heptachlors were found in higher concentration in water samples of Shkumbini with 23.2 ng/l (Figure 6). Levels of Heptachlors in Semani and Vjosa rivers were respectively with 12.0 ng/l and 4.6 ng/l. The higher levels in three rivers were found for Heptachlorepoxyde, its degradation products. This fact is connected with previous use of Heptachlor. Levels of Heptachlors in some stations of Shkumbini and Semani rivers were higher than EU Directive 2013/39 or Albanian norms.

Concentrations and profiles of Aldrines were shown in Figure 7. The higher levels of Aldrines were for Shkumbini River with 21.5 ng/l and for Semani River with 20.2 ng/l. In fact the higher level of Aldrine in Semani River was connected with higher concentration of Dieldrin while in Shkumbini River in higher concentration was Endrin. This is connected with time of use for Aldrine in the agricultural areas near these rivers. Aldrines were found 2 times higher than EU directive 2013/39 and Albanian norms for Semani and Shkumbini river.

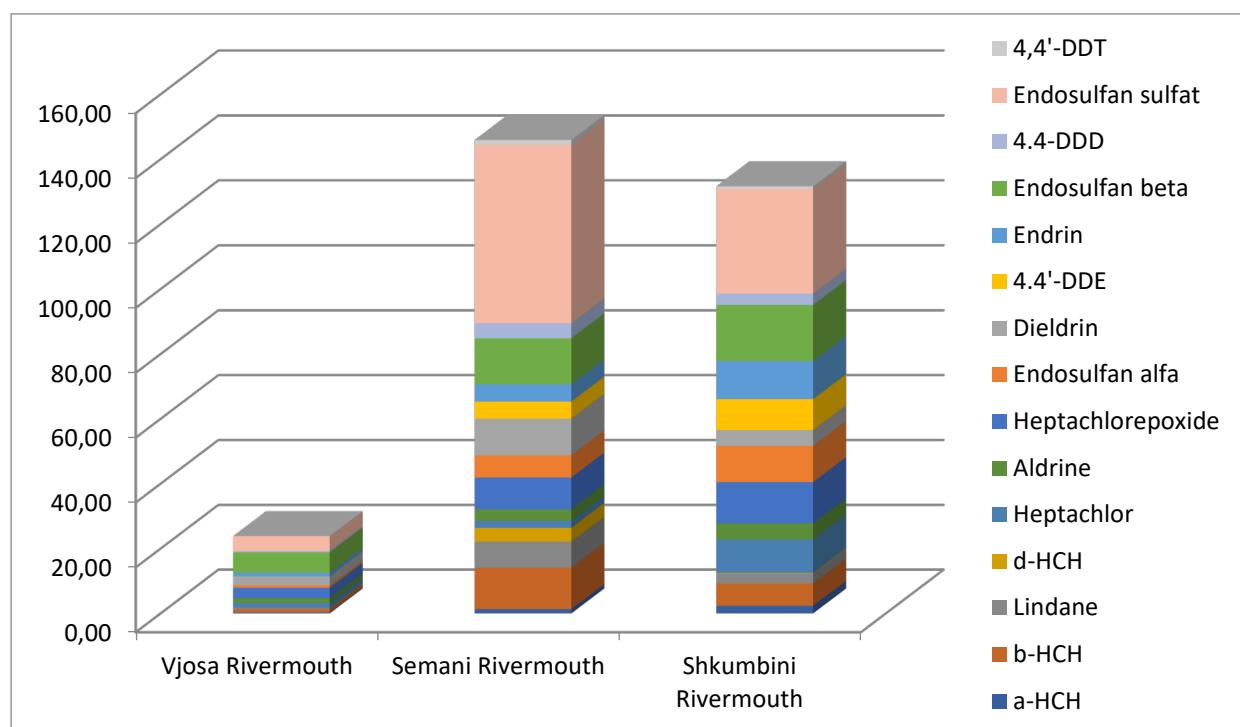
Concentrations of DDTs for Vjosa, Semani and Shkumbini rivers were shown in Figure 8. The higher level of DDTs was found in Shkumbini River with 13.9 ng/l and after that in Semani River with 11.4 ng/l. Total of DDTs in Vjosa River was 0.5 ng/l. DDT was found on 25% of samples only for Semani and Shkumbini rivers. DDT was not detected in water samples of Vjosa River. Its degradation products (DDE and DDD) were found in high concentration for all samples because of previous use of DDTs in the agricultural areas of Myzeqeja. DDT levels were lower than 1 ng/l for all stations except two samples in Semani rivermouth station (2017). 4,4'-DDT were lower than permitted level of 0.01 ug/L for Vjosa and Shkumbini rivers.

Endosulfans concentrations in three rivers were presents in Figure 9. Total of Endosulfans were higher in Semani River (76 ng/l) and Shkumbini River (60.6 ng/l). Note that Endosulfans were found in higher level only for two samples in Semani River (2017 and 2018) and for one sample in Shkumbini River (2018). This fact suggests punctual source of Endosulfan's in these ecosystems. It's not excluded the recent use of Endosulfan in water basins of Semani and Shkumbini rivers. Endosulfans could be in

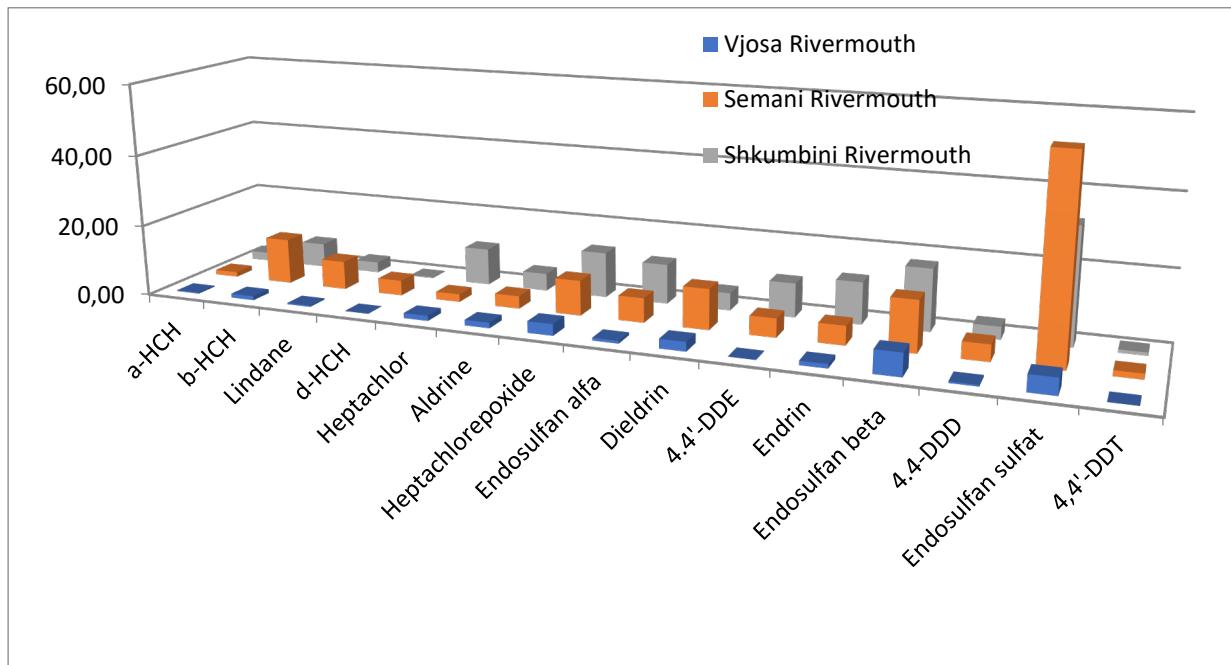
use in these areas under false trade name. Endosulfanes concentrations for water samples of Semani and Shkumbini rivers were more than 10 times higher than permitted level based on EU Directive 2013/39. Presence of Endosulfane in surface water samples must be lower than N.D.5 ug/l.

**Table 1.** Average levels (ng/l) of individual organochlorine pesticides in water samples

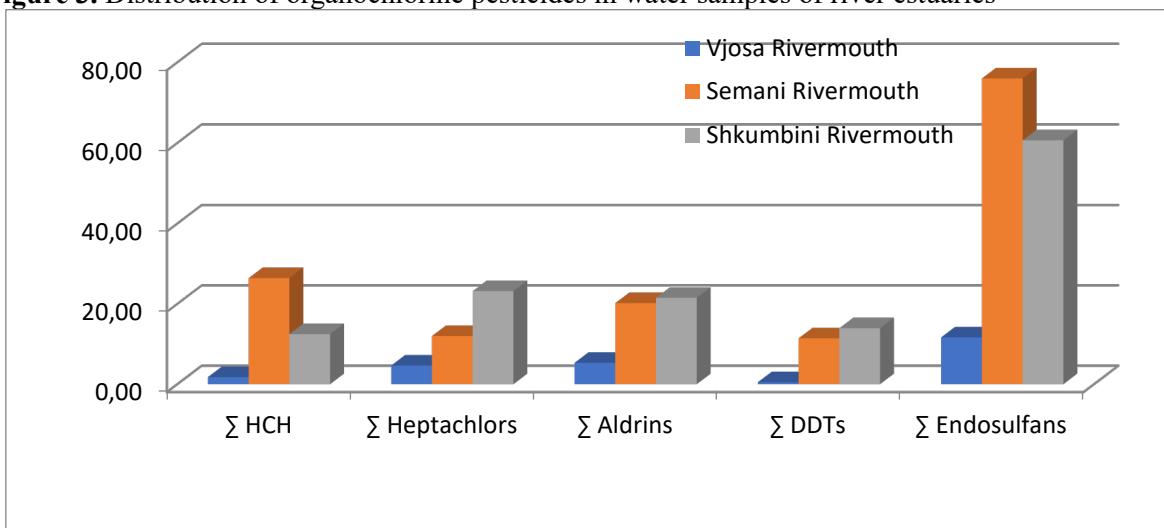
	Vjosa Rivermouth	Semani Rivermouth	Shkumbini Rivermouth
<b>a-HCH</b>	0.28	1.34	2.37
<b>b-HCH</b>	1.13	12.79	6.90
<b>Lindane</b>	0.35	8.02	2.99
<b>d-HCH</b>	N.D.	4.25	0.20
<b>Heptachlor</b>	1.43	2.17	10.40
<b>Aldrine</b>	1.53	3.54	4.90
<b>Heptachlorepoxyde</b>	3.21	9.81	12.76
<b>Endosulfan alfa</b>	0.76	6.84	11.16
<b>Dieldrin</b>	2.61	11.31	4.87
<b>4,4'-DDE</b>	0.06	5.26	9.54
<b>Endrin</b>	1.17	5.33	11.73
<b>Endosulfan beta</b>	6.32	14.18	17.30
<b>4,4-DDD</b>	0.42	4.61	3.52
<b>Endosulfan sulfat</b>	4.57	54.96	32.17
<b>4,4'-DDT</b>	N.D.	1.54	0.87
<b><math>\Sigma</math> OCP</b>	<b>23.84</b>	<b>145.95</b>	<b>131.68</b>
<b><math>\Sigma</math> HCH</b>	1.76	26.40	12.46
<b><math>\Sigma</math> Heptachlors</b>	4.64	11.98	23.16
<b><math>\Sigma</math> Aldrins</b>	5.31	20.18	21.50
<b><math>\Sigma</math> DDTs</b>	0.48	11.41	13.93
<b><math>\Sigma</math> Endosulfans</b>	11.65	75.98	60.63



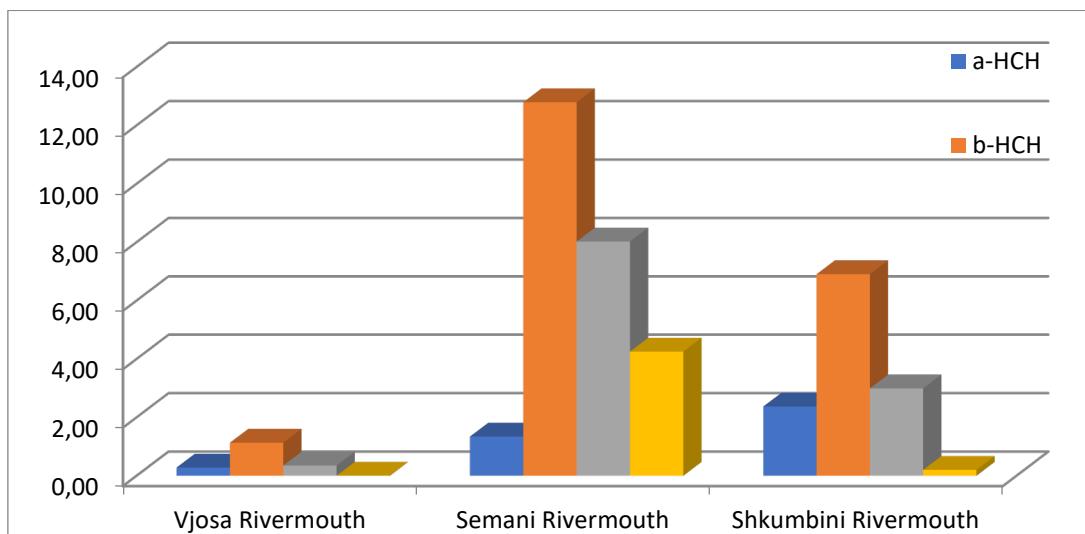
**Figure 2.** Total of organochlorine pesticides in water samples of Vjosa, Semani and Shkumbini river estuaries



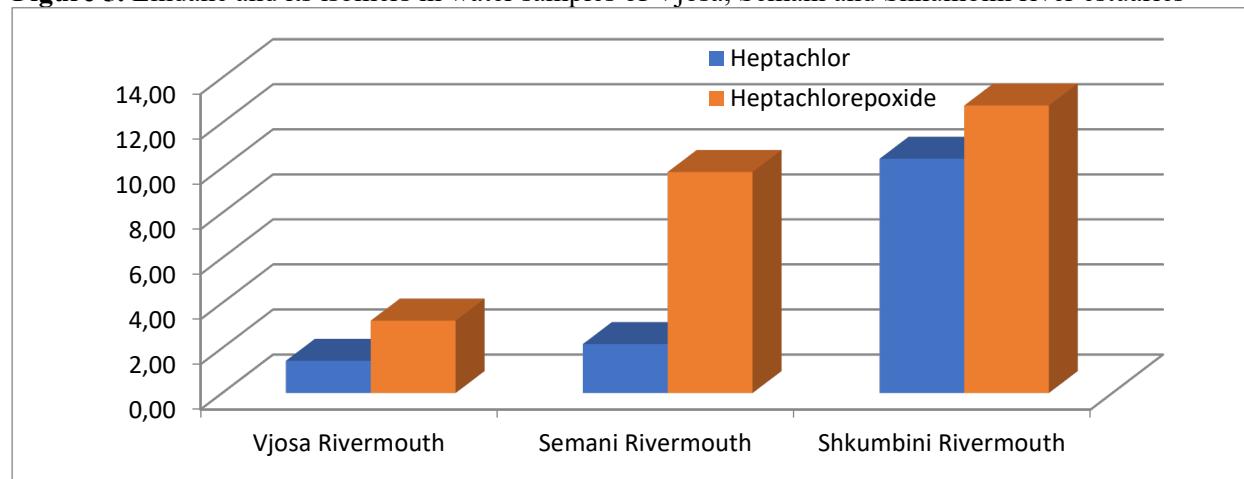
**Figure 3.** Distribution of organochlorine pesticides in water samples of river estuaries



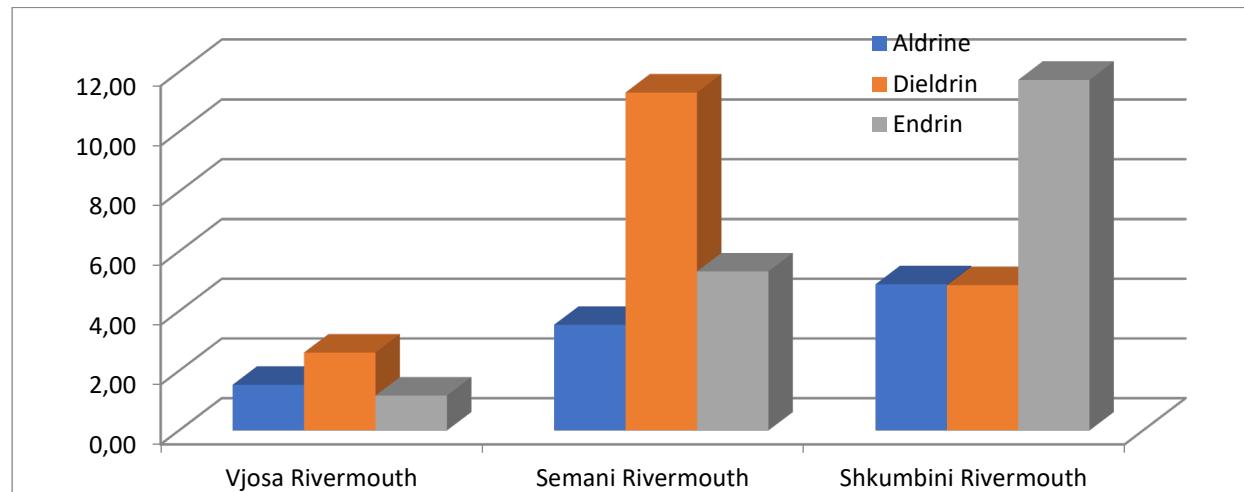
**Figure 4.** Distribution of organochlorine pesticides based on their classes



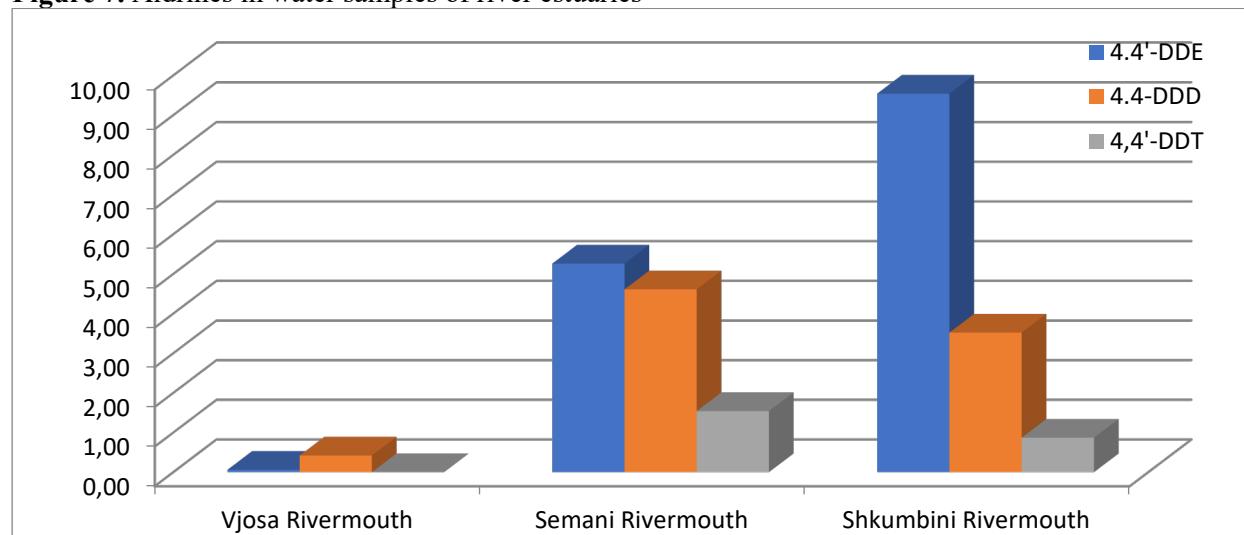
**Figure 5.** Lindane and its isomers in water samples of Vjosa, Semani and Shkumbini river estuaries



**Figure 6.** Heptachlors in water samples of river estuaries



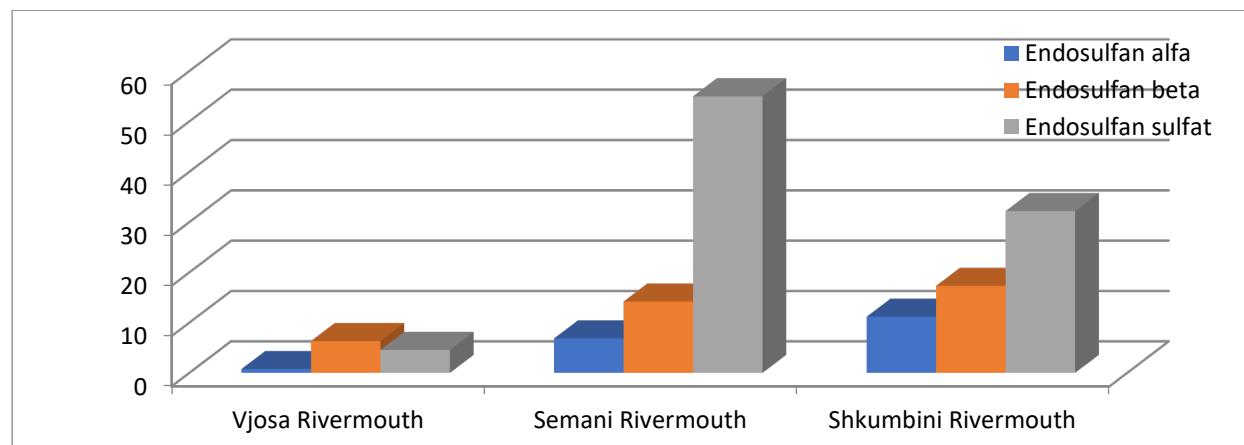
**Figure 7.** Aldrines in water samples of river estuaries



**Figure 8.** DDTs in water samples of three river estuaries

Average data on 7 PCB markers was shown in Table 2. Figure 10 shows total of PCB markers in water samples of river estuaries for Vjosa, Semani and Shkumbini. Also, higher level of PCBs were found in Semani River (69.7 ng/l) and Shkumbini River (60.8 ng/l). The main factor for higher

concentrations of PCBs in these two water rivers can be elevated industrial activity in their water basins. Again, Vjosa River was the most “clean” with PCBs (18.3 ng/l).

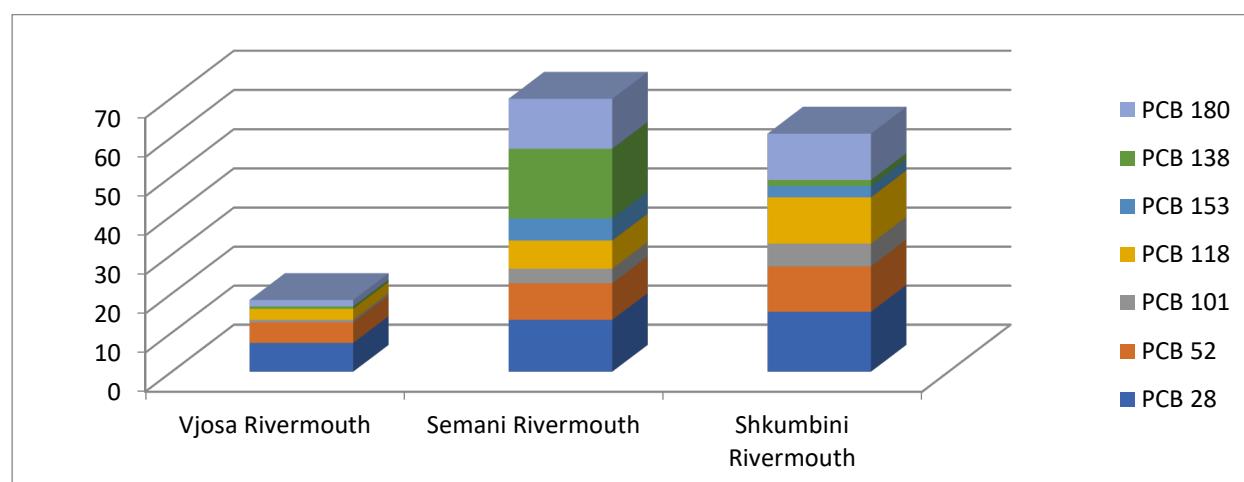


**Figure 9.** Endosulfanes in water samples Total of Vjosa, Semani and Shkumbini river estuaries

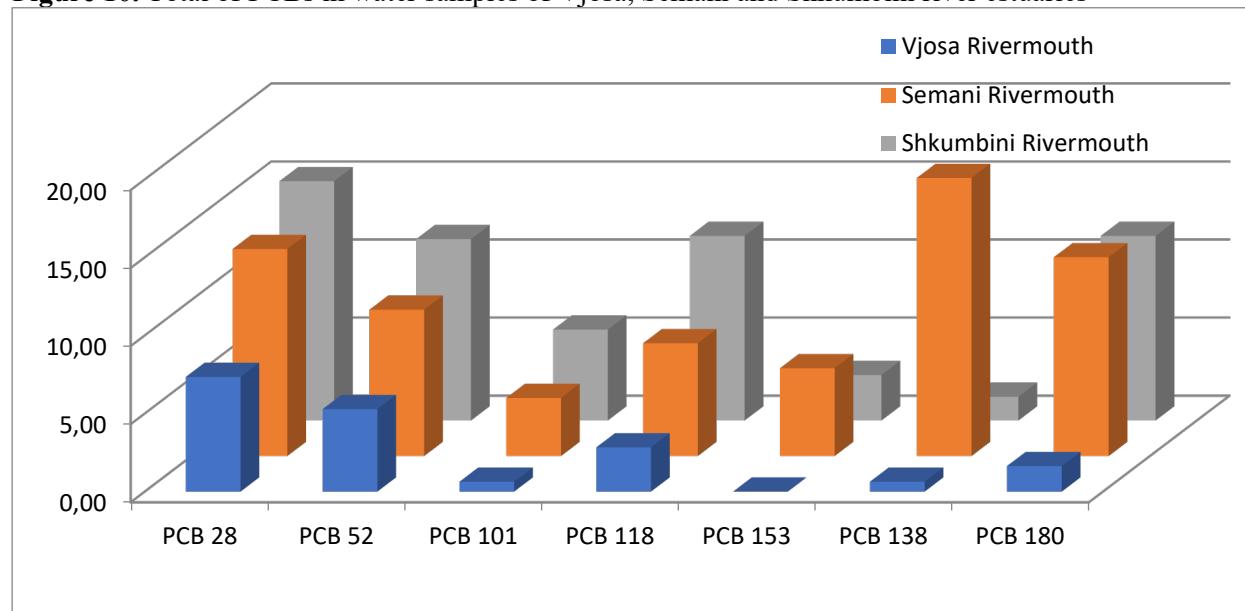
Figure 11 shown distributions of PCB markers in three river estuaries. There are not similarities between samples because differences in pollution origin. For Semani and Shkumbini rivers were noted the presence of heavy PCB congeners (PCB 180) that is connected with punctual sources for PCBs in these ecosystems while in Vjosa River in higher levels were detected volatile congeners (PCB 28 and PCB 52) that is connected with atmospheric deposition. These differences could be because of impact that came from elevated industrial activity in Semani and Shkumbini rivers. Note that some of industries that can influence more are extraction and processing of oil industry (Semani Rivers) and metallurgical complex near Elbasani (Shkumbini River). PCB concentrations for water samples of Vjosa, Semani and Shkumbini rivers were in comparable levels than reported data on previous studies for the same stations (Murtaj et al 2014; Como et al 2013, Nuro et al 2017).

**Table 2.** PCB data (average) in water samples of Vjosa, Semani and Shkumbini river estuaries

	Vjosa Rivermouth	Semani Rivermouth	Shkumbini Rivermouth
<b>PCB 28</b>	7.34	13.26	15.33
<b>PCB 52</b>	5.28	9.37	11.62
<b>PCB 101</b>	0.63	3.72	5.82
<b>PCB 118</b>	2.83	7.22	11.82
<b>PCB 138</b>	N.D.	5.62	2.91
<b>PCB 138</b>	0.63	17.81	1.52
<b>PCB 180</b>	1.63	12.73	11.82
<b><math>\Sigma</math> PCB</b>	<b>18.34</b>	<b>69.73</b>	<b>60.84</b>



**Figure 10.** Total of PCBs in water samples of Vjosa, Semani and Shkumbini river estuaries



**Figure 11.** Distribution of PCBs in water samples of three river estuaries

#### 4. CONCLUSIONS

The highest level of contamination with organochlorine pesticides and PCBs were found in Semani and Shkumbini rivers because of new arrivals from waters that are collected by channels of Myzeqeja Field. For some stations of these two rivers were noted the presence of individual pesticides in higher levels than others. In waters samples of Shkumbini and Semani rivers were found in high level heavy PCB. This could be connected with punctual sources of pesticides and PCBs in these stations or a momentum value. It was noted presence of degradation products of pesticides in higher level. This fact is connected with previous use of pesticides in Albania. Endosulfanes were shown to be primary pollutants in all samples. This pesticide could be in use in agricultural areas near these rivers under false trade name. Presence of PCBs could be because of industrial activity or atmospheric deposition. Concentrations of organochlorine pesticides in all water samples of Vjosa River were lower than permitted levels for surface waters according EU Directive 2013/39 while some samples of Semani and Shkumbini rivers were above these norms. Concentrations of organochlorine pesticides and PCBs were found to be in comparable levels than reported data on previous studies for the same stations (Murtaj et al 2014; Como et al 2013, Nuro et al 2017).

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**O 12. BETWEEN A RESILIENT AND SUSTAINABLE FUTURE: RESHAPING  
HUMAN–NATURE INTERACTIONS TO AVOID THE COLLAPSE OF OUR  
SOCIO–ECONOMIC SYSTEMUNDWATER QUALITY FOR IRRIGATION  
SUITABILITY IN KONYA CITY**

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**ABSTRACT:** Socio-economic systems built by humans are subsystems of the natural systems and are closely related with each other. The history of past human civilizations reveals that all socio-economic systems of the past used to experience short periods of economic prosperity which were followed by the inevitable collapse. The failure of those systems may be explained with the depletion of natural resources, climate changes, and the inability of former civilizations to act wisely by adjusting their needs to the carrying capacity of nature. Bearing in mind the past of humanity, this presentation aims at contributing to: 1) applying a holistic framework to integrate socioeconomic and natural systems, 2) proposing the use of system dynamics principles to prepare simulation models to design and implement better socio-economic and environmental policies at different space-time scales, 3) applying system dynamics methodology via simulation models to forecast future scenarios for our socio-economic system and the depletion of natural resources in the coming decades. Due to the complexity of the real world, simulation models may be the best alternative in comparison with the analytical (mathematical) solutions to forecast the future reality. These models can continuously be improved to offer better approximations of the real world situations by using software programs.

**Keywords:** Holistic Approach, System Dynamics, Software Programming.

## O 13. CHALLENGES IN STANDARDIZING THE INDOOR CLIMATE OF MEDIEVAL CULTURAL HERITAGE BUILDINGS IN ALBANIA

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**ABSTRACT:** The core problem addressed in this contribution is connected with current challenge on "how nowadays knowledge and best practices regarding climate environment control of the post byzantine churches should be handled in order to secure presentation and further management". Based on the historical reasons, dozens of important cultural heritages within country are facing serious threatening aspect linked with indoor climate and lack of control. The control of the relative humidity in climate specifications in limits of 25 to 75 % for preventing the all high risk extremes is affected by: (i) damages in structures; (ii) lack of financial support and (iii) lack of management. Further on the particularities in climate conditions, high oscillation of temperature and climate change appears as further threatening aspects. Following the best practices within this contribution we propose a multi step developing of environmental management strategy and setting an environmental specification for a collection.

**Keywords:** Standards, Climate, Environment, Medieval, Preservation.

## O 14. THE ROLE OF BEECH FOREST IN BIODIVERSITY CONSERVATION IN ALBANIA

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**ABSTRACT:** In the last three decades the size of protected areas has been considerably increasing particularly after the Strategy and Action Plan on Biodiversity, 2000. Since 2005, the number of protected areas has more than doubled, out of 5 % to over 16 %. The current network of Protected areas includes 119.401 ha coastal areas and 13.261 ha marine areas. In the last decades the national interest in the protection of the virgin beech forests in Albania with its natural values and high biodiversity has been reflected in proclaiming series of protected area including Rrajca and Lumi i Gashit as strict nature reserves. After the '90s due to the hard economic situation, these forest sites were affected by unsustainable forest use in the surrounding areas, but the current policy reflects an increased conservation effort. The current beech forest cover in Albania is estimated to be approximately 142 610 ha, with ancient and virgin forests almost completely altered. Beech forest in Albania provide important habitat for a number of medium to large mammals, including Balkan lynx, wolf and brown bear. Further on the aquatic biodiversity is also connected with beech forest areas. In both Albanian Alps and also at the northeastern and eastern part of the country, there are numerous species of community interest and other species. Among amphibians is been identified *Bombina variegata* and several reptiles that are listed in the Annex II, while eight species of Amphibians and 31 species of Reptiles are listed in the Annex IV. These areas fit well with beech forest and subalpine areas distribution. 20 mammal species, of which 18 terrestrial mammals and two marine ones are included in the Annex II of HD in Albania, while 40 mammal species in Albania are part of the HD Annex IV.

**Keywords:** *Biodiversity, Beech forest, Conservation, Species, Wildlife.*

## O 15. INVESTIGATION OF THE EFFECT OF CORONA VIRUS OUTBREAK MEASURES ON ATMOSPHERIC PM VALUES FOR KONYA CITY CENTRE

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**ABSTRACT:** This present study is to investigate the change in atmospheric particulate matter values of curfews taken due to the corona virus outbreak in Konya city centre. In this study, PM10 pollutant data was used in Konya city centre data of the Ministry of Environment and Urbanization. The period in which strict measures were taken in the study was compared with the period between 16 March 2020 and 15 April 2020 before and after. In addition, seasonal conditions, 2020 epidemic period data and normal period 2018 and 2019 data were also compared. As a result, because the vast majority of living in major cities in the epidemic period of restrictions in Turkey Konya seen the positive effects on air quality in the city centre it has been found to be examined in PM10. It was revealed that the measures taken in the period of virus outbreak, curtailment of traffic and reduction of industrial activities caused a remarkable improvement in air quality. Considering the measures and improvements in air quality, it is considered to be worth investigating how the measures should be evaluated in the coming periods in combating air pollution.

**Keywords:** Air pollution, Konya, Corona Virus, Pandemic, Air quality

### 1. INTRODUCTION

Coronavirus, a novel infectious disease, was first identified in the Wuhan province of China in December 2019 (Kanniah *et al.*, 2020; Huang *et al.*, 2020; Chen *et al.*, 2020). This disease later spread to other countries in Asia, Europe (mainly Italy, Spain, France and the United Kingdom), Africa and America (mainly the United States), and became a pandemic. COVID-19 is extremely communicable to more than 11.8 million People (confirmed cases on 09 July 2020) have been contaminated in 210 countries with more than 534, 902 recorded deaths (09 July 2020; URL-1). When countries entered the lockdown, manufacturing operations were shut down worldwide (Muhammad & Xingle, 2020). Transport is, among many other industries, the business most seriously impacted by the lockdown. Road and air transport comes to a stop because people were not permitted or hesitant to fly. According to the survey, air traffic decreased by 96 per cent attributable to COVID-19, the lowest in 75 years (CNN, 2020). As a potential side effect of this extraordinary lockdown, several countries have undergone a drastic decrease in air quality. In China, the Finnish Centre for Energy and Clean Air Study announced that steps to curb the spread of COVID-19, such as travel restrictions and plant closures, culminated in a 25% decrease in CO<sub>2</sub> emission (Carbon Brief 2020, URL-2) Similarly, satellite images by the European Space Agency (ESA) revealed a substantial reduction in NO<sub>2</sub> pollution in northern Italy between 01.January and 11.March 2020. Lockdowns to protect off coronavirus (Bao & Zhang, 2020). In addition, the Institute of environmental Science and Meteorology (IESM) has reported that since the launch of the Luzon strengthened environmental quarantine on 16 March 2020, the PM<sub>2.5</sub> and PM<sub>10</sub> concentrations in Metro Manila have been substantially decreased due to reduced use in crushing and grinding machines and low road dust exposure (Wang *et al.*, 2020).

Particle matter (PM) air pollution is more complicated, spanning a broad variety of applications. This consists of a multi-component matrix derived from different anthropogenic (power production, traffic-related, etc.) and natural causes (biomass combustion, pollen, etc.) and is subject to a variety of atmospheric processes (Zoran *et al.*, 2020). In certain urban coagulated regions, PM concentrations are

typically dominated by various size fractions (ultrafine PM0.1 particles with a diameter of  $< 0.1 \mu\text{m}$ ; small PM2.5 particles with a diameter of  $\leq 0.2.5 \mu\text{m}$ ; coarse PM10 particles with a diameter of  $> 0.2.5 \mu\text{m}$  and  $\leq 10 \mu\text{m}$ ) (Zoran et al., 2019; Khan et al., 2019). many studied in different countries were done to investigate the impact of COVID19 on air pollution concentrations and these studies have shown that the lockdown contributed to a substantial decrease in aerosols optical depth AOD over sea and emissions over oceanic regions, although a large decrease in tropospheric NO<sub>2</sub> was reported over areas not influenced by seasonal biomass combustion. PM10, PM2.5, NO<sub>2</sub>, SO<sub>2</sub> and CO concentrations showing a notable decreased in urban areas during the lock-down process relative to the same times in 2018 and 2019 (Dutheil et al., 2020; Muhammad & Xingle, 2020; Bao & Zhang, 2020; Otmani et al., 2020). The present study aims to investigate the change of PM10 concentration due to the effects of coronavirus outbreak in Konya city center, Turkey using the data of the existing air quality monitoring station in the city before and after Covid19 measures.

## 2. MATERIAL AND METHOD

### Study area and data sources

Konya is a closed basin located in the central part of the interior of Anatolia, Turkey (Figure 1). The closed basin consists of wide ovals and plateaus. As the Taurus Mountains cover the south of the basin, it prevents the moist air of the Mediterranean from coming to the region. Therefore, although it is close to the Mediterranean, it has a very arid climate and has a semi-arid feature. With this feature, summers are hot and dry and winters are cold. Turkey is much less rainfall than in the general. In the past, it called Turkey's granary and socio-cultural development, as this feature is also changed by the change of climate and water resources. Industrial areas, especially provincial center, have also developed. Since air circulation is not enough in the city center from time to time, air pollution events reach levels that disturb people on some days.

**Climate:** In Konya, located in the southern part of Central Anatolia, winters are harsh, cold and snowy, summers are hot and dry. The average annual temperature is 11.6 ° C. The daily maximum annual temperature is 17.9 ° C and the minimum annual temperature is 5.4 ° C. The highest temperature is 40.6 ° C and the lowest is -28.2 ° C (Figure 1).

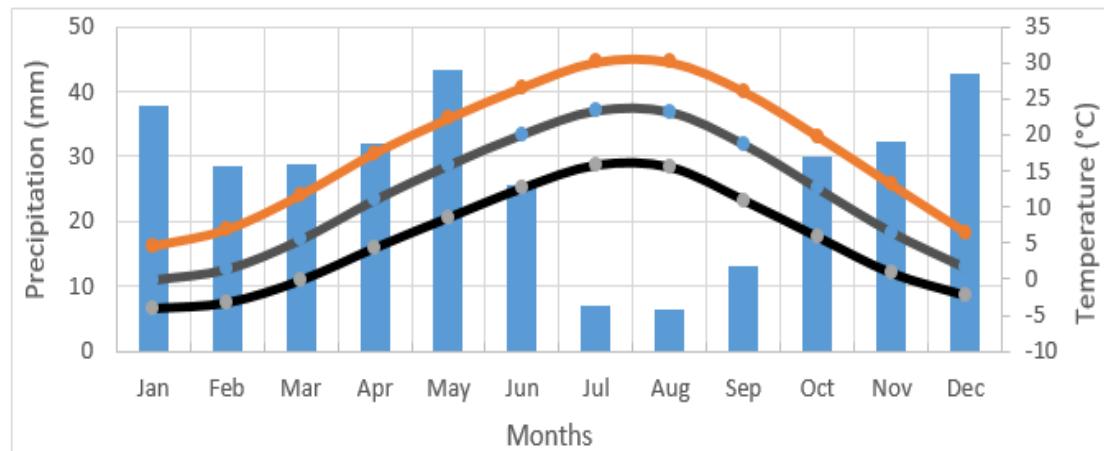


Figure 1. long term, between 1929 to 2019, average values of Temperature and precipitation of Konya city (URL-3).

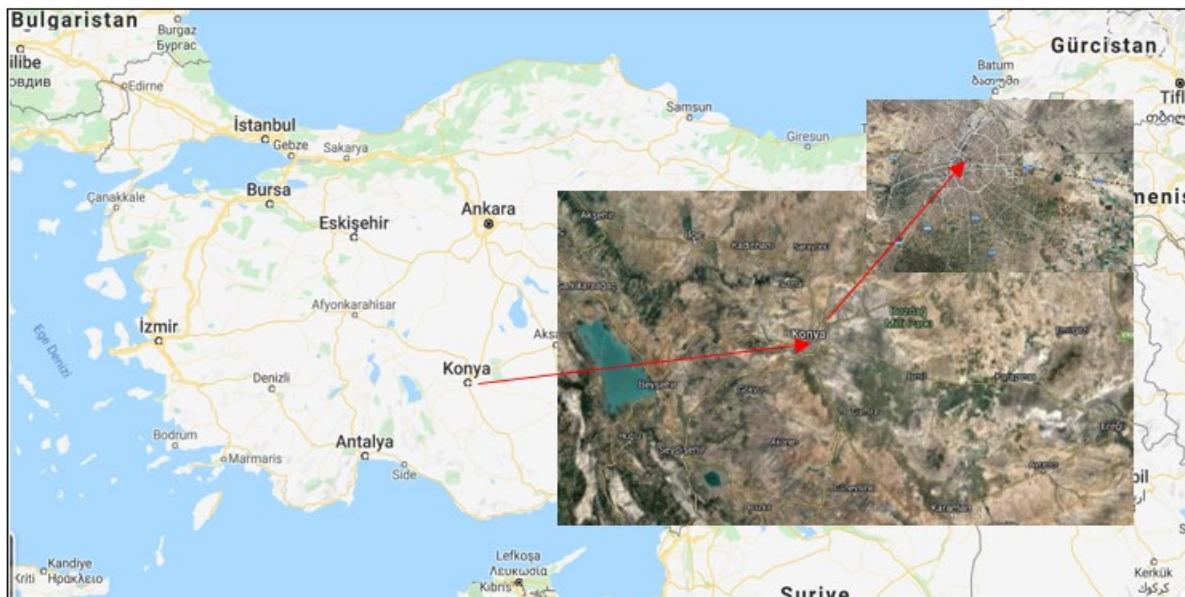


Figure 1. Location of research area Konya (URL-4)

**Air pollution:** Depending on the development of the industry in the city center, fossil fuel consumption for energy needs is one of the emission sources thrown into the air. Again, because the region is very cold in the winter months, fossil fuels used for heating are another important source of air pollution. It is thought that it contributes to air pollution from industrial processes. Vehicles in traffic have a significant impact on air pollution, and their contribution to air pollution especially increases in some periods and hours. The exhaust gases of the vehicles are especially important in terms of very small PM, CO, and NOx emissions.

**Data:** The air quality monitoring stations located in the center of Konya as an all other Turkish cities. In this study, air pollution measurement values of 4 stations in the city center of Konya were obtained from the Ministry of Environment and Urbanization WEB page (URL-5). PM<sub>10</sub>, SO<sub>2</sub>, PM<sub>2.5</sub>, NO<sub>2</sub> and O<sub>3</sub> values are measured at the sampling stations of the Ministry and Konya municipality are published on the WEB page as hourly and then daily averages measurement values are given in  $\mu\text{g}/\text{m}^3$ .

This present study is to investigate air quality with the change in atmospheric particulate matter values of curfews taken due to the coronavirus outbreak in Konya city center. The 2<sup>nd</sup> period which is strict measures were taken for Covis-19 which were compared two periods 1 January 2020 - 15 March 2020 and 16 March 2020 - 15 April 2020. In addition, seasonal conditions, 2020 epidemic period data, and normal period 2018 and 2019 data were compared. Period 1<sup>st</sup>, before the Covid-19 measures (between January 1 and March 15). Period 2<sup>nd</sup>, after the Covid-19 struggle started (between March 16 and April 15).

R-statistic program, which is an open code statistics program, was used to create the distribution of pollution maps of the data, daily air pollutants data of 01.01.2018-15.06.2020 compared.

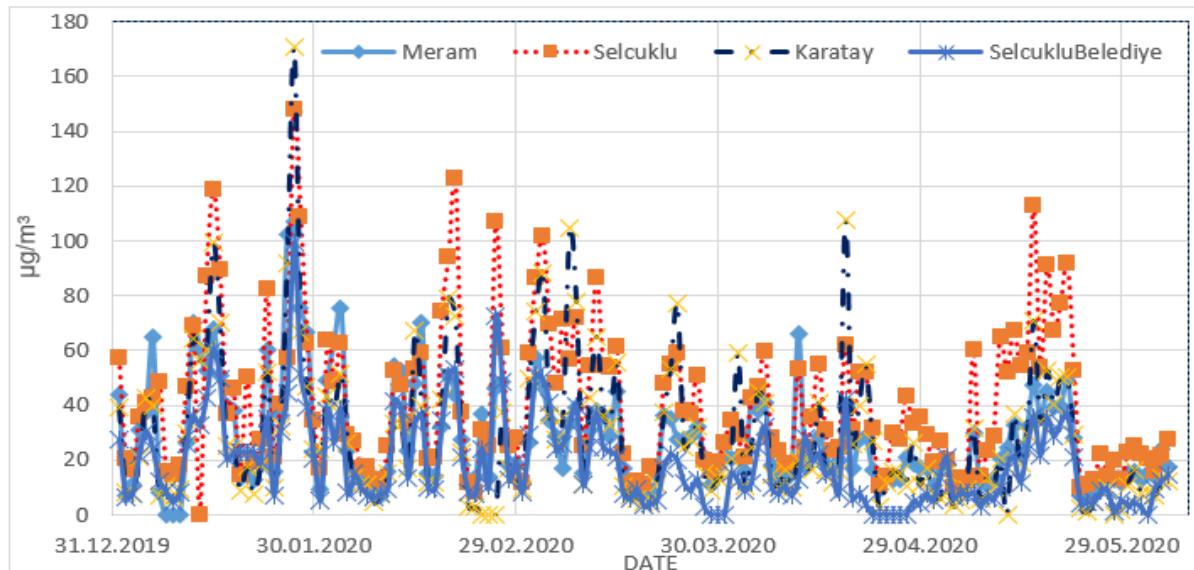
### 3. RESULTS AND DISCUSSION

Any region in the world where the industry is highly developed, provincial centers where traffic is very heavy, and settlements in the places where winter seasons are cold and using low-quality fossil fuel consumption affects the quality of human life, especially in people with respiratory diseases problems. The topographic structure and climatic features of a region are also as effective as emission sources in the formation of air pollution. Especially in the winter months, there is an increase in the emission levels as the temperature decreases with increasing fuel usage for heating systems. However, the negativity caused by meteorological conditions causes lower than expected levels of air quality problems.

Using the data of the existing air quality monitoring stations in the Konya city center: it is seen that the air quality increases and then returns to normal levels during the period when a curfew is restricted for measures taken due to the Covid-19 pandemic outbreak period. outbreak restrictions that cause the

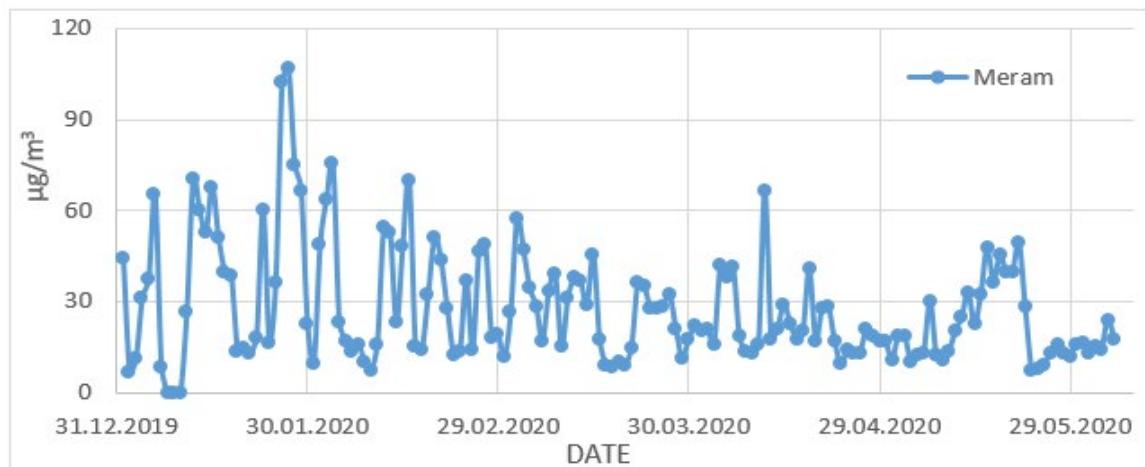
reduction in vehicle exhaust emissions, which are important factors in the formation of some air pollutant parameters, are thought to be effective in improving the air quality in city centers.

Figure 2 shows the mean daily particle matter concentration for 4 different sampling stations in Konya city center from the beginning of 2020 to the middle of June 2020. Values in graph show a significant decreasing after pandemic outbreak middle of March 2020 except Selcuklu sampling point differentiation due to the effect of Saharan dust effect period.



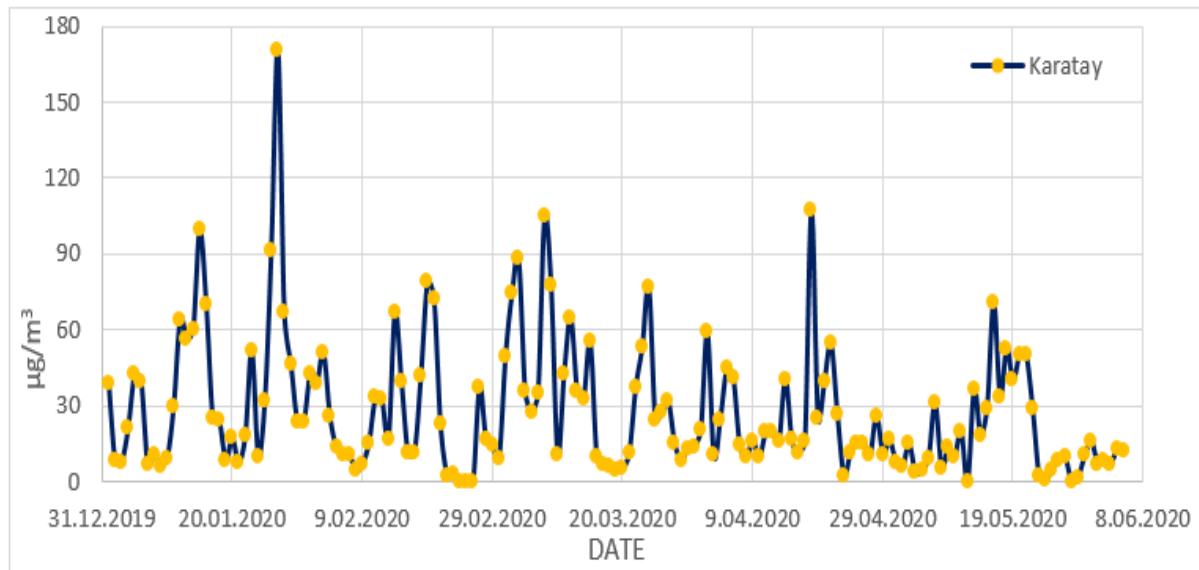
**Figure 2.** PM<sub>10</sub> values for four different sampling stations at Meram, Karatay, Selcuklu districts of Konya city center.

When it is seen separately in Figure 3, daily mean of PM<sub>10</sub> levels as an air quality parameter in Meram district sampling station of Konya city. They show that PM<sub>10</sub> values decreased and values significantly changed for Meram regions during the outbreak of virus pandemic period.



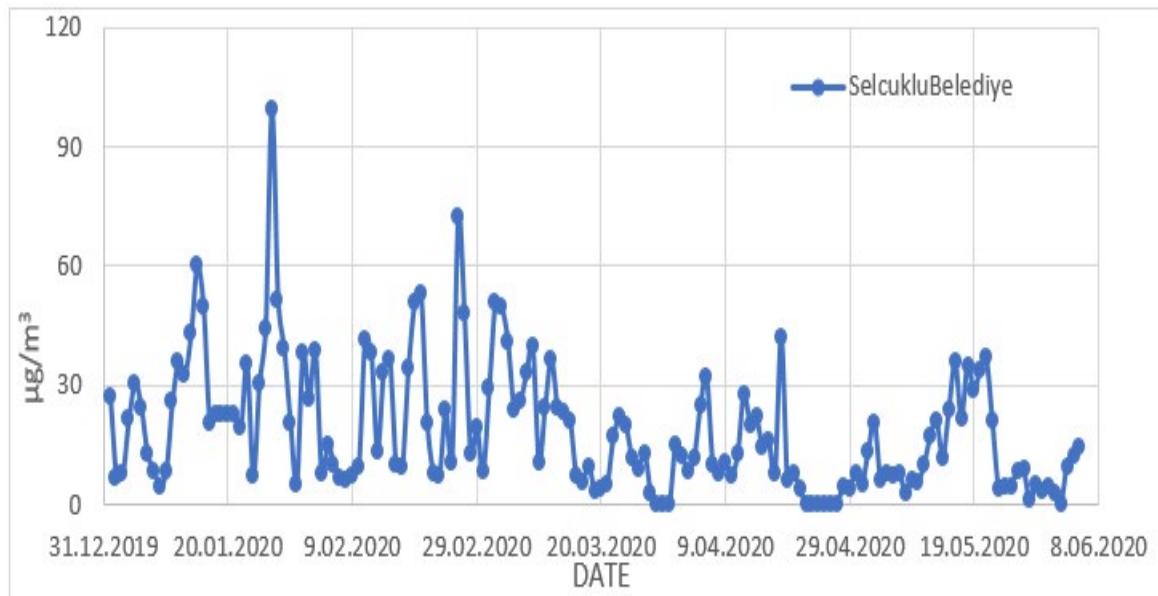
**Figure 3.** PM<sub>10</sub> values for sampling stations of Meram district of Konya city center for the beginning of January 2020 to middle of June 2020.

According to Figure 4, PM<sub>10</sub> values for sampling stations in Karatay district of Konya city center are higher than Meram district but values are parallel trend with Meram region. This district includes places that are a more industrialized factory region. Values were significantly decreased during the restriction of COVID-19 pandemic after March 16<sup>th</sup>, 2020.



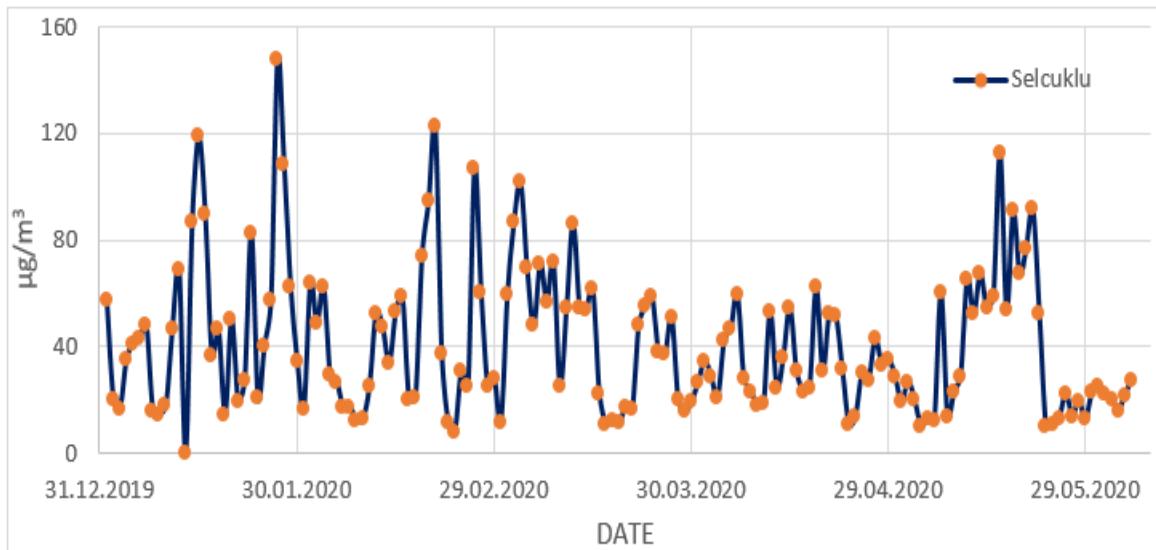
**Figure 4.** PM<sub>10</sub> values for sampling stations of Karatay district of Konya city center for the beginning of January 2020 to middle of June 2020.

When it is seen in Figure 5, PM<sub>10</sub> values for sampling stations of Selcuklu municipality region show a similar sampling period with Meram district, values of PM<sub>10</sub> and trends are similar. Improvement of air quality was seen as a similar period of a pandemic outbreak.



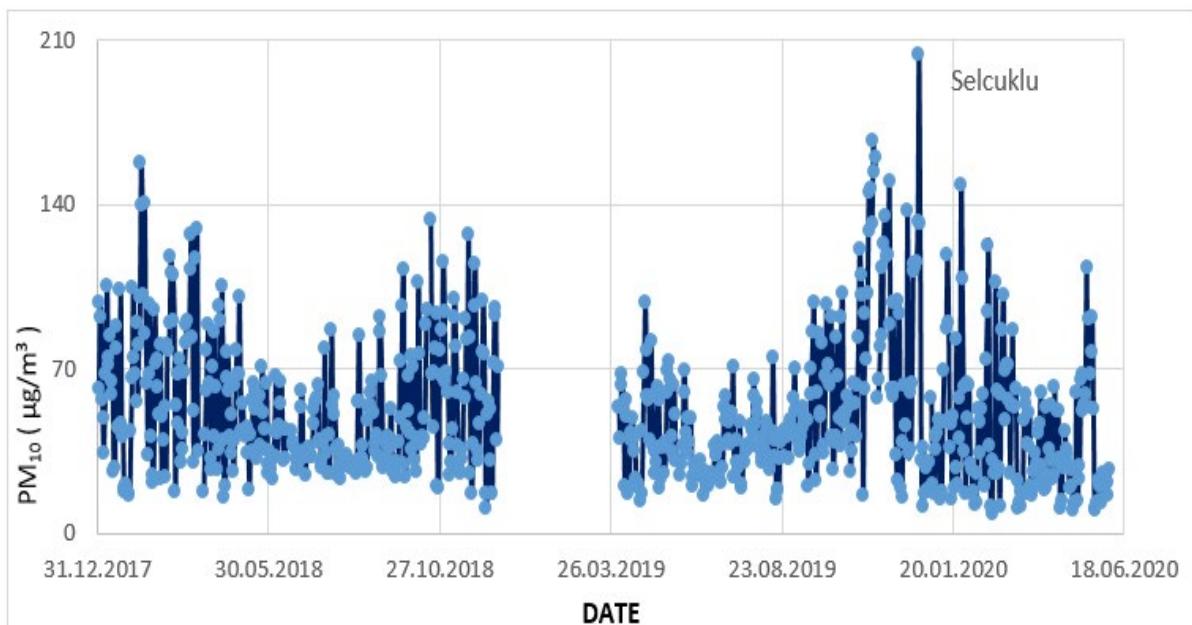
**Figure 5.** PM<sub>10</sub> values for sampling stations of Selcuklu municipality region of Konya city center for the beginning of January 2020 to middle of June 2020.

Figure 5 shows PM<sub>10</sub> values for another sampling station of Selcuklu district in Konya city center during the period beginning of January 2020 to middle of June 2020. This region is mostly residential area including a part of a small industrial area. Most of the pollution comes from fossil fuels burning for production of energy for heating systems in homes. A small amount of pollution was introduced by industry and traffic. During cold wintertime, PM<sub>10</sub> values were increased. PM<sub>10</sub> values were significantly decreased during pandemic outbreak time and an increase was detected with the situation created by the effect of field dust and then decreased again.



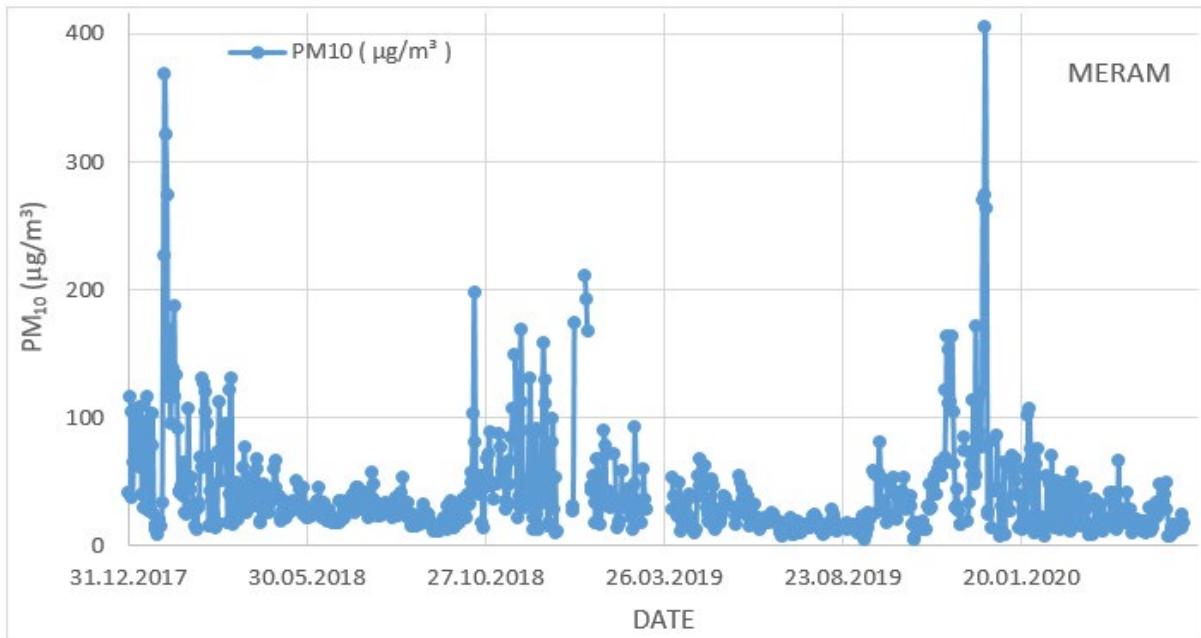
**Figure 6.** PM<sub>10</sub> values for sampling station of Selcuklu district of Konya city center for the beginning of January 2020 to middle of June 2020.

Figure 7 is summarizing the daily mean values of PM<sub>10</sub> as an air quality parameter for Selcuklu, Konya sampling station from beginning January of 2018 to the middle of June 2020. Values showing that PM<sub>10</sub> values during summer hot period lower than colder winter periods the highest values were December 2019. Values significantly decreased during the pandemic outbreak period and after the returned to normal levels. Four month values from the middle of December 2018 are missing for some problem of the sampling equipment in the station.



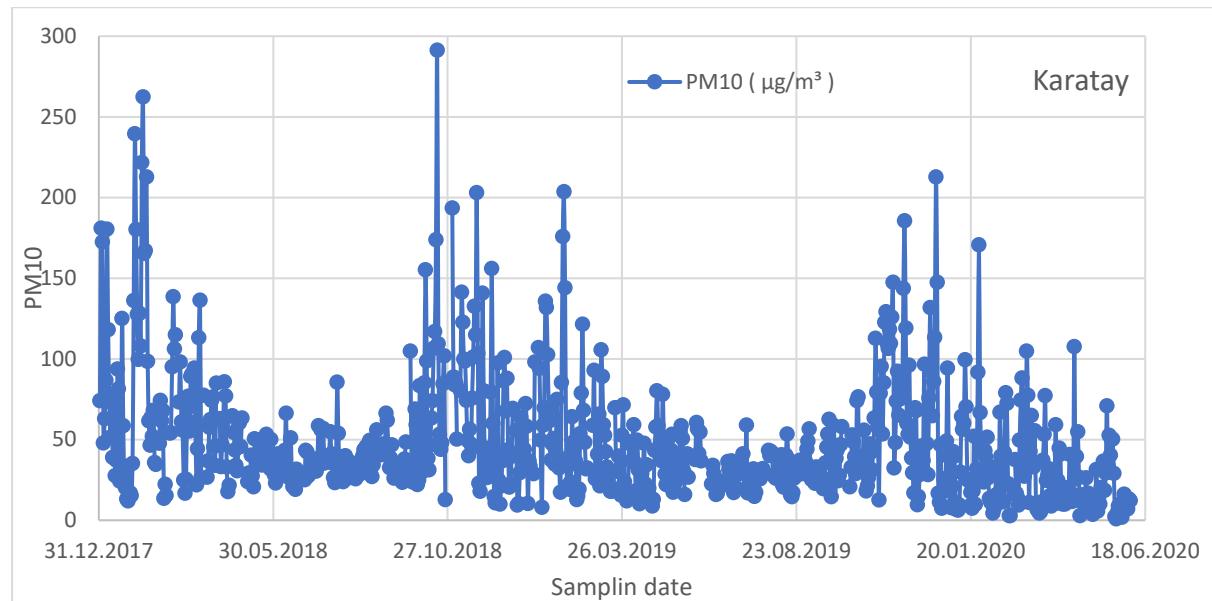
**Figure 7.** Daily mean values of PM<sub>10</sub>, as an air quality parameter of Selculu, Konya sampling station from beginning January of 2018 to middle of June 2020.

Daily mean values of PM<sub>10</sub>, as an air quality parameter of Meram, Konya sampling station from beginning January of 2018 to middle of June 2020 (Figure 8) which shows that PM<sub>10</sub> values decreased during a pandemic outbreak. PM<sub>10</sub> values during summer hot period lower than colder winter periods and highest values were seen in December 2019.



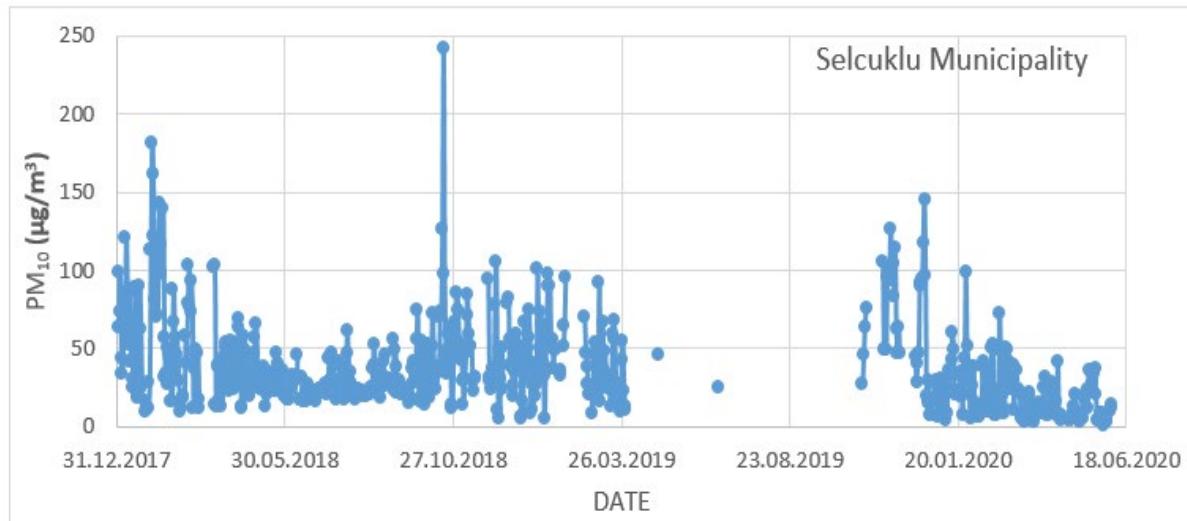
**Figure 8.** Daily mean values of PM<sub>10</sub>, as an air quality parameter of Meram, Konya sampling station from beginning January of 2018 to middle of June 2020.

Daily mean values of PM<sub>10</sub>, as an air quality parameter of Karatay, Konya sampling station from beginning January of 2018 to middle of June 2020 (Figure 9) which shows that PM<sub>10</sub>, values decreased during a pandemic outbreak. PM<sub>10</sub> values during the summer hot period lower than colder winter periods.



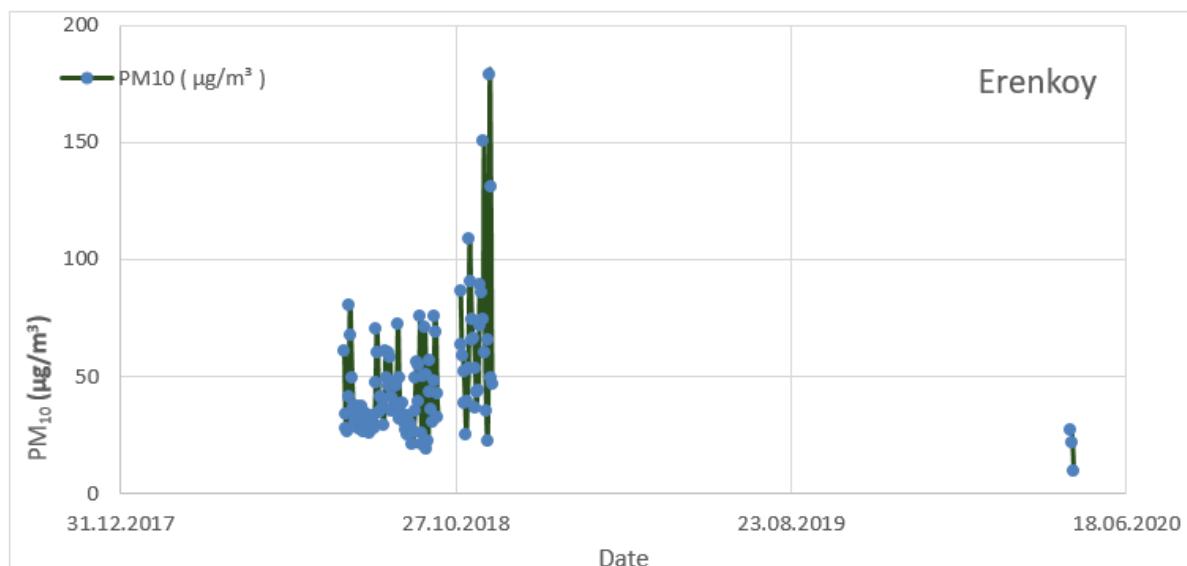
**Figure 9.** Daily mean values of PM<sub>10</sub>, as an air quality parameter of Karatay, Konya sampling station from the end of March of 2018 to middle of October 2019.

Daily mean values of PM<sub>10</sub>, as an air quality parameter of Selcuklu municipality, Konya sampling station from beginning January of 2018 to middle of June 2020 (Figure 9) which shows that PM<sub>10</sub>, values decreased during a pandemic outbreak. PM<sub>10</sub> values during the summer hot period lower than colder winter periods. Eight month values from middle of December 2018 are missing for some problem of the sampling equipment in the station.



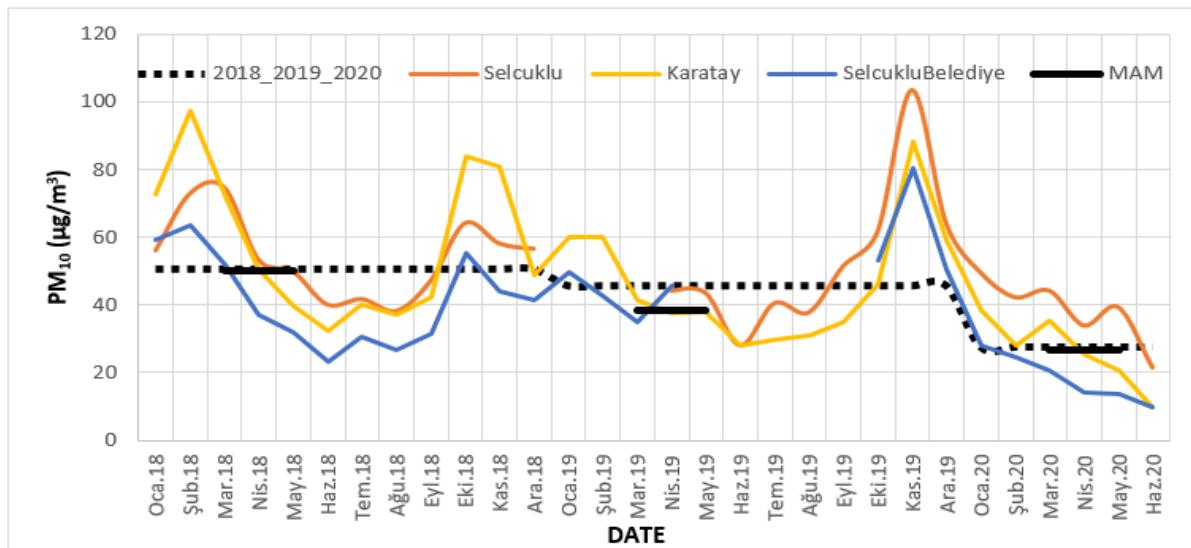
**Figure 10.** Daily mean values of PM<sub>10</sub>, as an air quality parameter of Selcuklu municipality, Konya sampling station from beginning January of 2018 to middle of June 2020.

Daily mean values of PM<sub>10</sub>, as an air quality parameter of Erenkoy, Konya sampling station from end July of 2018 to end of December 2018 (Figure 9) PM<sub>10</sub> values were higher during colder winter periods. Other values than 4 months are missing for some problem of the sampling equipment in the station.



**Figure 11.** Daily mean values of PM<sub>10</sub>, as an air quality parameter of Erenkoy, Konya sampling station from beginning January of 2018 to middle of June 2020.

Figure 12 explains the monthly mean of PM<sub>10</sub> levels for three different sampling stations at Meram, Karatay, and Selcuklu districts of Konya city center from beginning January of 2018 to middle of June 2020. When data were being examined the monthly mean of PM<sub>10</sub> values for three different sampling stations shows that winter periods are high and summer periods are lower in a comparison between seasonal rates. Solid lines show the period of March 16 to end of May which is Match 16 to end of May 2020 is significantly lower than 2018 and 2019 periods. Table 1 is summarizing the statistical reduction during period of pandemic outbreak time (16 March to end of April 2020) which is lower than before quarantine period (1 January to 15 March 2020) and also lower than similar time scale of 2018 and 2019 period. Monthly mean of PM<sub>2.5</sub> values during pandemic outbreak quarantine period (01 January to 15 March 2020) were also lower than before quarantine period (1 January to 15 March 2020) and same period of 2018 and 2019.



**Figure 12.** Monthly mean of PM<sub>10</sub> values for three different sampling stations at Karatay and Selcuklu districts of Konya city center from beginning January of 2018 to middle of June 2020.

PM, air quality parameters of Konya all sampling station which they show PM10 and PM2.5, values decreased during COVID-19 pandemic outbreak. Some values of sampling stations are missing and some calculations are not possible (n.a.). It is clearly has been shown that during pandemic quarantine period, air quality was improved (Table 1).

**Table 1.** Decrease of PM<sub>10</sub> and 2.5 micrometer particle size values during pandemic outbreak quarantine period (1 January to 15 March 2020)

	PM <sub>10</sub> (µg/m <sup>3</sup> )			PM <sub>2.5</sub> (µg/m <sup>3</sup> )		
	2018	2019	2020	2018	2019	2020
<b>Period 1</b>	72	116	42	n.a.	n.a.	35
<b>Period 2</b>	116	35	25	n.a.	26	22
<b>Period 2/ Period 1</b>	61	-70	-40	n.a.	n.a.	-36
<b>Term2 (2020) - Mean Term2 (2018, 2019)</b>			-66			n.a.

#### 4. CONCLUSION

Due to the continental climate of the Konya province, the winter season is very cold. Therefore, air pollution emissions to the atmosphere increase depending on the amount of fossil fuel used for heating system of heating of residences and other buildings. Meteorological conditions are also important airborne periods determinant in air pollution, since emission are important in air pollution. Covidien-19 coincides the emergence of the pandemic in Turkey that period that corresponds with the end of the winter, although air pollution is also reduced with increasing temperature. The restrictions imposed by the pandemic, besides decreasing the traffic density, caused the emissions to decrease as it also reduces the industry activities. Therefore, the decrease in the level of air pollutants between before and after the restriction is more pronounced compared to previous years. Thus, air quality of restrictions applied during the Covid-19 pandemic quarantine measures greatly influenced positively. Especially the improvement in air quality may be considered as one of important gain with the pandemic measures. Air quality monitoring studies are a great importance in terms of determining the causes and sources of pollution. Their distribution, developing appropriate control strategies, and controlling the effectiveness of these strategies. It was revealed that the measures are taken in the period of a virus outbreak, prohibition of traffic and the reduction of industrial activities caused, a remarkable improvement in air quality. Considering the measures and improvements in air quality, it is considered to be worth investigating how the measures should be evaluated in the coming periods in combating air pollution.

#### Future Recommendations

Air pollution and Environment affect each other through complex interactions in the atmosphere depending by meteorological factors. Covid-19 pandemic quarantine measures should be taken to

improve air quality and air quality standards should be well implemented. Depending on the ecological change, the related with air pollution should be well emphasized and more discussed in the situation of epidemic period. To increase the sustainable environment and air quality, gains from the measures should be maintained. environmental quality has decreased, as in many parts of the world with the end of the measures.

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## O 16. AIR QUALITY ASSESSMENT IN KONYA CITY CENTER DURING FIRST HALF OF 2020 YEAR

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**ABSTRACT:** In regions where the industry is very high developed, provincial centers where traffic is heavy and settlements where winter is cold, low-quality fossil fuel consumption affects quality of life especially in people with respiratory diseases. The topographic structure and climatic features of a region are as effective as emission sources in the formation of air pollution. Especially in the winter months, there is no increase in the emission levels as the temperature decreases. However, the negativity caused by meteorological conditions causes lower than expected levels of air quality. Using the data of the existing air quality monitoring station in the Konya city center, it is seen that the air quality increases and then returns to normal levels during the period when curfew is restricted for measures taken due to the covid-19 outbreak. The restrictions that cause the reduction of vehicle exhaust emissions, which are important factors in the formation of some air pollutants, are thought to be effective in improving the air quality. This should not be neglected; as meteorological conditions are effective on the days when air pollution occurs. For this reason, the changes in the air quality should be examined in more detail. It is thought that the reduction in HC, NOx and CO emissions, which can be evaluated as exhaust emissions, will be an effective factor due to the restrictions. In parallel with the decrease in air pollution, the increase in O<sub>3</sub> values increased by the sun rays in the atmosphere with the formation of O<sub>3</sub> in the clean air. In addition, atmospheric ozone reduces NO<sub>x</sub>, CO and HC compounds from the air pollutants by oxidizing them with the reactions it creates. It is estimated that the pollutants present in the air before the restriction will cause a decrease in the ozone values, and the increase in the air quality will cause an increase in the ozone values.

**Keywords:** Air quality, Ozone, NO<sub>x</sub>, CO, PM, emissions

### 1. INTRODUCTION

Rapid population growth in cities some countries causes many environmental problems including Air pollution (Aroh, 2019). For this reason, the changes in the air quality should be examined in more detail with its sources and related factors. It is thought that the reduction in HC, SO<sub>2</sub>, NO<sub>x</sub> and CO emissions, which can be evaluated as exhaust emissions, will be an effective factor due to the restrictions (Johnson, 1988). This should not be neglected; as meteorological conditions are effective on the days when air pollution occurs. In addition, atmospheric ozone reduces NO<sub>x</sub>, CO and HC compounds from the air pollutants by oxidizing them with the reactions it creates some different compounds. Investigation of Dursun (2019) showed that atmospheric PM levels were increased during could winter period and increasing traffic also evaluated PM levels around residential area. Mankolli *et al.* (2011) detected higher level of reparable size of PM capital city Tiran, because of because of heavy and clogged traffic in city centre. Edun *et al* (2015) were also show similar explanation for Istanbul city. During rush hours in the morning and evening concentration of PM was extremely increased. As well as the emission sources, many factors have effect on environmental pollution (Ayutan *et al.*, 2016).

The rapidly increasing population also increases the need for food production. Natural habitats are transformed into agricultural areas for food production (FAO, 2017; Le Mouél *et al.*, 2018). Occupation of people's natural areas for agriculture, become to contact with non-domestic wild animals and between humans has increased. Natural biodiversity, which helps protect people from zoonotic diseases, this recently is increasingly disappearing. The Covid-19 pandemic is thought to originate from China by human contact with non-domestic animals. The origin of the Covid-19 virus is thought to have spread from the wild animal market in Wuhan, China (<https://www.who.int>; Md Shah *et al*, 2020). Infectious rates of diseases occur faster than in the past, and the rate of spread increases with increasing human contact. Between beginning January 2020 to middle of July 2020, Covid-19 infections were detected in more than 13 million people worldwide, and about 600 thousand people died (Me & Fu, 2020; Riedel,

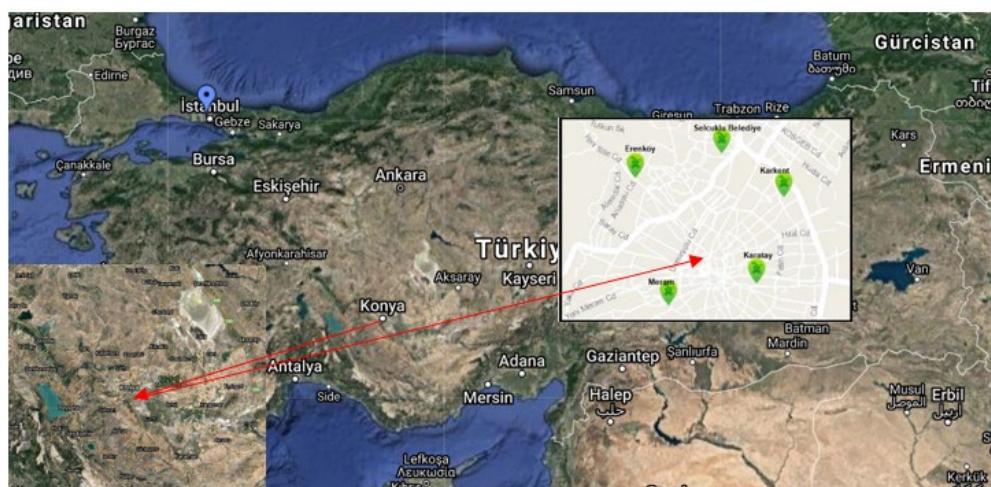
2004). Since contact is the most important factor in infection, methods should be developed to reduce it. It has become important to prevent sustainable environment and outbreaks. Covid- 19 infection first detected activity in Turkey is March 15, 2020 and the measures taken in Turkey to reduce the impact of Covidien-19. The causes and possible consequences of the outbreak have not yet been adequately studied. In this investigation, on air quality change due to the Covidien-19 outbreak of Konya was aimed to search. Fort the impact on air quality due to the measures taken were investigated in Konya city centre.

## 2. MATERIAL AND METHOD

### Workspace and features

Konya located in central Anatolia and it has largest surface area in the all provinces of Turkey land (41 thousand km<sup>2</sup>; Ceyhan, 2013). Konya is geographically located between 36° 41' and 39°16' north latitudes and 31°41' and 34 ° 26' east longitudes (Figure 1). The average height from the sea level is 1016 m and the height, the city center is 1028 m from the level of the sea. As the 2020 census, Konya population is at 2.25 million people, which constitutes 2.7% of Turkey's population of 84 million. When the comparisons made in other provinces of Konya, Turkey's 7<sup>th</sup> largest city. In terms of area it is the largest city of Turkey. The number of people per km<sup>2</sup> for Konya metropolitan is 55 people (URL-1).

Due to the fact that the annual average rainfall in Konya city is 320 mm, it made it necessary to carry out dry farming. Because summers are hot and dry in the research area; The steppe climate, which has a harsh and snowy winters, is observed. When Konya's long years of data are analysed, the seasonal condition of temperature and precipitation shows a continuous fluctuation according to the years. In the region, these fluctuations have reached extreme values, leading to the development of steppe vegetation. In terms of its land structure, vegetation has the appearance of a plain steppe. Low mountain and high mountain steppe surrounded the plain steppe (Kaya & Aladağ, 2009; Aka, 2007).



**Figure 1.** Location of investigation area (URL-2)

Konya province has a closed basin structure and the basin consists of wide plain areas and plateaus. The Taurus Mountains cover the south of the basin and there are high mountains to the west, preventing the moist air of the Mediterranean from coming to the region (Dogan & Yilmaz, 2011; Atalay, 2018). Therefore, it has a very arid climate and has an arid feature. With this feature, summer is hot and dry, and winter is cold and snowy. Konya is less rainfall compared to most provinces in Turkey. Although it is known in Turkey as a grain warehouse development, the change of climate and water resources vary this feature. Industrial areas have developed and are developing in the city centre.

### Data

Air quality data of PM<sub>10</sub>, NO<sub>2</sub>, CO, SO<sub>2</sub> and O<sub>3</sub> were gathered from four air sampling station of Konya city, via Ministry of Environment and Urbanization of Turkish Republic. Data of the research area were divided in two parts that; Period 1: before the Covid-19 measures were taken to reduce effect of pandemic problem which is between January 1 and March 15 of 2020. Period 2: after the Covid-19

struggle started in Turkey and Covid-19 measures applied which is between March 16 and April 15 of 2020. Daily air pollutant data of 01.01.2020-15.06.2020 compared to see effect of Covid-19 measures. To see effect of seasonal effect on pollution parameters, Same season of 2018 and 2019 were also collected and compared between 2020 and earlier data. Scientific techniques and methods for collecting numerical values collected in a particular area, organizing, statistical analysing, interpreting the collected data, making objective and correct decision should be examined. There are various sampling methods to be used in research. According to the purpose of the research, restrictive conditions such as cost, duration and the characteristics of the audience, the most appropriate among them should be selected. Data analysis covers all the statistical methods required to summarize and evaluate the data collected within the scope of the research. In this study, a comprehensive R-program, an open code statistics program, was used to create the distribution maps of the data.

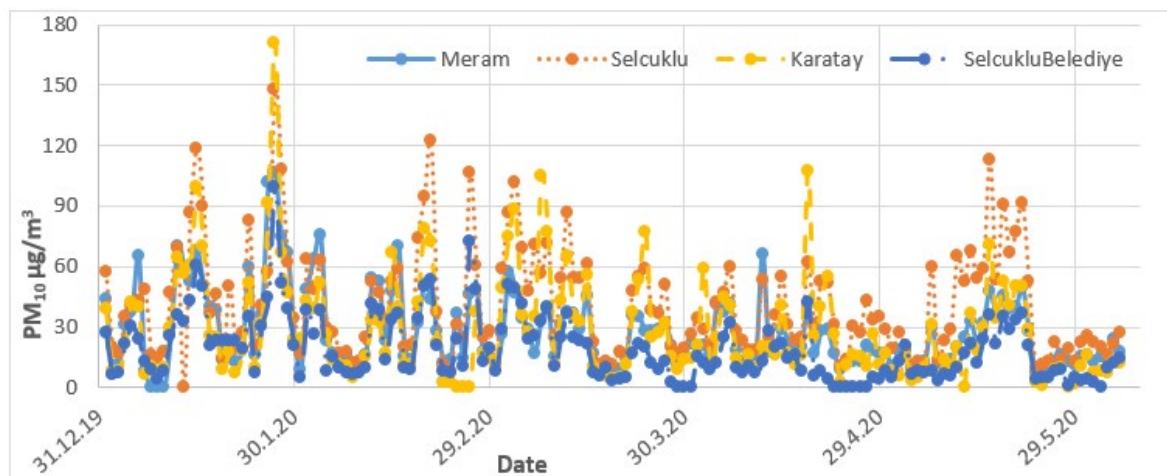
### Covid-19 measures in Turkey

After the occurrence of first infection case in Turkey, it is very quickly becoming measures as a part of the fight against infection with various precaution. In this context, after March 16, 2020 all schools were vacationed then online study was started in the Turkey, as well as Konya city. Mass worship was interrupted in mosques. Quarantine measures were implemented in all metropolitan cities in Turkey. Mobility people has been reduced between the metropolitan cities. Citizens over the age of 65 and then under the age of 20 are forbidden to go out for all cities of Turkey. On the weekends, a curfew measures were introduced for all age groups for all metropolitan. Commercial/touristic flights were cancelled with many countries where the pandemic infection was widespread.

### 3. RESULTS

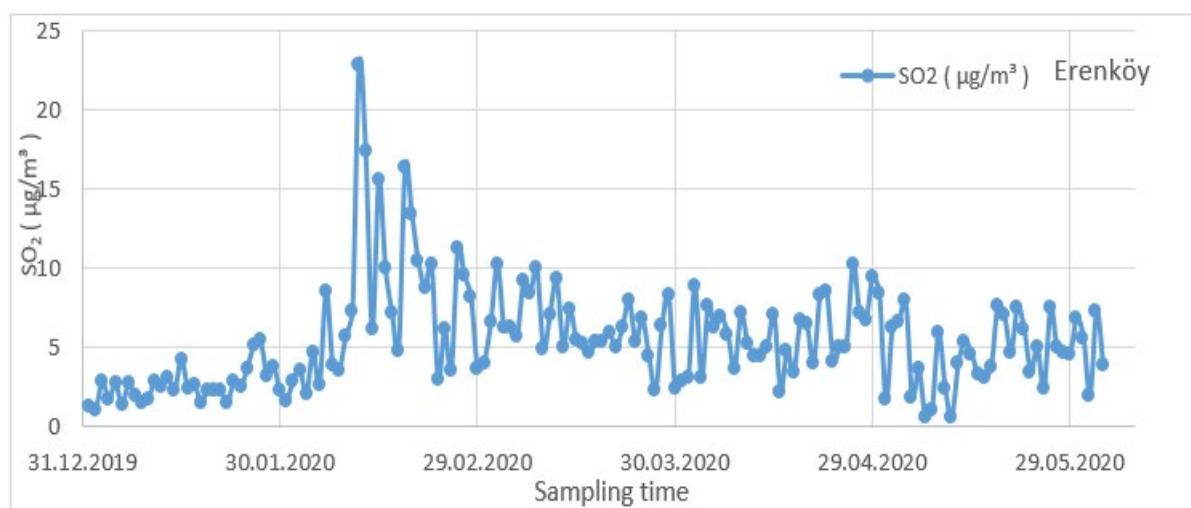
Investigation region where Konya metropolitan is one of the highly developed the industry province in Turkey. Provincial living centres has also heavy traffic around settlement roads, settlements region has a very cold winter seasons. When low-quality fossil fuels consumption affects quality of life especially in people with respiratory diseases because emission of incineration. Air pollution is increasing some days due to specific climatic condition occurring via the topographic structure of the region. climatic features of a region are as effective as increasing emission locally in the formation of air pollution. Especially in the winter months, there is increase in the emission levels as the temperature decreases with increasing fuel usage for heating system. However, some days of winter period, the negativity caused by meteorological conditions causes lower than expected levels of air quality.

Figure 2 shows the PM<sub>10</sub> values of four different air quality sampling station in Konya city centre during first half of 2020 including the period of covid-19 outbreak and Sahara dust effecting periods. Figure 2 shows that PM<sub>10</sub> levels of four air quality sampling station were significantly lowered by covid-19 outbreak period and were increased with Sahara dust effecting periods than lowered to normal levels again. Results of atmospheric PM<sub>10</sub> measurement not only affected by the emissions source, but also effected meteorological factors and special situations.



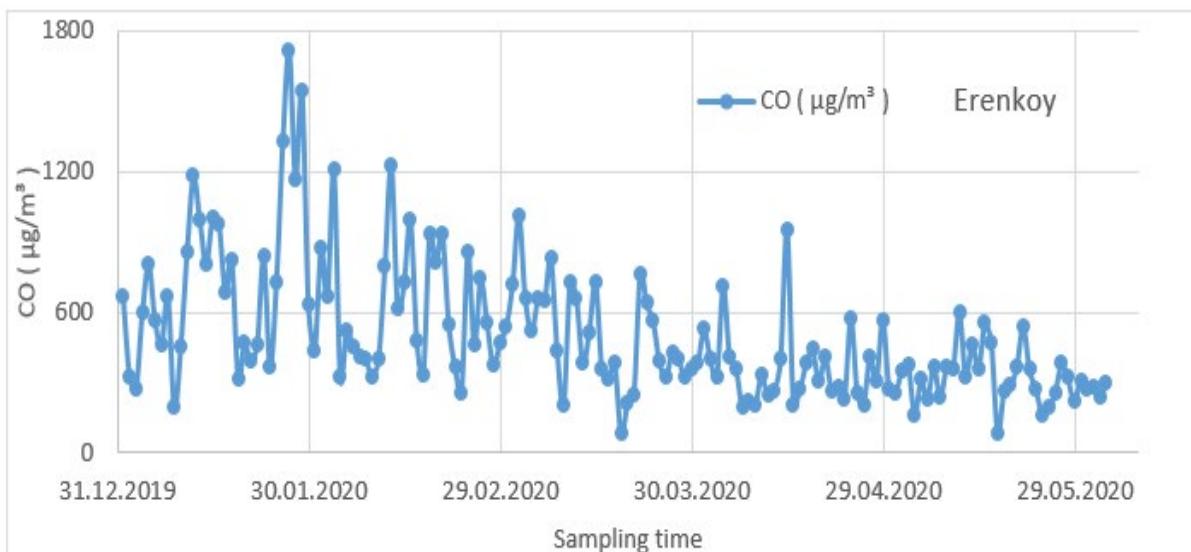
**Figure 2.** PM<sub>10</sub> values were being measured at four sampling station in Konya city centre during first half period of 2020 year.

Four air quality parameters of Konya Erenkoy sampling station which are SO<sub>2</sub>, CO, NO<sub>2</sub> and O<sub>3</sub> trends are shown in Figure 3. It is clear that the concentrations of gases such as SO<sub>2</sub>, NO<sub>2</sub> and CO, shows significant decreased and opposite trend for O<sub>3</sub> values which were increased, during the period of covid-19 outbreak, after March 15, 2020 (Figures 3-6). Figure 3 shows the SO<sub>2</sub> concentrations were higher in January and lowered down to 10 µg/m<sup>3</sup> and after covid-19 outbreak decreased about 5 µg/m<sup>3</sup> then turned to normal levels.



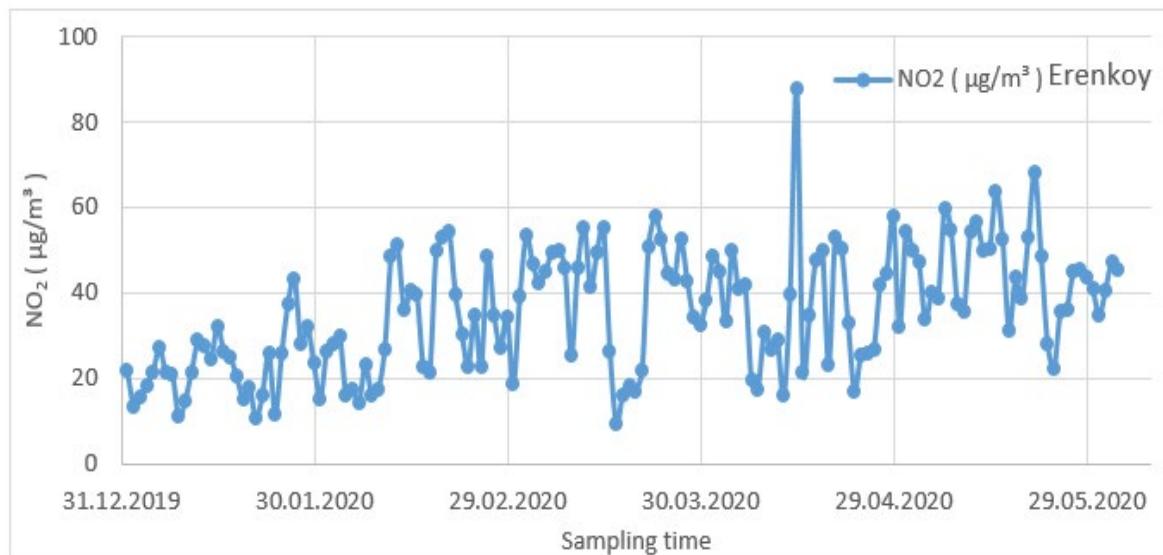
**Figure 3.** SO<sub>2</sub> values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 4 shows the CO concentrations that the highest were again in January about 1700 µg/m<sup>3</sup> and lowered down to 1000 µg/m<sup>3</sup> and after covid-19 outbreak decreased down to 500 µg/m<sup>3</sup> then turned to normal levels. More than 200% decrement of CO was seen and possible due to less motor vehicles that emits a lot of CO into the atmosphere and also other sources such as from industrial activities that shut down due to Pandemic Covid-19.



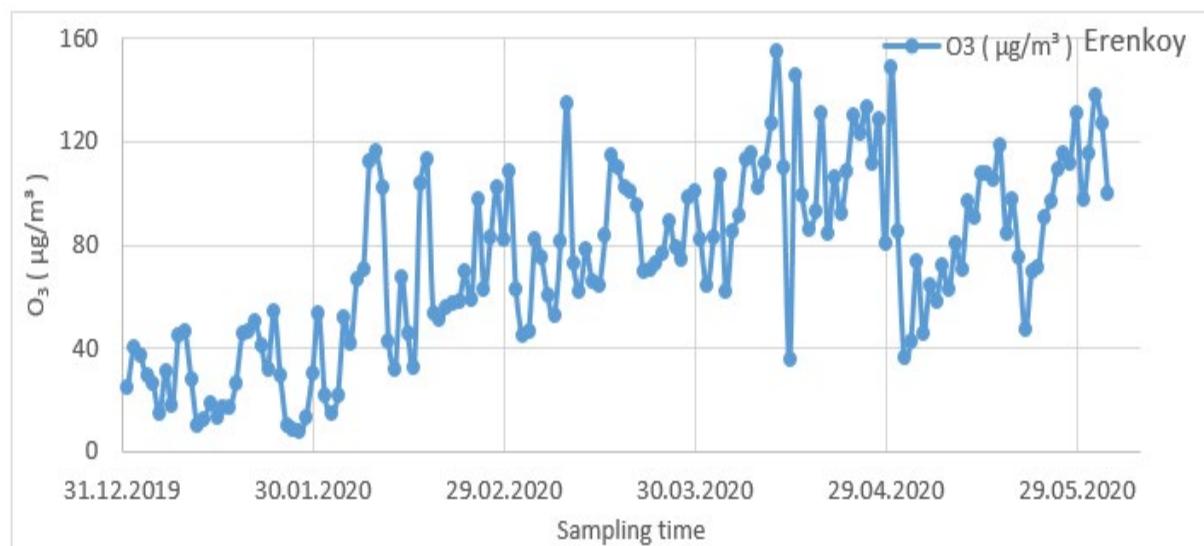
**Figure 4.** CO values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 5 shows the NO<sub>2</sub> concentrations that were generally about 60 µg/m<sup>3</sup> and after covid-19 outbreak decreased about 10 µg/m<sup>3</sup> then turned to normal levels.



**Figure 5.** NO<sub>2</sub> values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

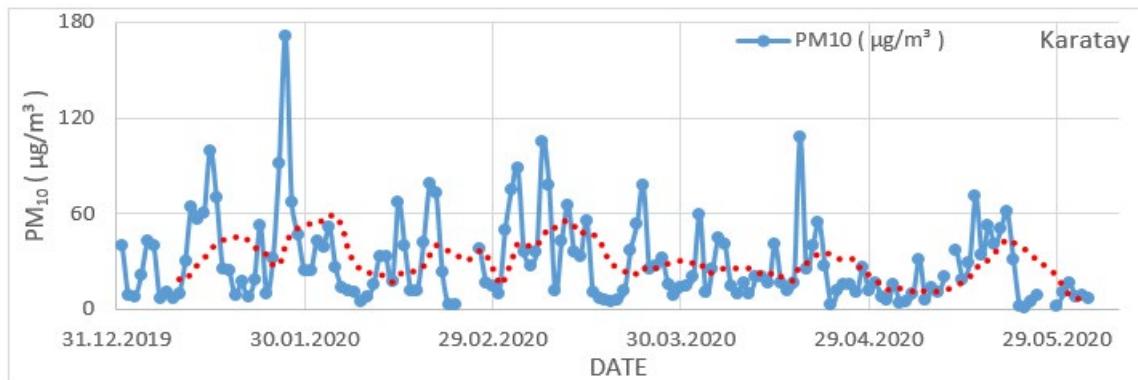
Figure 6 shows the O<sub>3</sub> concentrations that were the lower in January from 15 µg/m<sup>3</sup> and increased up to 150 µg/m<sup>3</sup> then after Sahran dust effect, the concentration of O<sub>3</sub> decreased about 35 µg/m<sup>3</sup> then turned to normal levels of 150 µg/m<sup>3</sup>. The concentrations of O<sub>3</sub> were increased as opposite with the decreasing other air pollution parameters, by the sun rays in the atmosphere with the formation of O<sub>3</sub> in the clean air. It is estimated that the pollutants present in the air during winter period will cause a decrease in the ozone values, and the increase in the air quality will affect an increase in the ozone values.



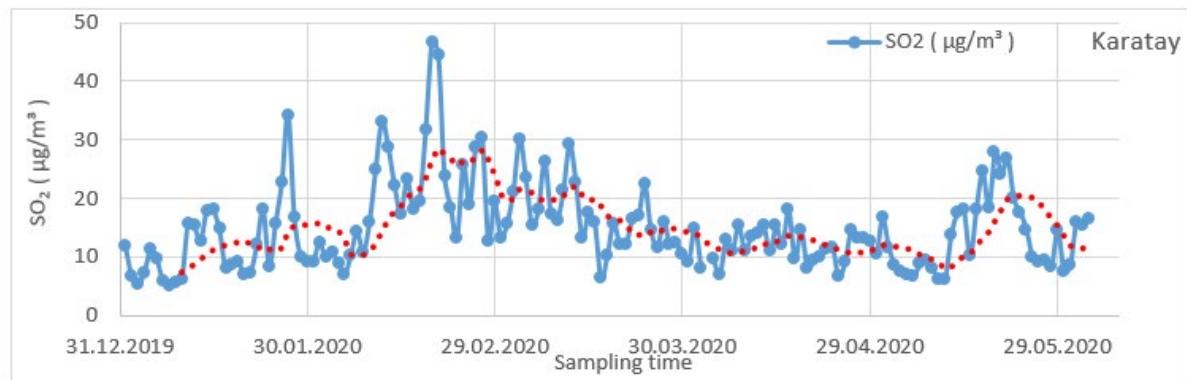
**Figure 6.** O<sub>3</sub> values of Erenkoy air quality sampling station in Konya city centre during first half period of 2020 year.

Four air quality parameters of Konya Karatay sampling station that are PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and O<sub>3</sub> given following figures. They show that values of all measured parameters similar trend changing for 6 months and O<sub>3</sub> values were also not increased, during the period of covid-19 outbreak period (Figures 7-10). Figure 6 shows that the O<sub>3</sub> concentrations were increasing with an improvement of air quality for Erenkoy air quality sampling station, but for the Karatay sampling station, the increase not seen after

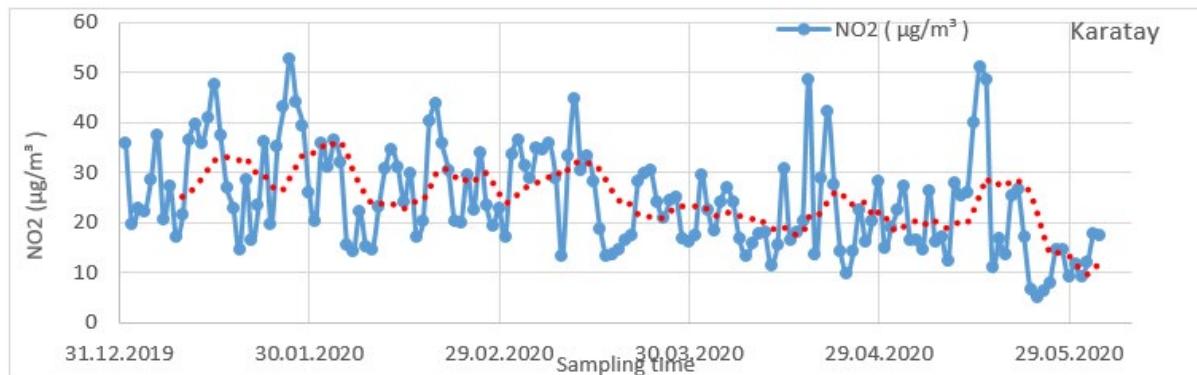
covid-19 outbreak. Karatay sampling station is near the industrial zone so differing from Erenkoy region and covid-19 outbreak did not effected air quality of this region for the investigation tame period.



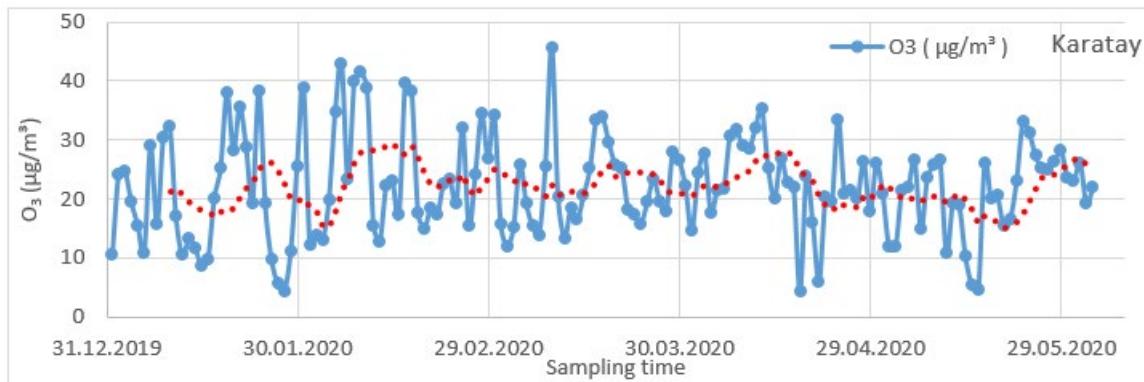
**Figure 7.** PM values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.



**Figure 8.** SO<sub>2</sub> values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

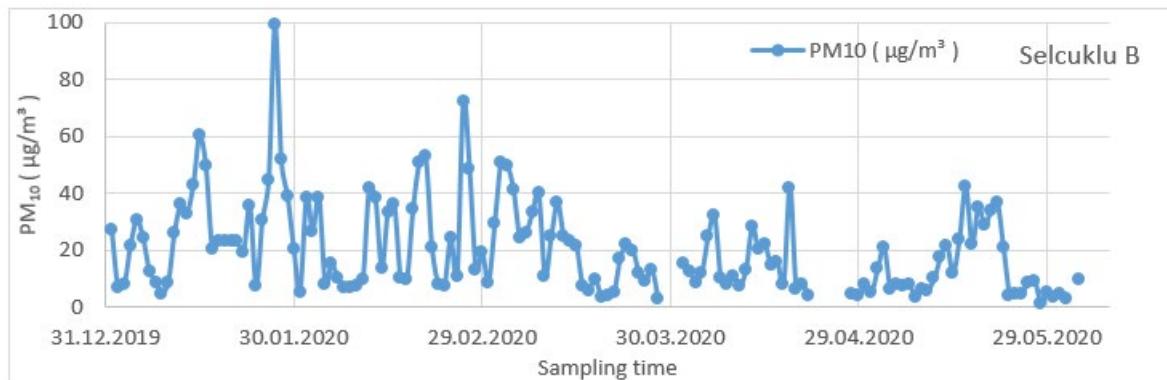


**Figure 9.** NO<sub>2</sub> values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

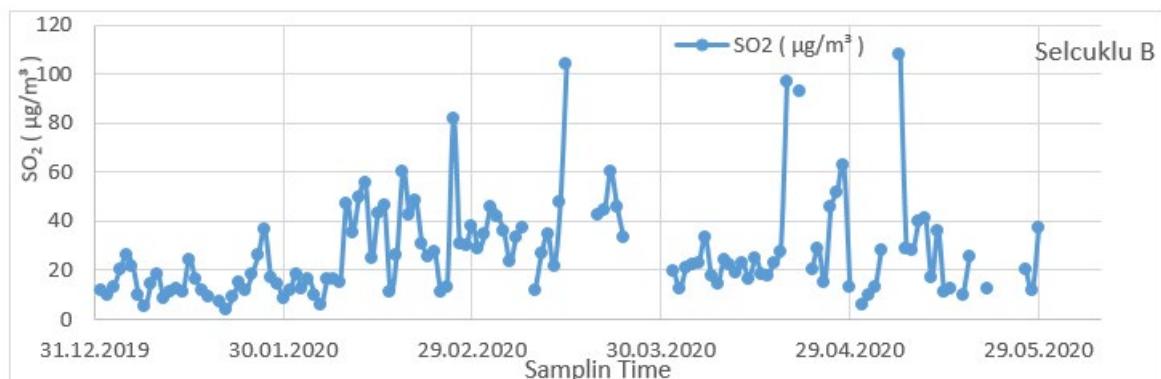


**Figure 10.** O<sub>3</sub> values of Karatay air quality sampling station in Konya city centre during first half period of 2020 year.

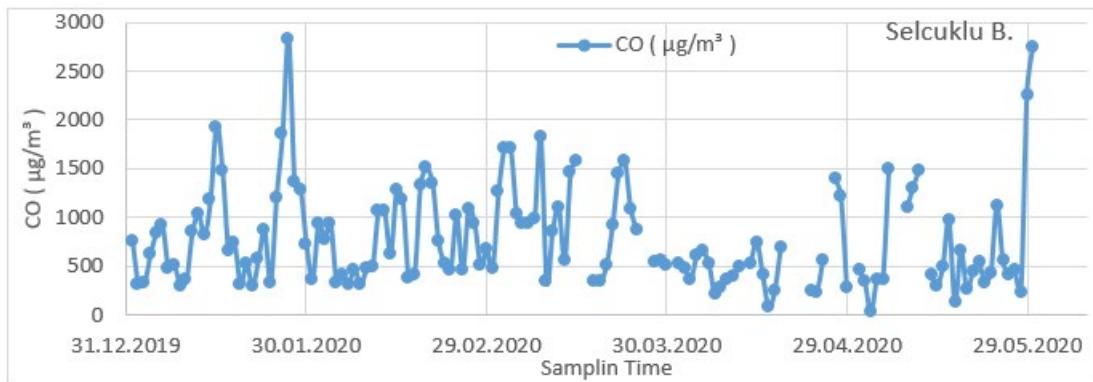
Four air quality parameters of Konya Selcuklu Municipality sampling station that are PM<sub>10</sub>, SO<sub>2</sub>, CO and NO<sub>2</sub>, there is not O<sub>3</sub> measurement in this station (Figures 11-14). Results of measurements for 4 pollutant parameters show that that PM<sub>10</sub> and NO<sub>2</sub> was initially lowered, but other two parameters, SO<sub>2</sub>, and CO values were not significantly decreased.



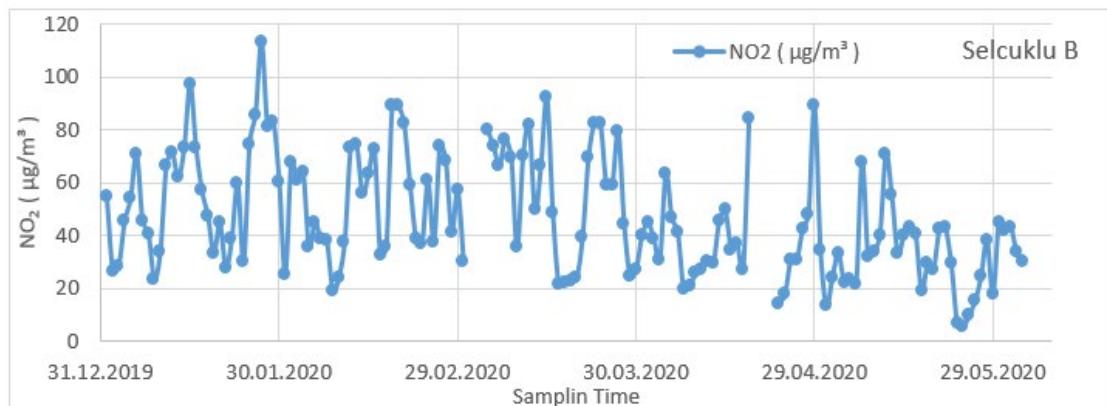
**Figure 11.** PM<sub>10</sub> values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.



**Figure 12.** SO<sub>2</sub> values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

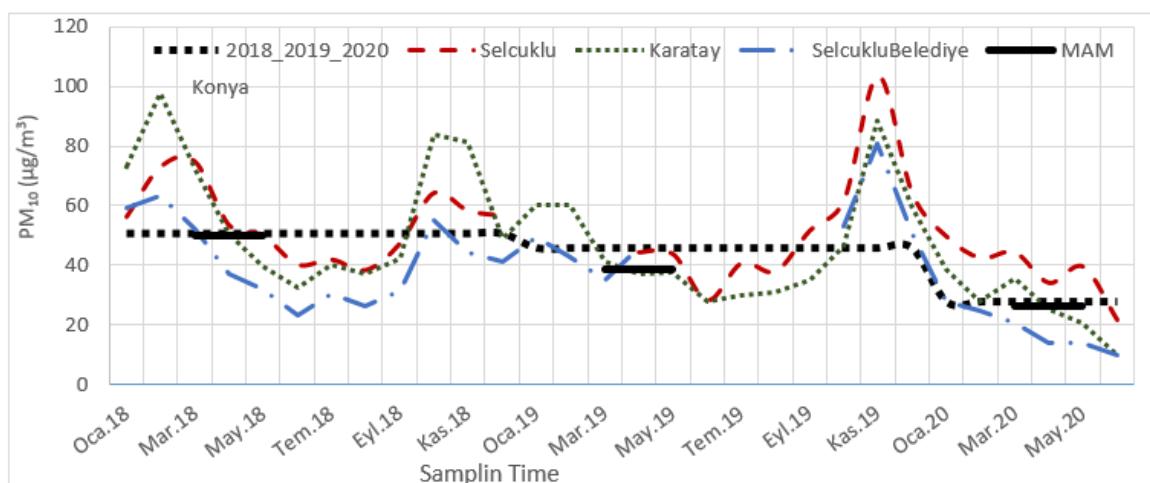


**Figure 13.** CO values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.



**Figure 14.** NO<sub>2</sub> values of Selcuklu Belediye air quality sampling station in Konya city centre during first half period of 2020 year.

Figure 15 show the PM<sub>10</sub> values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line (— MAM) show covid-19 outbreak period (01 January 2018, 15 June 2020) and other two are same period 2018 and 2019 years respectively. Dashed line (----) mean of each year 2018, 2019 and 2020. It can be seen slightly lowering from 2018 to 2019, but lowering rate is more 2020 year. It is clear that reduction of PM<sub>10</sub> concentrations was lower during covid-19 outbreak period (01 January 2018, 15 June 2020) than before the outbreak and 2018 and 2019 years at same period.



**Figure 15.** PM<sub>10</sub> values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line (— MAM) show covid-19

outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (----) mean of each year 2018, 2019 and 2020

Using the data of the existing air quality monitoring station in the Konya city centre, it is seen that the air quality increases covid-19 outbreak period (01 January 2018, 15 June 2020) and then returns to normal levels during the period when curfew is restricted for measures taken due to the covid-19 outbreak. The restrictions that cause the reduction of vehicle exhaust emissions, which are important factors in the formation of some air pollutants, are thought to be effective in improving the air quality. Four air quality parameters measured in Konya stations are SO<sub>2</sub>, NO<sub>2</sub>, CO and NO<sub>2</sub> mean of sampling stations to test effect of covid-19 outbreak measures on change of SO<sub>2</sub>, NO<sub>2</sub>, CO and NO<sub>2</sub> concentration between outbreak time period, with before, 2018 and 2019 period. It is clear that there is a significant decrement on SO<sub>2</sub>, NO<sub>2</sub> CO values and but O<sub>3</sub> concentrations pattern were in inverted (Tables 1 - 4). Table 1 – 4 shows the effect of covid-19 concentrations with minus values (-) show decrease and plus (+) values indicates the increment concentrations.

**Table 1.** Effect of covid-19 outbreak measures on SO<sub>2</sub> concentration ( $\mu\text{g}/\text{m}^3$ ) for Konya city centre

SO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	2018	2019	2020
Period 1	21	12	15
Period 2	12	6	12
Period 2/Term1	<b>-43</b>	<b>-51</b>	<b>-24</b>
Period 2(2020) - Mean Period 2 (2018,2019)			<b>34</b>

**Table 2.** Effect of covid-19 outbreak measures on NO<sub>2</sub> concentration ( $\mu\text{g}/\text{m}^3$ ) for Konya city centre

NO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	2018	2019	2020
Period 1	<b>n.a.</b>	<b>n.a.</b>	43
Period 2	<b>n.a.</b>	42	33
Period 2/Term1	<b>n.a.</b>	<b>n.a.</b>	<b>-24</b>
Period 2(2020) - Mean Period 2 (2018,2019)			<b>n.a.</b>

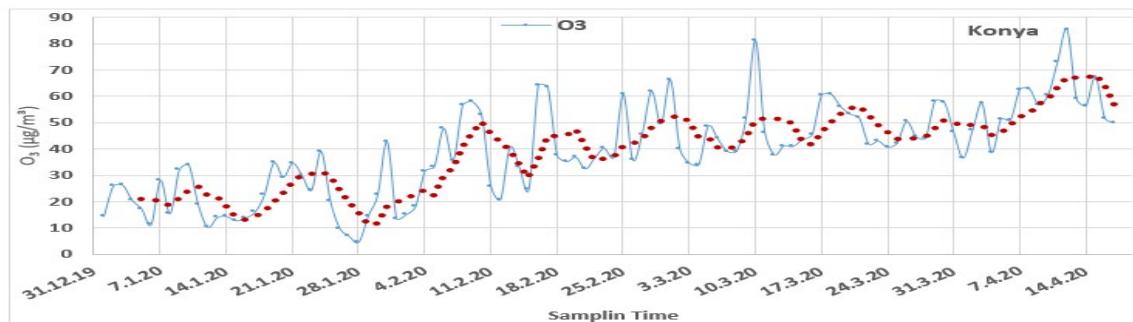
**Table 3.** Effect of covid-19 outbreak measures on CO concentration ( $\mu\text{g}/\text{m}^3$ ) for Konya city centre

CO ( $\mu\text{g}/\text{m}^3$ )	2018	2019	2020
Period 1	1528	1311	866
Period 2	1311	508	545
Period 2/Term1	<b>-14</b>	<b>-61</b>	<b>-37</b>
Period 2(2020) - Mean Period 2 (2018,2019)			<b>-40</b>

**Table 4.** Effect of covid-19 outbreak measures on O<sub>3</sub> concentration ( $\mu\text{g}/\text{m}^3$ ) for Konya city centre

O <sub>3</sub> ( $\mu\text{g}/\text{m}^3$ )	2018	2019	2020
Period 1	7	7	35
Period 2	7	25	53
Period 2/Term1	<b>-1</b>	<b>248</b>	<b>50</b>
Period 2(2020) - Mean Period 2 (2018,2019)			<b>227</b>

Figure 16. shows an O<sub>3</sub> values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line show covid-19 outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (----) Slope line of period. Both of increasing ambient temperatures and covid-19 outbreak measures reduced the fossil fuel usage and increased air quality. This situation gave positive effect production of atmospheric ozone production.



**Figure 16.** O<sub>3</sub> values of three air quality sampling station Selcuklu, Karatay and Selcuklu Belediye in Konya city centre during first half period of 2020 year. Last solid line show covid-19 outbreak period and other two are same period 2018 and 2019 years respectively. Dashed line (----) Slope line of period.

#### 4. CONCLUSION

Most of the population (about 70%) living in 31 metropolitans of Turkey. Cities have high population and industrialised that means of increasing air pollution. Konya metropolitan has air pollution potential some days in winter times. Meteorological factor are also may have potential effect on air pollution problem. Air quality of restrictions applied during the Covid-19 pandemic quarantine measures greatly influenced positively decreasing concentration of air pollutants. Some measures taken during the Covid-19 pandemic period may be turn into permanent habits over time. The Covid-19 outbreak may be a turning point in combating global climate change. Especially the improvement in air quality can be considered as the most important gain after the pandemic. Improvements gained through measures should be expanded.

#### Future recommendations

Air pollution and climate change affect each other through complex interactions in the atmosphere. Emergency measures should be taken and apply strict air quality standards to improve air quality. Reduction of air pollution during the pandemic period on global climate change will be further studied and discussed. For sustainable environmental and air quality, gains from measures should be continued. With the end of the measures, as in many parts of the world, environmental quality decreases.

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## O 17. OVERVIEW OF MEDICAL WASTE INCINERATION SYSTEMS

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**ABSTRACT:** Medical wastes are wastes released during healthcare. The institutions with the highest medical waste generation are hospitals. However, medical wastes are generated at many points, such as health cabins, pharmacies and infirmary facilities that employ more than 50 workers. Although 75-90% of these wastes fall under the general waste category, the rest fall into hazardous waste. Medical wastes are beginning to form in large volumes today due to the developing technology, increasing welfare level and widespread health services. Especially, the increase in the use of disposable devices and consumables used to provide hygiene are the most important factors that increase the formation of medical waste. In addition to being infected, medical wastes contain hazardous chemicals, drugs, toxins, radioactive substances, etc. Medical wastes are in hazardous / risky waste group that threatens human and environmental health. The separation, temporary storage, transportation and disposal of medical wastes in hospitals is critical for the environment and human health. In this study, investigation of waste incineration processes, one of the methods of disposal of medical wastes threatening the environment and human health, and examination of emissions released after incineration will be carried out.

**Keywords:** Medical Waste, Waste Disposal, Waste Incineration Systems

## O 18. THE EFFECT OF SOCIAL RESPONSIBILITY TOWARD ENVIRONMENT AND SOCIETY A FIELD STUDY IN THE IRAQI BUSINESS ORGANIZATION

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**Abstract:** This study aims to know the extent to which Iraqi business organizations respect the principles and laws, environmental and social responsibility approved by the Iraqi government, a random sample was chosen from the group of small and medium industrial companies (research sample) and the estimated questionnaires were distributed, (150) a questionnaire for executives in the top management of companies and conduct structured personal interviews with the heads of environmental protection departments in the organizations to determine the pollution caused by these companies. On the other hand, this study light on attention to environmental issues on the part of social responsibility, especially in industrial projects because they have negative effects on the environment such as: pollution, desertification, global warming, increased carbon dioxide emissions, loss of biological diversity. The researchers reached several conclusions, the most important of which can be mentioned: There is a multiplicity of views on social and environmental responsibility by the sample members, some companies were applying environmental responsibility, but with a small percentage, many companies do not apply responsibility because they affect the company's economy.

**Keywords:** Social Responsibility, Environment Responsibility, Environment pollution, Environmental policy, Iraqi business organization

## O 19. THE EFFECT OF PARTICULATE MATTER POLLUTION OF SAHARAN DUST OVER EUROPE IN MAY-2020: A CASE STUDY OF KARAMAN CITY CENTER, TURKEY

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**ABSTRACT:** Desert dust rising from the African region and covered very long distances with meteorological events can be an important source of pollution for many countries from time to time. Although dust and sand masses that remain in the atmosphere for a long time are known to be inert and stable, but studies show that they affect vegetative production by changes in precipitation and radiation regimes. It is important for natural phenomena and has also revealed their effects in regions over which the atmospheric transport occurs. The Sahara dust storm of mid-May 2020 has strongly affected many European countries. The Sahara dust and hot air transport is reported over the Mediterranean region to the Balkans and further to Turkey. Depending on the climatic conditions, the Sahara dust may remain in some regions for longer period. Rainy and humid weather conditions slow down the flow of dust and increase the settling rate in that region. In such cases it creates mud-like precipitation accompanying with rain. In this study, Sahara dust pollution effect is investigated for a particulate event pollution with the use of measurements from the network system in all cities in Turkey. For this purpose, the values of PM pollution are analysed before the desert dust reached Turkey, during the event and when it left the country. PM measurement values in Karaman province were examined and it was shown that the Sahara dust increased significantly in the period when it reached this region. Then, PM values were seen to come down to normal levels.

**Keywords:** Africa, Dust, Sahara, Karaman, Particulate matter, Air pollution.

### 1. INTRODUCTION

Particulate matter (PM) including dust is a combination of solid and liquid particles with different sizes, which result both from natural phenomenon and anthropogenic activities and it is one of the main contributors to the global aerosol load (Kamani et al., 2014; Zender et al., 2004; Textor et al., 2006). Dust storms usually occur depending meteorological synoptic system when strong winds lift large amounts of sand and dust from bare, dry soils into the atmosphere. Dust cover often includes a small solid particle which may remain suspended for some time, with an aerodynamic diameter between 10 and 2.5  $\mu\text{m}$  (PM10, PM2.5). Dust decrease air quality downwind and plays a vital role in climate and biophysical feedbacks in the Earth system like it is essential in atmosphere for cloud formation, raindrops, snowflakes and air temperatures changes through the absorption and scattering of solar and terrestrial radiation (Washington et al., 2009; Middleton and Goudie, 2001; Perez et al., 2012; Balkanski et al., 2007; De Mott et al., 2003; Levin et al., 2005; Koren et al., 2010). Billions of tons of soil erode due to strong wind move thousands kilo meter through the atmosphere each year from not plant areas (Griffin, 2007). The World's most important dust sources are located in the Sahara in north Africa, followed by Arabia and southwest and central Asia and it has been estimated that 55% of the global dust emissions originate from the North African desert (Parsons and Abrahams, 2009; Huneus et al., 2011).

Dust deposits are a source of micro-nutrients for both continental and maritime ecosystems, but serious risks for human health. Particles also carry large amounts of biogenic factors providing biologic plausibility for triggering health effects (Griffin, 2007). Dust particle size is a key determinant of potential hazard to human health, usually finer particles, smaller than about 10  $\mu\text{m}$ , may penetrate the lower respiratory tract and may pass through the lungs and enter the bloodstream, affect other organs, with possible cardiovascular consequence health problems (Brook et al., 2010; Martinelli et al., 2013; Goudie, 2014).

Dust transport from Northern Africa towards higher latitudes, focusing on wind and cyclonic activity inside and around the Mediterranean basin (Alpert et al., 1990; Moulin et al., 1998). The transport of Saharan dust into the Mediterranean countries has a clear seasonality permanently loaded with significant amounts of dust in spring and autumn depending meteorological synoptic system (Escudero et al., 2005; Karanasiou et al., 2012).

An air pollution event of elevated surface concentrations of PM<sub>10</sub> occurred in the Karaman city during 10-22 May 2020. The aim of this work is to characterize changes of urban area air quality affected by Saharan dust. Air quality in small cities like Karaman is sensitive to long range transportation of pollution and meteorological conditions. Air pollution time series show changes from day to day not only due to emission of cities. Thus, the analysis of local air pollution data as well as meteorological and topographical conditions is very important. Daily air pollution values are generally below the legislative limits in Karaman. However, from the air pollution data time series one can see that the limit values are exceeded for certain days. In particularly, the 10-22 May 2020 period, when PM<sub>10</sub> values increase the allowable values, should be specially evaluated. In terms of health, sustainability and safety, reports on long-term pollution transport and clean air action plans on the air quality of the city require special evaluation of pollutants from outside the city. We expect this study to contribute to the evaluation of episode states in other cities and days as in this example.

## 2. DATA AND METHOD

Karaman, inhabited from the beginning of BC 8000, is located to the south of the Central Anatolian Region with a major commerce, culture and art center. Karaman province and its vicinity is known as the region charms and fascinates the visitors with the touristic beauties as underground cities, caves, religious centers and also with natural beauties as plateaus and other natural flora and fauna. According to the data of the General Directorate of Meteorology between 1951 and 2019, Karaman has dry periods in July, August and September, less than 10 mm. In the province with an annual total rainfall of 341 mm, the minimum precipitation falls in July with 5.3 mm and in December with a maximum of 47 mm. There is an average of 78 days of precipitation per year. The rainiest days are 10 days in December. The warmest months are July and August with an average maximum temperature of 31°C. The coldest month is January with an average minimum temperature of -3.7°C (Table 1).

**Table 1.** Karaman climate data, measurement period (1951 - 2019)

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Temperature (°C)	0.5	1.9	6.3	12	16	20	23	23	19	13	6.9	2.5	12
Avg. Max. Temperature (°C)	5.4	7.3	13	18	23	28	31	31	27	21	14	7.5	18.7
Avg. Min. Temperature (°C)	-3.7	-3	0.5	4.9	8.8	12	15	15	10	5.7	1.1	-1.7	5.4
Avg. Sunshine duration (hour)	3.5	4.5	6.3	7.8	9.7	12	13	12	10	7.5	5.4	3.3	94.4
Avg. Rainy Days	10	9.4	9.1	8.1	8.6	5.3	1.5	1.1	1.9	5.9	6.6	10	77.9
Avg. Monthly Precipitation (mm)	42	35	36	37	35	24	5.3	6.7	9	29	34	47	341

In this study, hourly PM<sub>10</sub> from air quality measurement stations of the Ministry of Environment and Urbanization between 01.01.2018 and 31.05.2020 were used. The period is chosen to assess how important the corona virus outbreak and the Sahara dust are for the local and regional atmospheric dust charges and how we can implement these sources for better understanding the dust emission. Sahara dust pollution effect and its consequences were investigated on particulate matter pollution measured from the network system of Karaman cities in Turkey. For this purpose, analysis of the of PM pollution value has been carried out before reaching the desert dust over Turkey land, when it comes to Turkey and left it. The results revealed that the Sahara dust concentration increased significantly in the period when it reached this region. Then, PM values returned to normal levels.

This study investigates the change in atmospheric particulate matter values of curfews taken due to the corona virus outbreak and Saharan dust period at Karaman city Centre. PM<sub>10</sub> pollutant data was used in Karaman city Centre data of the Ministry of Environment and Urbanization. The measures gathered during this event were compared with the values of period from 1 January to 15 march before the covid-19 and after the epidemic period 16 March to 30 April 2020 and May 2020 before and after. In addition, seasonal conditions, 2020 data and normal period 2018 and 2019 data were also compared. Period 1, before the Covid-19 measures (between January 1 and March 15). Period-2, after the Covid-

19 struggle started (between March 16 and April 15). Period 3 is still Covid-19 struggle continue. Period 4, Saharan dust period 10-22 May. Daily air pollutant data of the period of last three years were compared.

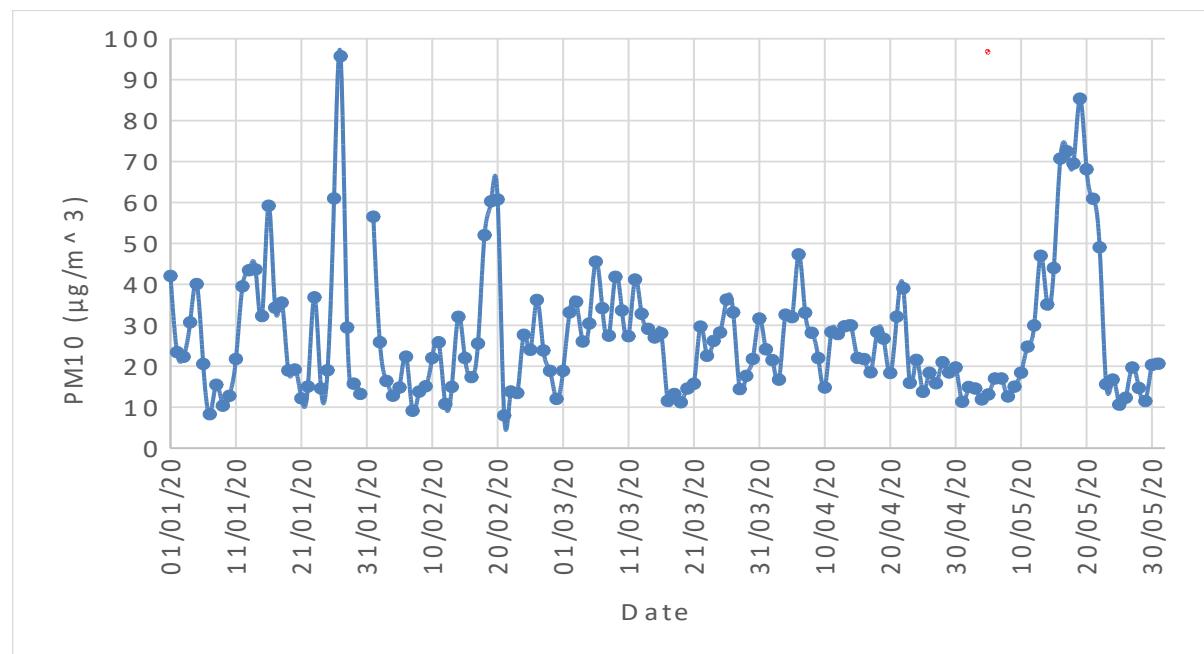
### 3. RESULTS AND DISCUSSION

Data were analysed for 3 different periods in order to examine the effects of Covid-19 measures taken from the frame of the intervention studies on dust PM<sub>10</sub> values in Karaman. The first semester is between 1 January and 15 March, which was before covid-19. The second term is between March 16 and April 30, when effective combat with covid-19 was held. Period 3 includes the month of the fight against covid-19. Period 4, on the other hand, is the 10-22 may date when long-distance transport and dust transport from Africa are effective. The daily average PM<sub>10</sub> values are below the limit value of 50 µg / m<sup>3</sup> in all periods except 10-22 May 2020 , when dust transportation is significant (Table 2). Prior to Covid-19, in 2020 year, PM<sub>10</sub> values were 12 percent less than in previous years. In the context of the fight against Covic-19, in the 2nd period when human activities decreased, the value of 2020 decreased significantly by 27% compared to previous years.

**Table 2.** PM<sub>10</sub> values in 4 different periods in the last three years and percentages of change in the same period compared to previous years in 2020

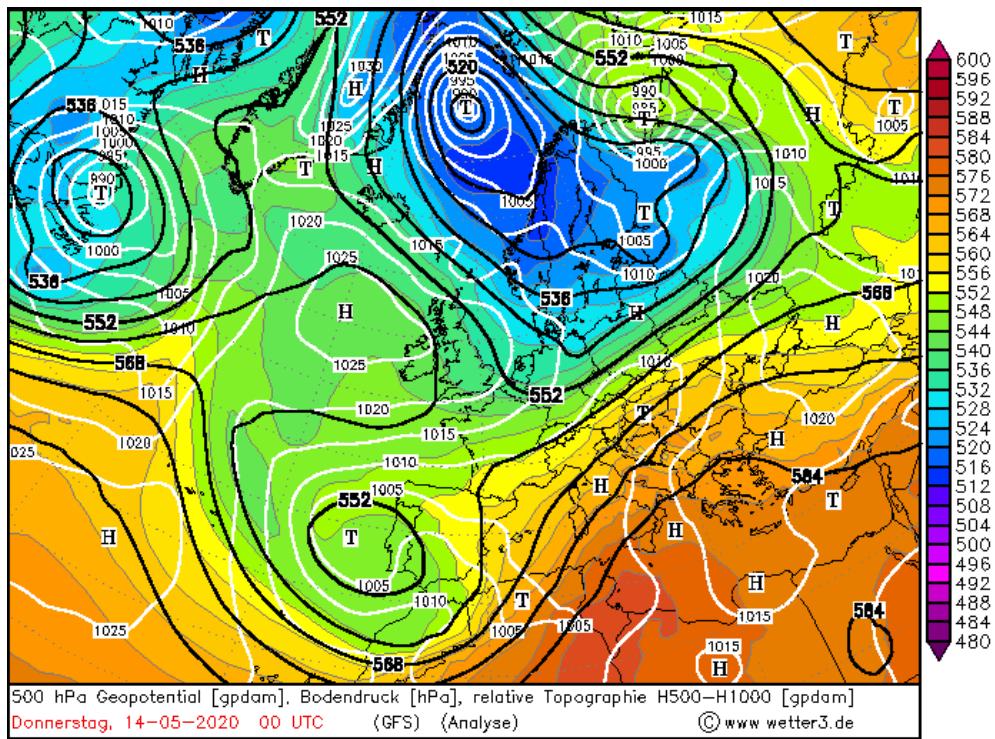
Periods	2018	2019	2020	2020/(2018;2019)
Jan 1, 15 March	36	28	28	-12
March 16, April 30	37	29	24	-27
May	30	32	30	-2
12-20 May	23	30	52	97

PM<sub>10</sub> as the air quality parameter in Karaman city sampling station shows that PM<sub>10</sub> values decreased significantly during pandemic outbreak and increased during Sahara dust event. In particular, the effect of desert dust reflected in increasing PM<sub>10</sub> values by 97 percent in Karaman city comparing to the average values of 2018 and 2019 years (Figure 1).

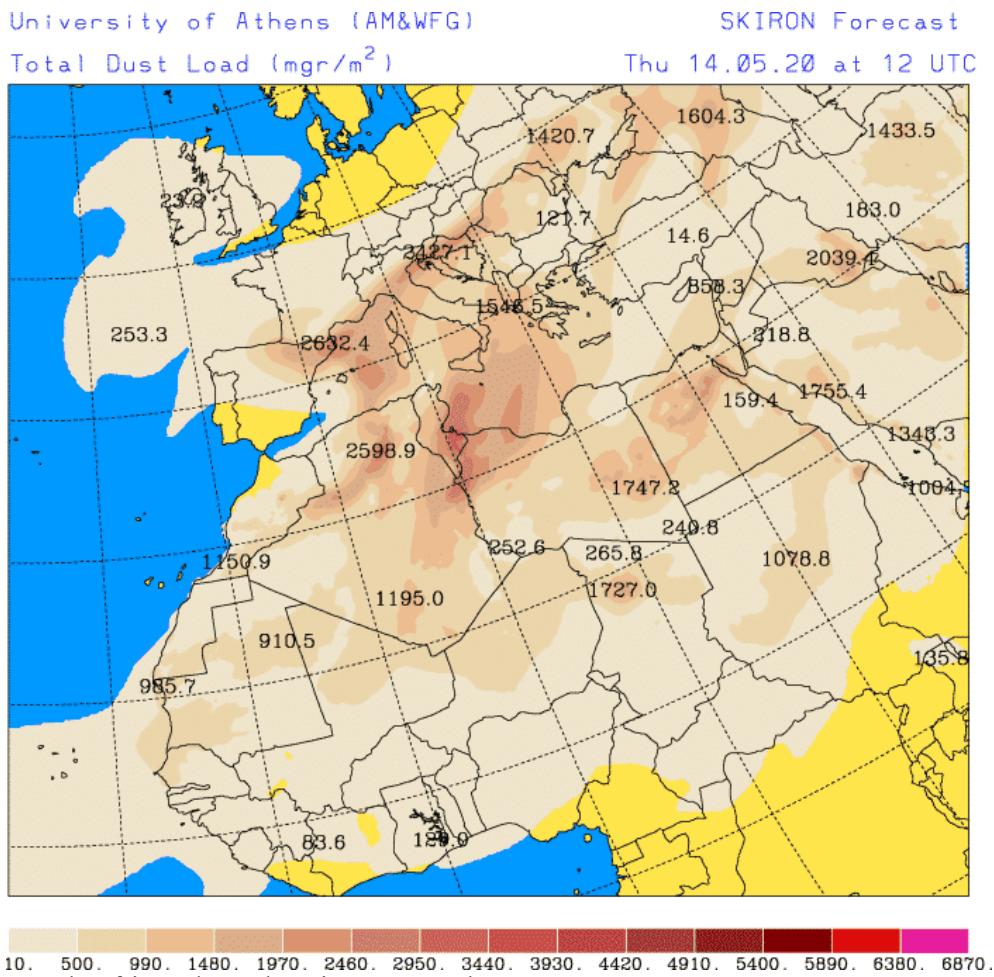


**Figure 3.** PM<sub>10</sub> values time series from January 1 to May 31, 2020

Usually, due to spring hot days dry desert air masses move to northern latitude. This also occurred during, 10-22 May 2020, when the plume of air pollution by dust from the Sahara Desert was transported over the Europe including Turkey and reached Karaman. (Figure 2 and Figure 3)



**Figure 4.** Strong advection of Saharan dust from North Africa into Europe during 14 May 2020



**Figure 5.** North African dust advection over Turkey

#### 4. CONCLUSION

Industrial restrictions applied during the Covid-19 pandemic quarantine shows great positive influence on air quality. Air quality monitoring studies are of great importance in terms of determining the causes and sources of pollution. The distribution and transport of pollution compounds allow us to better develop appropriate control strategies and evaluate the effectiveness of these strategies. It was revealed that the measurements gathering during the period of virus outbreak, limited traffic and reduction of industrial activities have shown remarkable improvement in air quality. The other important aspect is that air pollution and physical atmosphere affect each other through complex interactions. This means that network measurement systems should satisfy to air quality control, but also to monitor atmospheric processes. In order to improve the sustainable environment and keep air quality control at a required level, the measurement networks should be maintained at a proper state.

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## O 20. ENERGY AUDITING IN ALBANIAN HOSPITALS, A CASE STUDY FOR LEZHA REGIONAL HOSPITAL

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**ABSTRACT:** General objective of this paper is to realize an Energy Audit Services for the facilities in order to contribute towards improving the energy efficiency of the building sector and specifically towards energy efficient hospital buildings. The Energy Audit did prepare the technical analysis based on energy performance assessment of hospital buildings for Lezha Regional Hospital. Main goal of the study has been how to collect data and provide useful information on the existing energy performance of selected Hospital buildings through energy auditing as well as suggest possible interventions for improving their energy efficiency. The audit of the Lezha Regional Hospital also aims to integrate the latest technological solutions in order to get a significant energy saving in the existing hospital building, through better management of energy resources and reduction of losses. An analysis of building structure, technical systems and thermal comfort is given. Electricity represent the main energy source followed by diesel oil. Are identified and analysed factors that influence energy consumption. This analysis presents the key findings and recommendations from the application of EE/RES measures for Lezha Regional Hospital as an example that can be applied to other hospitals. Following energy audit, a list of prioritized energy conservation measures requiring further consideration are drawn up, indicating the energy saving for each one, the respective investment required and providing a cost-benefit analysis, showing both economic and financial indicators.

**Keywords:** Energy auditing, hospitals, thermal comfort, heating, lighting.

### 1. INTRODUCTION

Saving money on energy bills is attractive to businesses, industries and individuals. Customers, to whom energy bills receive a large share of revenue, and especially companies where energy bills are a major component of operating costs, have a strong motivation to start and continue an energy cost control program. Cost-free or low-cost operating changes can save 10-20% on utility, customer or industry bills (Dorri, 2017). While programs for capital expenditures with a payback period of up to 2 years can offer a 20-30% higher savings. In many cases energy cost control programs result in saving energy consumed and reducing polluting emissions into the environment. Hospitals are known as major energy consumers and in most European countries the high proportion of obsolete elements makes hospitals public buildings with low energy efficiency. Nowadays there is an urgency to achieve real energy savings from existing building stocks and to build new more sustainable hospitals.

In this context efficient energy management possesses a key challenge for all building management and especially for hospitals. Adding the benefits of energy survey and audit as instrument to improve energy management has the potential to improve overall energy situation. Energy Audit is the key to a systematic approach for decision-making in the area of energy management (Thumann and Younger, 2008). It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame. The primary objective of Energy Audit is to determine ways to reduce energy consumption. Energy Audit provides a reference point for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization (Dorri et al. 2019).

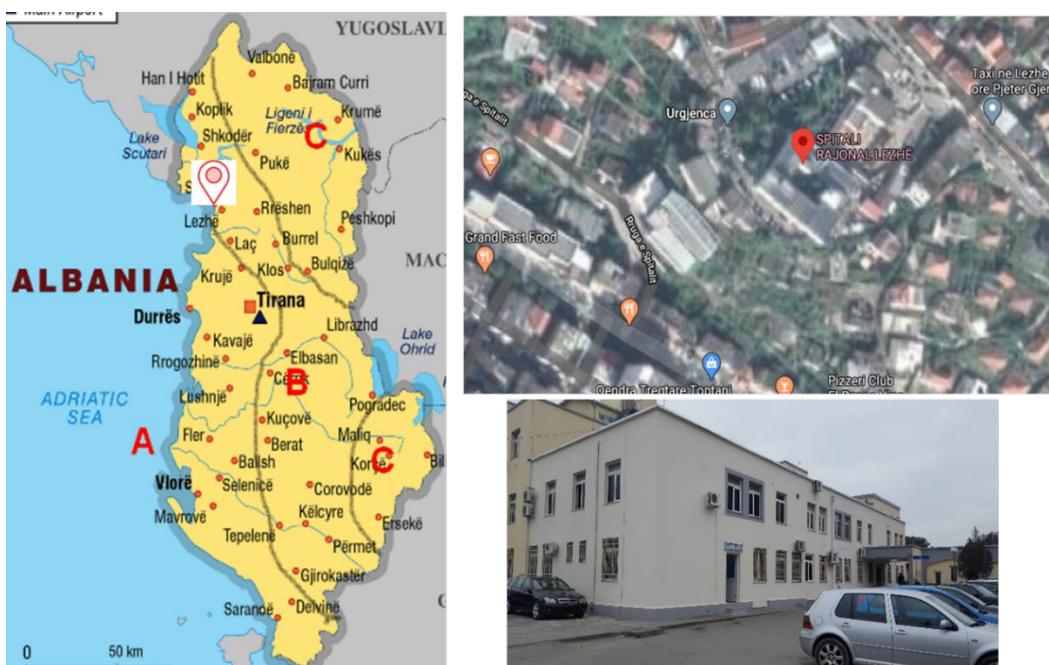
General objective of this work is to realize an Energy Audit Services for the facilities in order to contribute towards improving the energy efficiency of the building sector and specifically towards energy efficient hospital buildings. Also how to collect data and provide useful information on the existing energy performance in Hospitals. An analysis of building structure, technical systems and thermal comfort is made. And finally to suggest possible interventions for improving their energy efficiency. For this purpose, Lezha Regional Hospital is studied and analysed.

## **2. MATERIALS AND METHODS**

The Primary health care network in Albania consists of 413 health facilities (Health Centres), but the package of services, management and accountability mechanisms are being reviewed in the context of the administrative and territorial reform (INSTAT, 2020). Hospital services are provided through 42 public hospitals (municipal & regional). While university hospitals, situated in Tirana attract an increasing flow of patients, due to the missing services in municipal & regional hospitals. Specialized services, reliable on technology, have traditionally been concentrated in university hospitals in Tirana. Lezha Regional Hospital is located in Lezha city, in north-west Albania (see Fig. 1). In Table 1 some general information is given about this hospital. The last general building retrofit took place in 2005. In 2018 the emergency complex) has been renewed (emergency rooms, registration, entrance, polyclinic partly). The level of medical equipment is medium to high, e.g. new dialysis centre, new emergency with advanced equipment (CT, MRT scanners, reanimation, etc.). The general condition of the building is good. The level of damages of the building envelope and openings is low and maintenance level is medium. The block is supplied by heat by diesel boilers. The building management (interviewed stakeholders' director and facility managers) has a good understanding of retrofit and energy and efficiency aspects. A preliminary feasibility study for the CHP prepared by the study sponsored by the Ministry of Energy has been prepared and shows approximately that this technology is not positive to be implemented on this hospital. The operation expenses of the hospital are covered by funding from the Ministry of Health and secondary heath funds. In case of lower expenses, due to energy saving, the budget funds will be cut respectively. Preliminary evaluation of conditions is done according to visual inspection, verification measurement (on demand), interview with facility manager and expert estimations. Energy audit is realised according to the scheme represented in Figure 2. In order to realize the Energy Audit for Lezha Regional Hospital, a preliminary meeting with the hospital director was realized and objective of the energy audit was presented and next steps. Later data collection was performed. For this meeting with finance and technician department was established. During this step already collection forms were used and filled.

**Table 3.** General information for Lezha Regional Hospital

Construction Year	1969
Number of floors	3
Daily operating schedule (hours)	00.00 – 23.59
Days in a week on emergency	7
Total number of the administrative officers and patient/doctors/client including the security people	Administrative & working staff = 49 medical staff = 313
No of beds	486
Percentage of average annual bed occupancy	65%
Annual number of incoming/outgoing patients	1 878
Heated spaces surface (m <sup>2</sup> )	2 145
Air conditioned spaces surface (m <sup>2</sup> )	429
Average height (m)	3
Heated space volume (m <sup>3</sup> )	6 435
Air conditioned spaces volume (m <sup>3</sup> )	4 287



**Figure 1.** Position and view of Lezha Regional Hospital

Main energy source is electricity (almost all hospitals are highly depended on electricity). Another source is oil, especially for heating (boiler) during the winter or Domestic Hot Water (DHW) production (Dorri et al., 2019). And small amount of gas for cooking was used.

Most of energy is used in 6 services:

- 1) Heating (by oil boilers and AC)
- 2) Cooling (by AC)
- 3) Hot water (by oil boilers and electrical boilers)
- 4) Cooking (by LPG gas)
- 5) Electrical Equipment (electricity)
- 6) Illumination (electricity)



**Figure 2.** Scheme of energy audit performed

Comfort conditions at hospital are average, since space heating is secure in average, no space cooling, no hot water and lighting is close to average standard figures. As a standard, we used those temperatures:

Patient rooms inside temperature should be +20 °C.

Medical staff' room inside temperature should be +20 °C.

Halls for brake time inside temperature should be +18 °C.

In the meantime, according to Energy Building Code the comfort level temperature for patient rooms should follow the EU standard of 20 °C. Therefore, heating degree day calculations are significant in reflecting the demand for energy. Hospital buildings should be designed to an outside degree template of 0 °C for Lezha Municipality.

Comfort conditions for lighting: Comparison of existing lighting conditions with the comfort requirements, conclude that they do not met adequately. Number of lamps placed, is not in proportion to the intensity of the lighting they should provide. This happens because in some premises no efficient lamps are used and where they exist, are too old and dysfunctional. Also in order to have a full understanding for the building and technical systems a site visit were realised (Fig. 3).



**Figure 3.** On-site measurement

### 3. RESULTS AND DISCUSSION

After data collection and site visits, normally greatest work is done to analyse these data and findings. Calculations for each of hospital facilities are as follows:

- ✓ the relevant actual energy consumption,
- ✓ baseline energy demand without introduction of EE measures (but fulfilling comfort levels),  
energy demand with introduction of EE measures (but fulfilling comfort levels)
- ✓ the respective energy saving values for each EE measure.

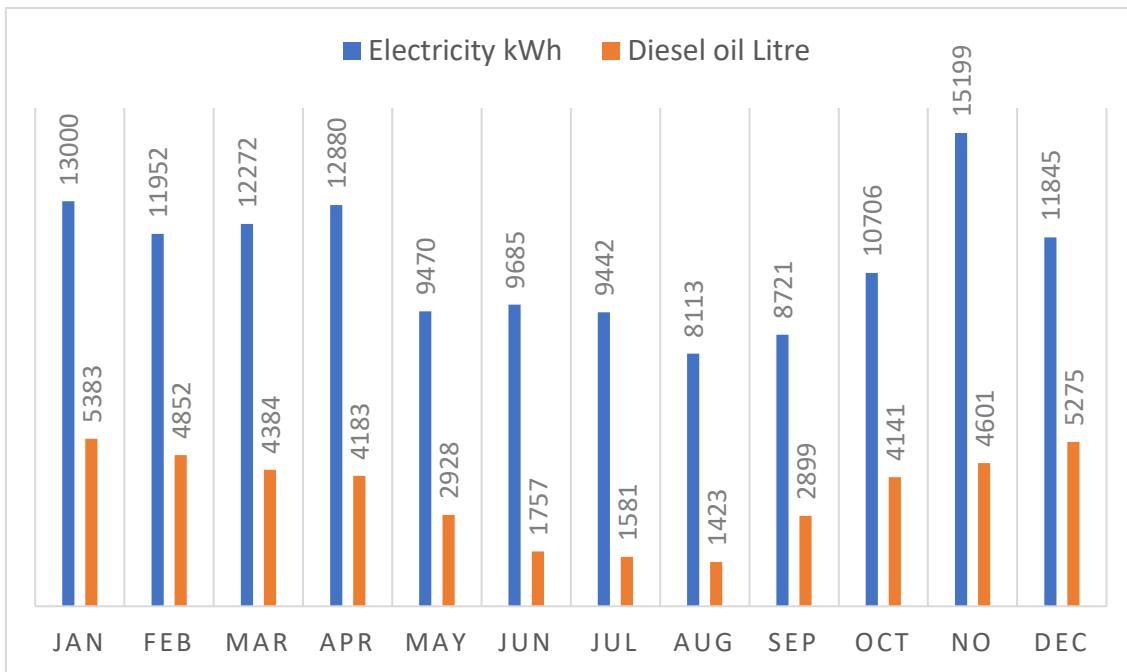
These values, together with investment values and respective energy prices, were used to determine:

- ✓ Energy savings in kWh/m<sup>2</sup> year (consistent with achieving mandatory comfort levels);
- ✓ Financial Internal Rate of Return (FIRR) of each package of EE measures;
- ✓ Financial Net Present Value (NPV) of each package of EE measures;
- ✓ Simple payback period of each package of EE measures;
- ✓ Overall total investment value of each EE measure and of the whole package of EE measures.

From a general viewpoint we realised some important findings, like:

- Physical and thermal situation of the hospital is generally not good. For this reason, it represents a great potential for energy saving by taking energy efficient measures (thermal insulation, efficient window/door, lighting, etc.).
- Lezha hospital has a central heating system but not a cooling systems.
- Automatic regulation system is missing or outdated, so it is difficult to measure the use of energy.
- Only one part of the hospital building is heated, to save energy and to have lower costs.

As we stated above main energy source was electricity and the second one was diesel oil for the boilers. In the figure below is given electricity and diesel oil consumption for the last year (2019).



**Figure 4.** Energy consumption (electricity and diesel oil)

As we can see energy consumption is greater during winter season for heating purpose. Diesel boilers provide not only central heating but also Sanitary Hot Water (SHW). But heating is not covered all by boilers also by electricity, like split air conditioners. While cooling in the summer season is provided only by these split air conditioners. Hospital does not have a ventilation system, this is done naturally by opening doors and windows.

While thermal losses and needs are done based on the existing “Albanian Building Code” (DCM No. 38, 2003). Determination of the energy loss coefficient  $G_v$  ( $G_v \leq G_v^{\max}$ ) is done as follow:

$$G_v = \frac{Q}{V_b(t_{in} - t_{out})}$$

Where:  $Q$  – heat losses,  $V_b$  – inhabited volume,  $t_{in}$  – inside temperature,  $t_{out}$  – outside temperature.

Also:  $G_{vo} = G_{vt} + G_{vv}$ , where:  $G_{vt} = (F/V) \cdot k_m$  is transmissivity and  $G_{vv}$  is for ventilation

Annual Transmissivity losses:

$$Q_{tr} = DD * G_{vt} * 24 * V/(1000 * S) \quad [\text{kWh/m}^2\text{a}]$$

DD - Number of Degree Days

$G_{vt}$  - as given before

$V$  - Heated volume

$S$  - Exposed surface

Ventilation losses:

$$Q_{vent} = DD * n * 24 / 1000 * \rho * c_p * V / (3600 * S) \quad [\text{kWh/m}^2\text{a}]$$

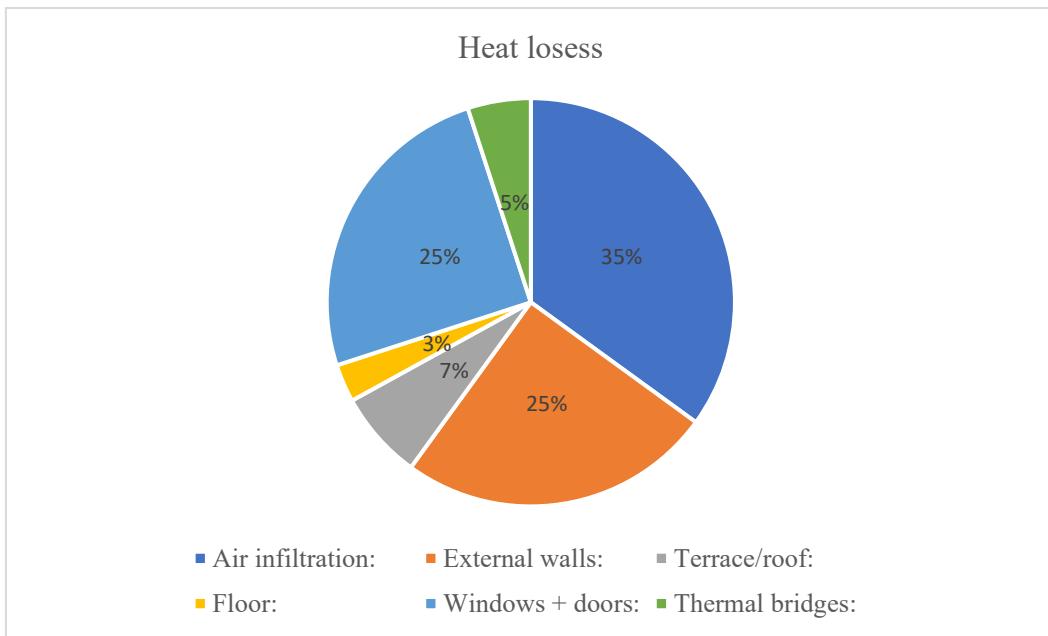
$n$  - Number of air changes per hour

$\rho$  - density of air

$c_p$  - specific thermal storage capacity of air

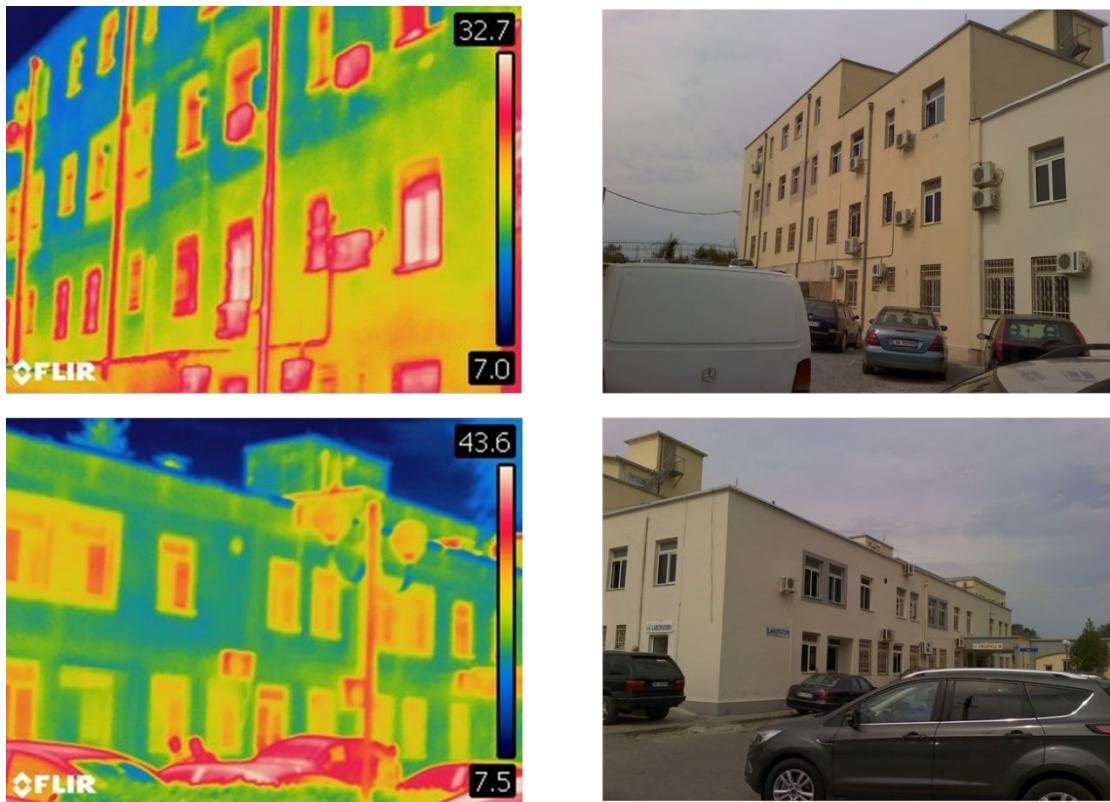
So annual Total losses:  $Q_{tot} = Q_{tr} + Q_{vent}$   $[\text{kWh/m}^2\text{a}]$ .

Analysing heat losses we have seen that most of heat was lost due to infiltration and then do to walls and roofs. Figure below represents heat losses by each building element.



**Figure 5.** Heat losses from each building element

In order to analyse more in details heat losses scanning by thermal camera was performed (See Fig. 6).



**Figure 6.** Images from thermal camera scanning

From these images we can state that buildings have a poor thermal insulation and poor windows quality. The energy losses depend on the structure of the building, insulation material thickness and the climatic conditions. The energy losses have not a linear correlation with the above three parameters. The difference in the extra savings will be lower for extra cm of insulation. Thus, for the first cm-s, as it was underlined above, there are higher savings than the other cm-s. The economical insulation thickness is

that the sum of the costs of energy losses and costs of investments for insulation, to be lower. With the current world prices of energy market, the economical thickness of the insulation for Europe is 8-12 cm. The previous experience has shown that the electricity prices are subject to the rapid changes. The optimum insulation layer is calculated based on the program of technical-economic analysis of thermal insulation, by taking into consideration the fuel cost, maintenance of district heating plant, initial investment of the thermal insulation material, labour power for placing the insulating material etc. By using the external insulation, we can eliminate the existing thermal bridges, the damages of concrete walls can be repaired, the losses can be reduced drastically and the lifespan of the building is extended. In general, the problems related to the condensation should be avoided, there is not any more the risk of dew point in the walls and the construction remains dry during all the time. Before installing the external layer of insulation, the transporting load abilities should be tested and the cracks and existing damages should be repaired. Installation of a thermal insulation of the outside wall and roof will bring energy savings, will protect forest from its continuous destruction and will also protect the environment.

#### **4. CONCLUSIONS**

An energy audit can help an organization to identify opportunities to improve energy efficiency. It can be part of a site-wide energy management system. The use and operation of hospital requires the provision of services such as heating, cooling, ventilation, lighting, domestic hot water, transportation systems (e.g. elevators, escalators and moving walkways) in hospital facilities. In addition, energy is used by the electrical appliances within the hospital facilities. The energy consumption in the all hospitals to be selected depends on: i) local climatic conditions; ii) the characteristics of the buildings envelope; iii) the designed indoor environment conditions; iv) the characteristics and settings of the technical buildings systems; v) usage, activities and processes in the buildings; vi) occupant behaviour and operational regime; vii) energy systems and equipment used in the buildings; and other (less important) factors. Energy performance indicators (benchmark values, if available) or average statistical specific energy consumption data, are usually published nationally for the all hospitals to be selected of different types and ages and structures/income. Following the detailed energy audit, a list of prioritized energy conservation measures requiring further consideration will be drawn up, indicating the energy saving for each one, the respective investment required and providing a cost-benefit analysis, showing both economic and financial indicators.

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**O 21. EVALUATING THE ENVIRONMENTAL MANAGEMENT SYSTEM  
ACCORDING TO INTERNATIONAL STANDARDS (ISO 14001: 2015) A FIELD  
STUDY IN THE IRAQI OIL WELLS**

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**ABSTRACT:** One of the ways to reduce environmental pollution is to improve the environmental performance of companies that extract oil. As the word ISO became the buzzword in the world today, the international standard ISO 14001: 2015 aims to help organizations reduce activities that negatively affect the environment and define controls for these activities, including the use of natural resources, waste handling and treatment and energy consumption. The research aims to Highlight on the benefits of the application of ISO 14001: 2015, with the availability of administrative tools that companies operating in the field of refining crude oil in Iraq lie in controlling the negative effects in the environment and the trend towards green technology without side effects on the environment, we mention the most important advantages of using ISO: Reducing the use of raw materials / resources, improving the efficiency of operations, reducing the amount of waste generated by operations and reducing costs of disposal, and reusing recyclable resources. On the other hand, there are major environmental damages that occur during oil refining operations, such as air and soil pollution. These impacts can be decrease by setting a comprehensive plan for environmental management by reducing pollutants produced during operational, in addition to that, And expedite the enactment of new strict laws by the Iraqi government to reduce pollution.

**Keywords:** Environmental management, Environment management system Air pollution, ISO 14001: 2015, Iraqi Oil wells

## O 22. DEBT MONETIZATION

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**ABSTRACT:** Although it remains one of the most discussed economic issues in various countries, everyone wants to find the best possible solution. In developing countries like Albania, alternatives are limited, but we still tend to follow the example of the West, especially the United States. Debt management strategies are very different, what is required is to choose with less additional costs. What is often attempted is to reduce the burden of generations to pay. Often policies do not bring the expected result and the situation changes. Debt settlement has also been seen as a solution, but how many times will it give us a positive result that no one predicts. We believe that the issuance of new money will bring results in certain situations. Putting new money into circulation would not create new debt, but would have other costs for the country. New emissions could create inflation. Such strategies have been used since early times in developed countries. In cases like this, the cost of new emissions and inflation costs remain to be compared. Many policymakers are affected here and follow the negative consequences of these cases and link the events one after the other. Different countries have different reactions, but a common goal, before the state budget. These and more will be addressed throughout the topic Debt Monetization.

*Keywords:* Money issuance, dept, inflation, cost.

### 1. INTRODUCTION

#### *Monetization*

WE treat this topic thinking as another solution for public debt repayment. As mentioned in other articles debt in our country is mentioned after the 1990s. In the beginning, due to the need for liquidity, the privatization of properties began to accumulate money. Later, we started to borrow, sometimes even the two processes combined together more or less, until started concessions or otherwise public-private partnership. Many discussions started at this stage. Procurement method, laws, schemes and their amounts were changed just like any other phenomenon. The monetization solution has been tried in the world for years. Its sides are more positive as they provide solutions immediately after the main role is taken by the central bank of the country. We often call monetization a legal tender, but not always the best positive solution. Monetization does not directly highlight the debt created. There are cases when governments take measures for direct payments to the state treasury in order to immediately close the deficit problem without making known to the public the need for liquidity in the budget. However, there is no idea that everything is not noticed. There is a moment when the institutions cooperate and the situation is resolved only by the central bank, either by intervening the bank itself in auctions for the purchase of issued bonds, or by the lenders that can be given by third parties. Issuance of new bonds means monetization. Monetization can be in 2 forms:

1. Money issue
2. Creation of new government bonds purchased by the central bank

In the first case all costs fall on the central bank and it must bear them alone. The CB has to deal with policy changes and up to the cost of issuing money. In this way the action in the market is direct and there is no creation of new debt. This is positive and worth noting, but for the central bank it has a negative side because its balance sheet is directly affected. From this moment the bank bears all the risks, if the bank issues and disburses money in the market and then withdraws them in other instruments then this is risky and it is the same as increasing the direct debt. Rather here leaves a new debt.

This phenomenon is related to the withdrawal of CB from the solution and is required to resume action with fiscal instruments. This phenomenon takes us away from monetization and takes us further to examples for developed countries such as the US and the UK. In these countries, monetization has been implemented for years as a solution to increase liquidity. In the policies pursued by the CBs, the solution is to intervene in situations when there is a lack of liquidity. In economics, it is the duty of the CB to monitor the performance of the monetary situation. Even if the necessary chief CB gets involved in situations and by buying government bonds directly. Only in a country where it is prohibited by law

to intervene, the Central Bank is not involved in resolving situations where there are liquidity difficulties. If this does not happen and the lack of liquidity lasts for a long time, then the CB has a duty to intervene and systematize the situation.

### **Special Cases**

The ways of political and economic organization of countries continue to remain different despite the fact that developing countries follow the examples of developed countries. Monetization requires a country to have an independent CB and it is this independent CB that makes the country independent of other countries. Monetizing this requires solving the problem individually, without involving other countries, without creating other financing instruments which later complicate the economy. This is also a positive side of monetization, solving the problem where it arises, of course we have to see the conditions and risks that we will address further, but there are also special cases.

Special cases are EU member states. Their degree of economic integration goes as far as monetary union and the main function in controlling and liquidity situation has the ECB. This is where the problem with monetization in EU countries arises. Liquidity needs vary from country to country, but the ECB cannot intervene as a central bank of a particular state. Its actions must take into account all the risks involved in the process. The ECB cannot change its policy just for the liquidity needs that only one country has. This reflects an important condition for making the monetization process real. The CB should be totally independent and thus maneuver with instruments for quick solution of the problem in cases of lack of liquidity in the budget. However, just as there is a negative side, there are also positive sides, such as the incentive for good liquidity management that they own as well as the wealth of their countries.

While there are some reasons to worry, central banks are doing the right thing and economically there seems to be no reason to panic. In the UK, the Treasury and the Bank of England have just announced the temporary reactivation of a scheme that makes it possible for the central bank to finance public spending directly. Other commentators want central banks to do even more and start some form of "helicopter money". In a way, they are practicing what helicopter money backers demanded - but in a much more targeted way than anything central banks could ever do.

At the same time, central banks have initiated new, large-scale government bond-buying programs.

It is known that China in recent years has undergone a long economic reform, the rate of growth of money supply has been consistently greater than the sum of real GDP growth and the rate of inflation. Most of the "surplus money" was absorbed by the newly earned economy and inflation was moderate. The reason is that the economy can't absorb more excess money than it has received so far. Excess money supply above and beyond the level of real GDP growth has mainly resulted in inflation. This is what economists fear when we choose monetization.

The government can borrow money, print money, raise taxes, or cut spending.

The government decides to borrow money from the public by issuing thousands of dollars or Euros in bonds and offering bond buyers favorable interest rates.

What should not be forgotten is the fact that everyone seeks to benefit in order to secure greater resources for the future. Here we mention the example of earning trading money.

When people browse websites and click on advertisers' links, website owners - whether individuals or large media companies - make money. If a website attracts enough visitors, the money paid by advertisers can add significant profits. You can't be profitable without taking risks or otherwise there is no benefit without taking risks. We seek to close the deficit but there are other risks to the economy. Regardless of whether the deficit gain is or not, it is often thought to have significant macroeconomic consequences. Here are 2 questions to ask about monetization:

1. Does its gain matter depending on the impact on macro models? and
2. How much money would the Bank need to intervene in the market?

At first macro models take into account the positive sides and in the first moment monetization has a positive effect. For the second the bank decides how much money it will put on the market either by issuance, or by touching the reserve and so there are no major changes in its balance sheet in figures, but simply in items. What matters is the money and future behavior of the central bank. Our previous proposal was that, as long as interest rates are close to zero, regardless of whether the consolidated government's liabilities are debt or money does not matter.

The consolidated government now has two types of debt: regular debt and interest-paying money. Neglecting the impact of the term premium, the total interest rate burden is the same regardless of the composition of the debt between the two. One of the implications of higher inflation will be the reduction of the real value of nominal debt, easing the debt burden.

If current large-scale purchases by central banks of government securities are really interpreted as a signal that, when the time comes, they will not pay interest on the big money stock and thus allow overheating, inflation and reducing the real value of government debt? It is true that the larger the government bond portfolio held by the central bank, the stronger the effect of its policy on debt sustainability. On the one hand, having the ability to lower the real value of debt if things are extremely bad is clearly a rewarding opportunity to have.

If the virus crisis lasts for a long time and imposes such a debt burden on governments that they cannot pay their debt, they will be forced to choose between inflation, debt restructuring, financial oppression and expropriation of assets and there is no a priori reason to claim that they should rule out inflation.

If we mention in our country, we continue with Eurobonds and grants. Monetization to be heard in public is still a scheme. Not even immediate intervention by the central bank. Perhaps our policymakers better judge the growing share of debt or the impact of concessions on the economy than monetization.

### **Risks**

Like any action that has a positive side, monetization has additional costs and risks. Not only that, but monetization becomes the cause of macro problems if the situation is not managed well. Monetization brings about inflation, frequently changing interest rates, changes in monetary policy, production and economic growth. We mention these as factors that are affected but not necessarily on the negative side. We define who they are to avoid to some extent problems that can be generated by monetization. The risk that you encounter the most and that accompanies the longest monetization process is inflation. In the views of an economist, delivering new money to the market brings about many changes. What worries economists and policymakers the most is inflation and of course the case when interest rates are low and the economy still lacks liquidity. It seems that the economy itself sets up traps to make it possible to properly assess the changes that need recovery.

It can also be thought that there are high risks because the problem it solves is current. But if this lasted, then it would appear that in addition to the lack of liquidity in the long run we would also have falling interest rates, two different issues for the monetary market that need to be resolved at the same time. So if we start with the delivery of new money in the market this would increase the possibilities of consumption of course, but at the same time the increase in consumption shows an increase in aggregate demand and a real increase in prices. In the market we already have rising prices and investments that can be increased because there are low interest rates. Here it depends on which parameter gives the highest impact on the economy and normally on this basis the best solution is given. If we took together any direct claims that our production would increase, our labor market would develop and thus we would have economic growth. How many guarantees this has is not known because it depends on how much investor could eliminate the problems and risks to develop the economy, how many good initiatives we would have in a troubled economy. This is why there is no "fixed recipe" for monetization. So we try to look more positively. Putting on a scale often acknowledges the positive fact of boosting the economy and igniting inflation.

## **2. CONCLUSIONS**

The central bank, regardless of the situation, seeks to keep its instruments within the set target. It seeks to control interest rates and inflation. In a country like ours, we have these with directives from the EU. Fluctuations in interest rates and the emergence of inflation are not positive for a developing country like ours. Making new money is really the same as driving the economy, but there are risks that need to be managed and eliminated. Fast liquidity ratios need to be addressed quickly. Often attempted with restrictive fiscal policy, but it limits consumption and production. With monetary policy, it depends on the central bank's role in the economy. They choose monetization for the reason that they do not add debt. Due to short-term estimates claiming we expect a more positive result in the long run. Monetization has costs but also benefits. Government expenditure using this new money boosts incomes and raises private demand in the economy. Thus, it fuels inflation, but a little increase in inflation is healthy as it

encourages business activity. If the government doesn't stop in time, more and more money floods the market and creates high inflation.

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## O 23. DETERMINATION OF PRIORITY CLASSES IN WATER PROTECTION ZONES OF LECHTINGEN AREA BY GIS

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**ABSTRACT:** Water protection zones are mainly established for protecting different types of water sources such as surface water, coastal water, and groundwater. Many European countries use these areas to evaluate the potential contamination risk encountered by the water sources. Germany has described three different water protection zones changing with respect to the types of water sources. Zone I covers the immediate water catchment area within a radius of at least 10 meters. Zone II covers the area of zone I and distance which has been reached by the contaminant up to 50 days. Zone III is more comprehensive than others. It covers the area from Zone II to the very edge of the catchment area of the water source. Determination of priority classes in water sources is important to evaluate the risk of contamination. In this study, priority classes for nitrate leaching, which is dangerous for health if it is found higher levels in a drinking water source, in the water protection zones found in Lechtingen area of Osnabrück, Germany was determined with geographic information system (GIS). The data of nitrate leaching risk, land use, and water protection zones in that area were used to make evaluation about priority classes. As a result, almost 40% percent of the area found as a high priority against nitrate leaching.

**Keywords:** Water protection zones, nitrate leaching, priority classes, GIS, water sources.

### 1. INTRODUCTION

Water is the most important life source of human being, so the protection of water sources is a great issue. There are different types of water sources present all over the world such as surface water, groundwater, and ocean water. For drinking purposes mainly groundwater and surface water are used. Especially in developing countries groundwater is preferred water source because of the less requirement of treatment and better bacteriological quality (Appel & Postma, 2005). Groundwater is defined as water in the underground between cracks and other spaces in the soil. It mainly moves between geological formations and stored in the rocks and sand. These structures mainly called aquifers which has different properties with respect to its confined or not (Fitts, 2002; Usul, 2012). Groundwater provides drinking water requirement of 51% of United States (U.S.) population and 99% of the rural population. It is also used for agricultural purposes. In U.S. 64% of groundwater is used for irrigation purposes to growth of crops. It is also an important source for some industrial activities. It can be used for recharge to wetlands, rivers, and lakes (The Groundwater Foundation, 2020). The other important source of drinking water is surface water which is defined as water in river, lake, spring, and pond. These waters are naturally recreated by precipitation and lost with evaporation, the discharge to the oceans, groundwater recharge and evapotranspiration (Ohe et al., 2004). Groundwater and surface waters behave like reservoirs to feed each other.

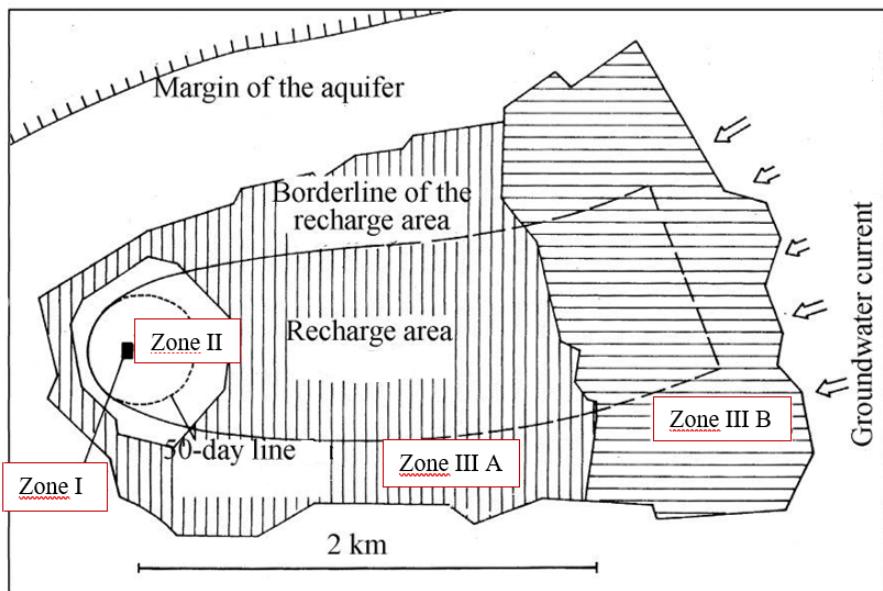
Ocean waters are the biggest water source in the world. However, while it is not appropriate for drinking purposes, there are several other benefits of oceans such as sea plants and animals farming in coastal waters, fishing in offshore waters and huge carbon sequestration (Srinivasan & Leben, 2004). Owing to the huge benefits of water sources, it is important to protect them from contamination. For that reason, water protection zones were developed.

#### 1.1. Water Protection Zones

Water protection zones are mainly established for protecting different types of water. Many European countries use these areas to evaluate the potential contamination risk encountered by the water sources.

The main federal law of Germans about water protection is Federal Water Act (Wasserhaushaltsgesetz, WHG, in German). The purpose of this act is providing a good status of all water bodies by 2027. This offers the elimination of pollutant concentrations in water bodies and protection of aquatic life (BMU, 2020). There are also several legislations present in Germany to provide

the sufficient protection of groundwater. These legislations are used for maintaining the quality of groundwater sources (Schleyer et al., 1992).



**Figure 1.** Groundwater protection zones for a well with respect to German legislations (Zhu & Balke, 2008)

In Figure 1, boundaries of groundwater protection zones for a well are given. In this figure the water protection zone has divided into three different zones. These are protection zone I (remedial action zone), protection zone II (attenuation zone) and protection zone III (well field management zone). Zone I mainly provide protection to the direct vicinity of a well. German legislations indicate the distance of 10 m from all sides of water source. Zone II protect water source against pollutants such as chemicals and microorganisms which are harmful for human body. Because the elimination of these kind of microorganisms takes 50 days, Zone II covers the distance of contamination from the water body up to 50 days. Zone III protects water source against radioactive pollutants and chemicals (Zhu et al., 2007). This protection affected by adsorption, decay and dilution with seepage water can be supplied by extension of boundaries of the zone over the hydrological and hydrogeological recharge area of a well. This zone includes two subdivisions called Zone III A and Zone III B, if the longitudinal axis of the recharge area is more than 2 km (Zhu & Balke, 2008). The boundaries of these zones are very important to protect water sources against pollution. There are several pollutants which can create risk on water bodies. In this work, the nitrate pollution risk on the groundwater wells was evaluated with priority classes by the help of geographical information systems (GIS), which is one of the most useful tool for creating evaluation systems and models using different types of data.. Nitrate leaching can have a direct impact on water quality because nitrate is very mobile and easily leaches with water. High levels of nitrates can be toxic to newborns, causing anoxia, or internal suffocation. The health standard limit of nitrate is determined as 10 ppm nitrate-N.

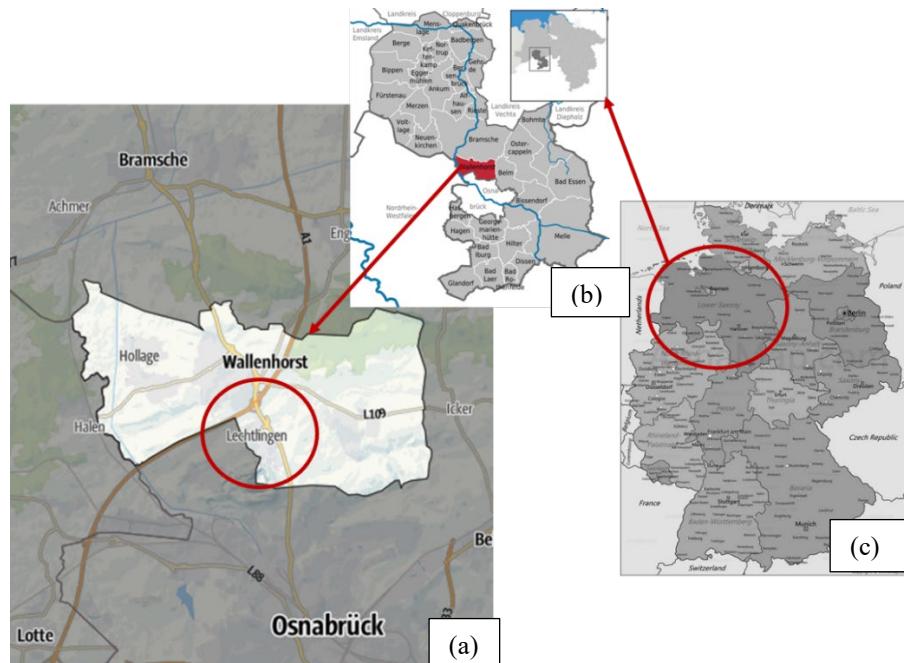
## 1.2. Priority Classes

Priority classes for groundwater protection may be developed to evaluate potential pollution risk on groundwater sources. It is a simple evaluation system. The urgency level of the sites is determined by the priority classes (Jobstmann, 2009). In the study of Jobstmann, three priority classes were defined. Class I represents the highest risk on the water body and the rapid spread of contaminants while class III represents the low contamination risk and limited spread of contamination (Jobstmann, 2009). In this study according to the land use of the area, the water protection zone type and pollution risk data, evaluation system of Priority Classes was developed. Different from Jobstmann evaluation system, the risk of contamination increases with priority class number in this work.

## 2. MATERIAL AND METHOD

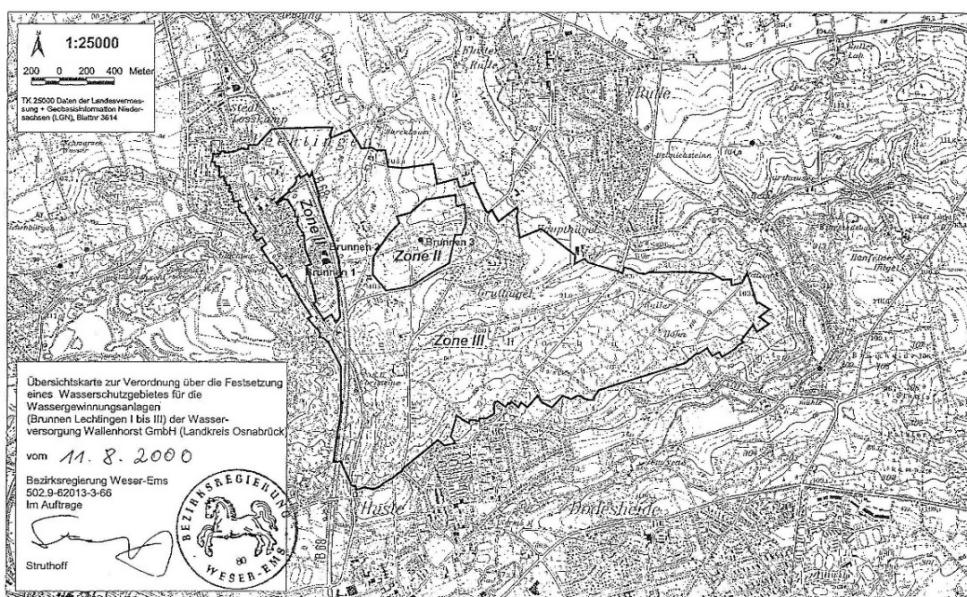
### 2.1. Study Area

Lechtingen area is found in the Wallenhorst district of Osnabrück, located at Lower Saxony of Germany. It is situated in the Wiehengebirge, approximately 10 km north of Osnabrück. In Figure 2 the map of Lechtingen area was given.



**Figure 2.** (a) Map of Lechtingen, (b) map of Osnabrück, (c) map of Germany (Anonymous, 2020 a; Anonymous, 2020 b; Anonymous, 2020 c)

In this study, the priority classes within water protection zones was determined. To make this evaluation, topographic map of the area is required. Topographic maps mainly used as a base map in GIS. In Figure 3 topographic map with a scale of 1:25000 was showed. In this map the boundaries of water protection zones of this area were seen also (Amtsblatt, 2000). There are two types of zones determined such as Zone II and Zone III with respect to the three groundwater wells found in the area.



**Figure 3.** Topographic map of the area with water protection zones' boundaries (Amtsblatt, 2000)

## 2.2. Georeferencing and Digitization of Water Protection Zone Map

The topographic map of Protection Zone II and III of Lechtingen area was first projected to arrange it with the world coordinate system. This operation is necessary if the map will be used together with other maps. Germany mainly uses Gauss-Krüger-System in all maps. Scanned maps are images which must be rotated, shifted, and scaled to fit to maps in world coordinates. Georeferencing tool of ArcGIS is used to make this operation. There are two different operations is possible. One uses exact world coordinates of some ground reference points on the image and by entering the coordinates directly to the system. The other one needs already georeferenced map to identify different control points between image and map. In this study, already georeferenced topographic map of Wallenhorst was used as a base map for georeferencing the map of Lechtingen area by using different ground control points in the image and on the map.

Then, the water protection zones were digitized by creating polygons. This operation provides the digitize new information within the selected boundaries. Arctoolbox was used for this operation. Data management tools, feature class, create feature class steps were followed, respectively. As a geometry type, polygon was selected. By editing operation, the boundaries were selected, and digitization of water protection zones was completed in the new layer.

## 2.3. Preparation of Land Use and Nitrate Leaching Risk Maps

Land use map of the water protection zones was prepared with respect to the land usage information (Geozentrum Hannover, 2016) of the area by using joins and relates operation. With this operation it is possible to join different information about the area into the attribute table. The steps include load of table, joining tables to the attribute table of the map and using common key fields. Finally, the symbology was created according to the soil types by using legend editor.

Similarly, nitrate leaching risk map was created by joining operation. Nitrate leaching risk is mainly affected from soil properties, the plant types, seepage water rate. In this study previously determined nitrate leaching risk data was used (Ayturan & Dursun, 2020). The table including the information of nitrate leaching risk was joined into the attribute table and distributed on the water protection zones of Lechtingen area. New symbology was created with different colors.

## 2.4. Evaluation Criteria for Priority Classes

Determination criteria for priority classes with respect to land use, water protection zone and nitrate leaching risk data was developed as seen in Table 1. These criteria were established according to the soil properties of land uses along with nitrate leaching risk and water protection zone type. Grass lands mainly includes dark and deep soils which has full of nutrients in upper layers and appropriate for the growth of different types of roots (UCMP, 2020). Forest soils are similar with the grassland because they are also nutrient rich with help of the organic matter recycling and offer a good environment for the deeply rooted trees (Boyle, 2005). However, because of the usage of arable lands for agricultural purposes the nutrient levels are not stable and soil quality may be affected negatively especially from crop farming (Adeyolanu et al., 2015). As a result of soil properties of land use types, the evaluation criteria were developed. While the priority of a grassland and forest was determined as 4 against high nitrate leaching risk and zone II, the priority of an arable land was determined as 5.

**Table 1.** Evaluation criteria for priority classes

Land Use	Nitrate Leaching Risk	Water Protection Zones	Priority Class
Grassland	Very Low	III	1
Grassland	Very Low	II	2
Grassland	Medium	III	2
Grassland	Medium	II	3
Grassland	High	III	3
Grassland	High	II	4
Arable land	Very Low	III	2
Arable land	Very Low	II	3
Arable land	Medium	III	3

Arable land	Medium	II	<b>4</b>
Arable land	High	III	<b>4</b>
Arable land	High	II	<b>5</b>
Forest	Very Low	III	<b>1</b>
Forest	Very Low	II	<b>2</b>
Forest	Medium	III	<b>2</b>
Forest	Medium	II	<b>3</b>
Forest	High	III	<b>3</b>
Forest	High	II	<b>4</b>

## 2.5. Preparation of Priority Classes Map

Land use map, nitrate leaching map and water protection zone map was overlaid. Overlay operation in Arctoolbox was used to create intersection between water protection zones and the other maps. Then priority class in the water protection zone was developed in the attribute table by creating new field. By the help of query builder, the evaluation criteria were applied on the new column of the table. Finally, the symbology editor was used distribute the priority classes on water protection zones of Lecthingen with different colors. Moreover, the percentages of priority classes in the map was determined by summarizing the attribute data and counting the numbers.

## 3. RESULTS

### 3.1. Land Use

In Figure 4 the land use map of water protection zones is given. According to this map, the main soil types in that area are grassland, forest, and arable land.

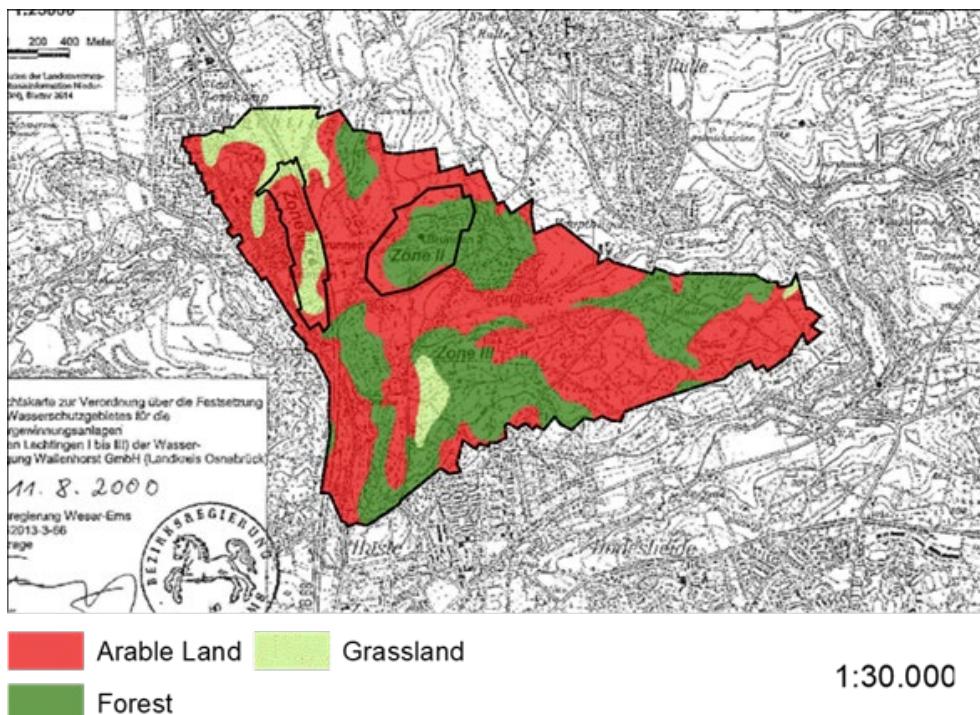
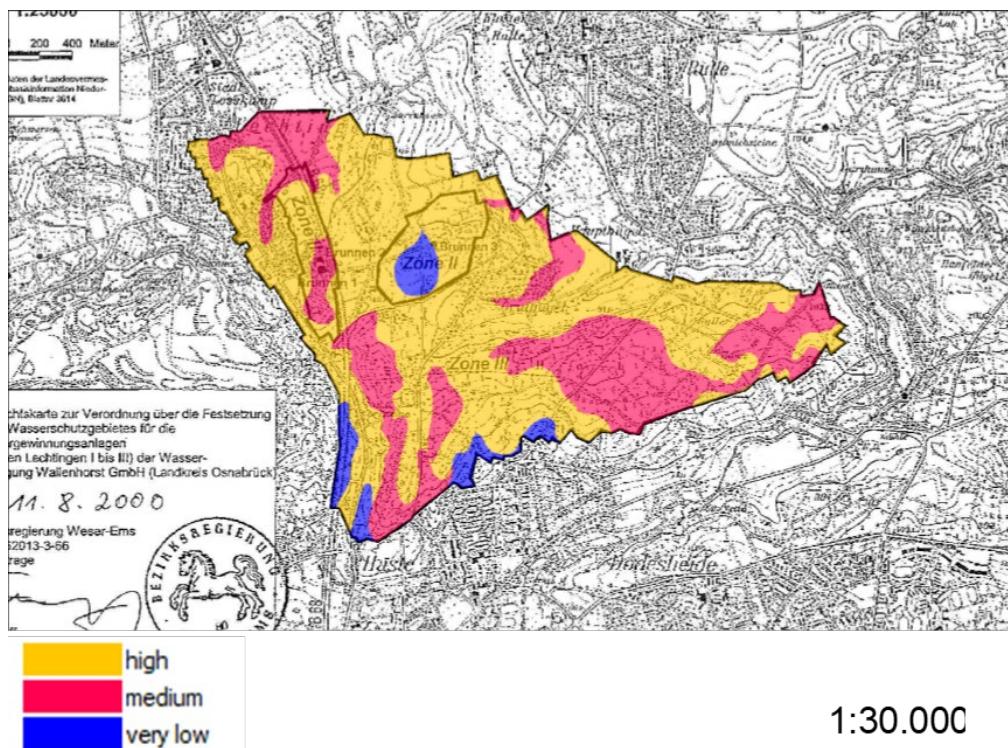


Figure 4. Land use map of water protection zones in Lecthingen

### 3.2. Nitrate Leaching Risk

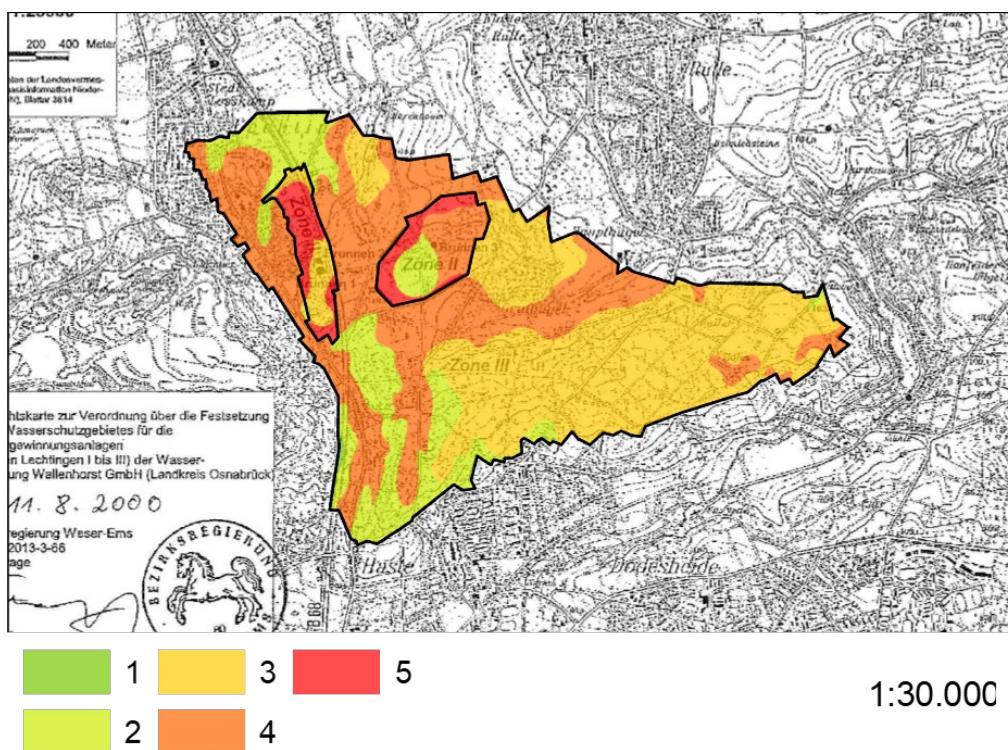
In Figure 5 nitrate leaching risk map of water protection zones is given. The risk of nitrate leaching was found high in the most part of the area according to this map.



**Figure 5.** Nitrate leaching risk map of water protection zones in Lechtingen

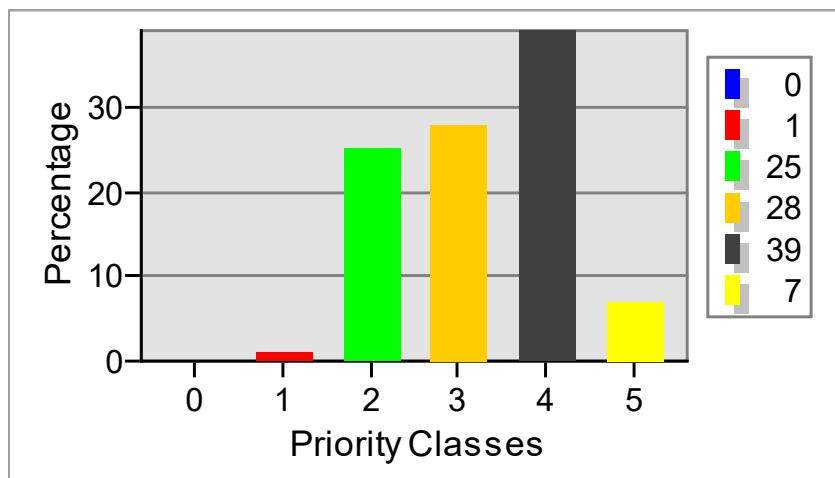
### 3.3. Priority Classes

Priority classes map of water protection zones is given in the Figure 6. The map shows that there are some areas which are priority of 5 against the nitrate leaching risk, and they are found in the Zone II. Moreover, the most part of the map includes areas of 4 priority which means these areas are under the high of risk nitrate leaching. The rest of the map includes areas which are priority of 2 and 3.



**Figure 6.** Priority classes map of water protection zones in Lechtingen

In Figure 7 the percentages of priority classes distributed over the map is given. 39% of the water protection zones of the area was found 4 of priority classes against nitrate leaching risk. The percentages of priority classes of 2 and 3 are similar with each other. 7% of the area was found 5 of priority classes.



**Figure 7.** Percentages of priority classes distributed over water protection zones

#### 4. CONCLUSION

Water protection zones are so important to protect water sources. The contamination risk of groundwater wells in Lechtingen area against nitrate leaching was evaluated in this work. In the 39% of the water protection zone, the risk of nitrate leaching was found priority classes of 4. 7% of the zones was evaluated as 5 in priority. These results show that a big part of this area is susceptible to be contaminated with the nitrate pollution. Some preventive precautions may be taken in this area to reduce the risk. Moreover, the nitrate levels of the wells should be measured continuously before usage. Especially infants and baby animals should be protected.

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## O 24. THE RELATIONSHIP BETWEEN HEALTH, ENVIRONMENT AND ECONOMIC DEVELOPMENT

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**ABSTRACT:** This paper examines the link between health, environment, and economic development, focusing on Albania. Health and development are irrevocably interrelated. Life expectancy and also child mortality are considered key development indicators. Air pollution leads to premature death from heart disease, stroke, and cancer, as well as acute lower respiratory infections. It caused an estimated 7 million deaths globally in 2016, according to the World Health Organization. Most recorded air pollution linked deaths occur in developing countries, where laws are weak or not applied, vehicle emission standards are less stringent and coal power stations more prevalent. In Albania, the situation of air quality is one of the major issues that disturb local and national authorities for the impact on the health of the population, agriculture, and the environment in general. The transport is the main source of urban air pollution. The number of vehicles continues to grow from year to year, and their average age is 20 years, from 10.2 years in the European Union. Moreover, we can say that Albania has become Europe's "rubbish bin" because new cars make up only 4% of the total number of cars and the difference, 96%, are used one, which, although developed the business of used cars, the pollution they cause is deadly. Clean air is a human right and a necessary pre-condition for addressing climate change as well as achieving many Sustainable Development Goals. Air pollution does not only damage human health, but it also hampers the economy in many ways. In Albania, it is noticed that the budget that municipalities allocate to services directly related to the environment (including the protection of air, soil, and water quality from pollution) is very low. The maximum value distributed in the total budget for these services is evidenced by 0.7% in 2016, and 2.9% in 2017. While for the years 2018 and 2019, the maximum value distributed in the budget for these services is evidenced by 1.6% in both years and the minimum value distributed is 0% for both years. According to the Household Budget Survey 2018. We use macroeconomic data to give answers to the basic hypothesis of the paper that environment situation is closely linked with the health and economic development of a country.

**Keywords:** *Health, Environment, Economic Development, Air pollution.*

## O 25. ENVIRONMENTAL IMPACTS OF THE INTERGRATED DRY GRANULATION METHOD APPLICATION OF FERONICKEL SLAG

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**ABSTRACT:** Metallurgical industries rentable and responsible towards the environment among the key objectives put the development of utilization schemes of all of its middle – products. The smelting process of nickel oxides ores, is almost slag process, where about 75% of the calcine pass to slag. In the New Ferronickel smelt plant in Kosova, produced slag is thrown in the landfill without adequate proper treatment. Such exploiting concepts, without any valorisation strategy, have resulted with the no effective manufacturing cost, irrational use of resources and high concentrations of polluting components. This slag represents the mid - product, with the high value effects in economy and environment. Developed research in terms of opportunities to use it, verify that the application of the integrated dry granulation method will transform slag into a resource with corrected qualities (composition and properties - by adjusting it in the valuable aggregate for cement products, asphalt concrete and all other of the construction industry). In renewable energy source, through returning it in production process and reduce its pollution impacts.

*Key words:* Slag, granulation, resources, energy recuperation, products performance

### 1. INTRODUCTION

Results that are based in the technological analysis of the ferronickel benefit from nickel oxide ore at the smelter of Kosovo show that the melting in the electric furnace is slag process, since 75% of the calcine passes in slag. The main physical - mechanical properties of slag depend on: chemical composition, formation temperature, method of production and solidification. Slags of non ferrous metals of the ferronickel high furnaces, according to their physical-mechanical properties represent very valuable raw materials for construction and chemical industries. In this smelter under the current scheme, slag periodically streams from electric furnaces and through special channel is subject of the granulation water process. Such processing concepts have degraded most of the technological properties, not guaranteeing the quality control (properties and composition) of slag, environmental presence and effective cost manufacturing. Lack of an adequate treatment of deposits over 8 million tons of slag, which excel with high level of pollution are exposed to atmospheric rainfalls and wind, and thus have substantially degraded not only the quality of life but also opportunities for sustainable economic development. Steams of granulation process with water, particles releasing and wool of slag (in size between 30µ and 5 µ), have high capability of the emission and imitation and impacts of water drainage are just some of the findings of this study, which were sufficient for most environmental organizations to evaluate this landfill as "environmental hotspot"<sup>3</sup>. Changing approach of the slag processing together with its reuse programs will reflect important impacts in establishing balancing relations between the rational use of natural resources, sustainable economic development and environmental sustainability. Processing by the "integrated dry granulation", will result with slag aggregates in good physical condition (appropriate for producing of cement), opportunities to regenerate energy during its cooling process, increasing its applicability in industry, improving the performance of products of specific areas of industry and generally ensure a sustainable economic growth.

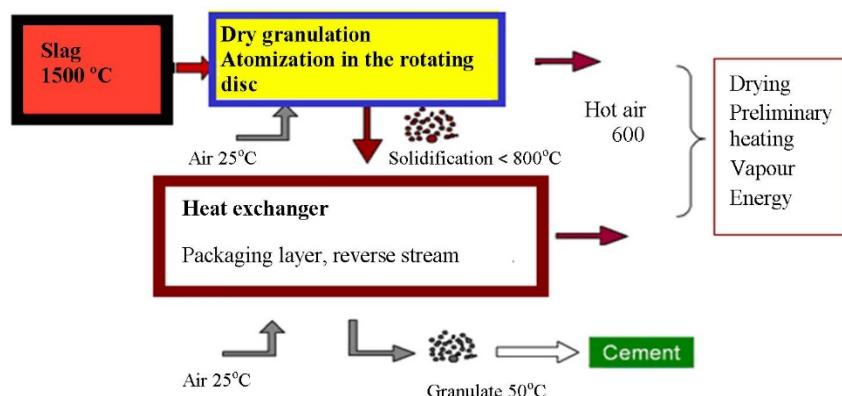
### 2. INTEGRATED DRY GRANULATION OF MOLTEN SLAG

Until recently metallurgical industries realize over 35% of all slag production with wet method. Such processes are accompanied by high costs, environmental problems and other technical - technological difficulties of production. Some of the modern technologies of processing of steel are realizing granulation of the molten slag through the new approaches which allow controlling the cooling process of slag and regeneration of process energy. Molten slag contains approximately 80% of the overall energy of minerals melting in the electric furnace. Under the current processing method all the heat transferred with slag is lost. In regard of the heat regeneration from slag processing according project concept "Integrated dry granulation" by Dr. Dongsheng Xie, it would potentially ensure the

storing of this energy (in the form of hot air and steam). Control of slag cooling process, will result with aggregates with higher content of hyaline, granulometry appropriate state and the highest level of its application. Energy returning in the technological process may include: use of hot air before ore heating in rotary furnace or any other power plant, heating the boiler for metal casting from electric furnaces, or for steam producing and energy generation. A similar concept of granulation has been the subject of studies by a huge number of scientists, particularly in Japan and United Kingdom.

For the first time in industrial conditions as a pilot project, high furnace slag is treated (re-melted at 1400-1500 °C) in quantities of 10 kg / min by the company "Sumitomo Metals Industry" in Japan (fig.1). Such design solution conceptually will be based on the two-stage process, which would include dry granulation and heat storage in the switcher. Granulator receiver and atomism of the molten slag up to the formation of steel hot granules (8000 °C), which pass in the second stage in heat exchanger to be exposed again to draft where further cooling takes place, to maximise the heat in the storage exchanger, which as a closed system prevents discharge of vapours and gases on the environment.

All industrial analysis of the process for the ferronickel benefit in Kosovo, argue the possibilities of the slag processing by the "integrated dry granulation" method. The main impacts of the process would be: improvement of physical - mechanical properties of slag, energy regeneration via hot air (with approximate temperature of 600 °C), increasing the possibilities of exploitation of mid-process products provided, optimization of manufacturing process and environmental acceptance.



**Fig .1** Concept of integrated dry granulation designed according CSIRO's

### 3. ENVIRONMENTAL IMPACTS BY APPLICATION OF THE "INTEGRATED DRY GRANULATION" METHOD OF FE-NI SLAG

Overall level of slag utilization of Ni, Cr and Cu, and knowledge about the behaviour of their products is still low. Association's reports of (Samaria, NAS, NAPA, etc.) that deal with quantity - quality assessments of metallurgical slag prove the validity and its application areas are exclusively dependent on solution design, methods of processing, marketing and organization of slag market. Practice of using the Fe-Ni slag produced in "Falcondo" in Bonao, argue that a more effective utilization of resources and energy resources through all stages of the calcine of electric furnaces in the smelter of "Ferronikeli" in Kosovo produced by current technological parameters, does not guarantee likable technical qualities, environmental presence and production manufacturing effective cost, and degrade most of its properties. Designed solutions by new methods of processing, will increase the requirements for valorisation of over 1.200.000 t ore / year, 11.000 t Ni / year, and over 800.000 t slag/year, while according to the current approach, all mid-products of process are unused and the rate of utilization of the metal is still not high. Keeping under control parameters of slag cooling process is the main condition in the improvement of technical qualities of slag. Fulfilment of technical criteria such as structural construction, favourable relations between hyaline and crystalline phases, good interactive capability between its constituent components, correction and keeping under control of any negative attribute of slag are some of the conditions that will affect the growth of its applicability in the industry. Mineralogical construction and concentration of minerals, olivine, pyroxene, tridymite,

magnesiowustite, cristobalite, monticellite, merwinite and minerals, besides the constituent components of the process greatly depend on the slag processing method.

Even under the current parameters ferronickel slag of Kosovo progresses with most of the physical - mechanical properties (table 1) compared with the quality of mineral aggregates which are assessed as highly precious by technical performance and by the level of applicability in the construction industry. According to the basic data from the study, quality and standard technical requirements for construction minerals andesite, basalt and other eruptive aggregates, their replacement with the ferronickel slag aggregate processed according to method "integrated dry granulations" will display special effects through:

- advanced technical qualities compared with traditional aggregates which are accompanied by technological difficulties and high costs during phases as: research, mining, exploration, washing, purifying, comminution, drying, homogenization, environmental protection, etc.,
- heat maximizing in storage exchanger and its return in the process will increase the production capacity, the utilization of metal coefficient, oxidation-reduction capabilities of ore in rotary furnace, and it will reduce specific energy consumption and eliminate the majority of technical-technological barriers and generally optimize the process,
- savings of connecting materials (gypsum, lime, cement, bitumen, etc.) in cases where it is used as aggregate to replace the traditional aggregate or as additional material,
- benefits from increased performance of slag products through the long- life, the coefficient of friction, resistance towards environmental impacts during exploitation etc when it will be used as aggregate for asphalt concrete production,
- benefits from capital decreasing of production costs, savings in maintenance and management of industrial landfills, re-cultivation, etc.

Cooling of 1 (ton) of slag melt in temperature of 1500 °C to environment temperature, contains heat from 1.8 to 2.5 GJ. Calculation of produced amount of slag from electric furnace (2 x 1280 t/day), its preservation and its return in the process would be a valuable potential energy. Keeping and re-use of energy released by the cooling process can serve the function of:

- drying in the oxidation reduction process of ore, through returning of the hot air,
- creasing of specific energy consumption (according to empirical data, slag transfers 80% of the overall heat from the melting of the nickel oxide ores and raising of the temperature of 1°C is equivalent to the reduction of specific consumption of electricity in electric furnace of 5.6 (kWh/t charge),
- pre- reduction of ores and partial reduction to the metal, with energy savings of about 300 (kWh/t fry) electric furnace,
- reduction of manufacturing costs, the technological progress and increasing production capacities, and the economy of the whole production process,
- regeneration of energy through the production of steam for production of electricity, production of technological steam for drying of the ore, heating of the boilers for the metal acceptation,
- as the environmental requirements are increasing, Kosovo slag landfill, according to the present state is counted as "environmental hotspot" because of the non utilization and growing layer of slag. Slag processing by integrating closed system will increase the degree of applicability of this mid-product, will reduce the polluting effects from useless expenditure during slag cooling, will reduce pollution from vapour release, other solid particles and overall reduction of heat emissions from "greenhouse effect" which comes during the heat release in the atmosphere,
- reducing water consumption and its content in slag (according the current method contains 15-20% water), and which will also decrease the polluting effects of Ni, Co, Cu, Fe +2, Fe +3, and other heavy metals transferred by water drainage during transport and slag storage

**Table 1.** Properties of some types of mineral aggregate and slag of the Ferronickel in Kosovo

Properties	Andesite	Basalt	FeNi slag
Durability against consumption and erosion (cm <sup>3</sup> /50 cm <sup>2</sup> )	8,05	8,65	7,52
Specific density (g/cm <sup>3</sup> )	2.640	3.250	2.80±3
Inhale of water for large grain aggregate (%)	0.80	0.73	0.56
The sand equivalent (%)	76,2	76,5	95,3
Inhale of bitumen by aggregate (%)	100/90	100/95	100/98
Illustrative values of the rock	63	59	55
Sustainability from dynamic shocks (breaking and consumption) – LA % (m/m)	12	11,8	10
Sustainability of crushing in cylinders % (m/m)	10,1- 14,5	11,3 – 13,2	19,7 - 20,3

#### **4. DISCUSSION**

Slag of electric furnaces "of Fe-Ni smelter" in Kosovo is melted ore, created during the reduction of nickel oxide ore. It represents a complex oxide system with excellent physical - mechanical properties. Processing of slag according the current manner does not guarantee control of the solidification process, and thus the physical - mechanical properties. Cooling under the pressure of water has stimulated high concentrations of crystalline phase, weakening the binding properties, small fractions and generally degradation of technical properties that limit its application. Slag production by "integrated dry granulations" method enables slag products with high content of hyaline, appropriate for the benefit of quality cements. Use of heat released during slag cooling will be used to produce steam and electricity production. Estimates of economy and manufacturing costs of slag processing according to the study (having in consideration slag with high content and regeneration of energy) would result in savings up to 23% of electricity consumption, 48% of fuel oil consumption, 27% of manufacturing costs, and overall optimization of the production process of ferronickel.

#### **5. CONCLUSION**

Processing of the ferronickel slag with "integrated dry granulations" method would be a key factor for valorisation of deposit of 8 million tonnes in valuable resources, which still continue to be treated as industrial residue problem for the environment, increasing the coefficient of metal, reducing maintenance costs for environmental protection, generation of new working places, reducing imports and generally increase the gross domestic product. The application of the method of "integrated dry granulations", compilation of the program on industrial waste management, marketing and organization of the right market of slag will ensure not only slag open market, but also the energy regeneration benefits through savings on water, energy resources (electricity and fuel oil) etc, and optimization of process through recovering of energy accumulated during the slag cooling process.

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## O 26. SUSTAINABILITY OF ENERGY SUPPLY IN THE CEMENT INDUSTRY

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**ABSTRACT:** Various roadmaps are drawn in the industry to reduce dependence on fossil fuels and to gain energy. In the cement industry, the use of waste in energy recovery is a very convenient method. This article details the use of waste as an energy source instead of fossil fuels in cement. Substituting waste for non-renewable fuels provides multiple advantages such as efficient use of energy, independence on fossil fuels, prevention of environmental pollution, reduction of waste volume, contribution to national economy, saving of greenhouse gases, conservation of natural resources and reduction of mining needs. Process conditions of the cement industry are different from other industrial sectors, providing an ideal environment for waste use. Combustion of waste does not have any effect to increase the production of cement emissions that occur under normal conditions, but it also helps to save investments in waste incineration plants. Co-processing of waste has no negative impact on the environment and the technical quality of the product. In this article, it has been shown that how the co-process waste saves energy with energy recovery at 2017 and provides safe and robust solutions for the environment and the energy supply.

**Keywords:** Cement, energy, waste.

## **O 27. WATER USE EFFICIENCY AND TECHNICAL APPLICATIONS IN LANDSCAPE ARCHITECTURE REGARDING CLIMATE CHANGE**

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**ABSTRACT:** Turkey is a water-rich country with large water resources. However, the cross-border water resources are shared between Turkey and the neighboring countries. Thus, the water supply of the country must be managed effectively, and water usage must be restricted. Therefore, drip irrigation is the most sufficient way to achieve this goal. Sustainable, easy-care landscape projects that both suit the climatic conditions and could still be perceived as an aesthetic entity help to prevent environmental issues. Drought and rising temperatures that are caused by global warming affect plant growth in a negative way. This article examines the irrigation systems that require minimum usage of resources and obtain maximum benefit. Also, the importance of xerophytes is discussed.

**Keywords:** Irrigation, Global warming, Landscape applications

### **1. INTRODUCTION**

Water is one of life's most essential substances and the primary necessity for life. Therefore, the presence and quality of water in the habitats are of vital importance. Water resources on earth are limited and the water cycle is constant. The rapid growth of population, high standard of living, industrialization cause the increasing need for water. Thus, problems in the share of water emerged and became one of the most strategical elements of the 21<sup>st</sup> century (Salturk, 2006; Gulgund Aslan et al., 2017). In recent years; climate change, high temperatures, irregular rainfall levels and drought risk become more significant which led designers, planners, local authorities to the search for efficient use of water. Water is the key factor in the life of ornamental plants which play an essential role in landscape architecture. The efficient use of water in landscape architecture is a necessity as water usage is high in public spaces such as parks, gardens (Yazici et al., 2013; Berkün, 2007). Irrigation of plants which need to be watered besides from precipitation is thought to be a prerequisite for the plants' optimum benefit to be gained from the irrigation. Today, deficit irrigation becomes more common due to limited water resources. Deficit irrigation is a watering approach that leads plants to experience water stress. The approach results in the reduction of cost and an increase in revenue (English and Raja, 1996).

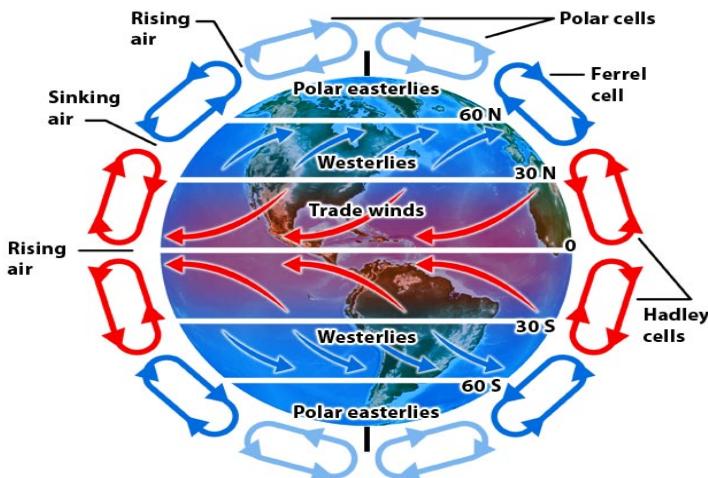
#### **1.1. World's Condition**

The earth contains 1,4 billion km<sup>3</sup> of water. 97.5% (1.3 billion km<sup>3</sup>) of earth covered in salty ocean water, 2.5% (35 million km<sup>3</sup>) in freshwater (DPT, 2007). 70% (24 million km<sup>3</sup>) of 35 million km<sup>3</sup> of drinking water is provided from Antarctica and polar regions (UNESCO, 2012). According to FAO (2002), in 1995 the ratio of people experience water shortage and stress was 29% and 12%. In 2005, it is expected to be 34% and 15%.

#### **1.2. Turkey's Condition**

There are 26 water basins in Turkey, the average precipitation is 642.6 mm which is equal to 501 billion m<sup>3</sup> of water. The water use limit in technical and economic areas is 112 billion m<sup>3</sup>. 95 billion m<sup>3</sup> of it is provided from rivers in the country, 3 billion m<sup>3</sup> is from the rivers that originate from other countries, 14 billion m<sup>3</sup> is from underground water (Akuzum et al., 2010). Due to the lack of facilities, 35% of the water reserve can be used in Turkey (Berkun, 2007). In Turkey, 37% of precipitation is stormwater runoff. 274 km<sup>3</sup> of water transpire from the leaves, stems, flowers and soil and return to the atmosphere. 41 km<sup>3</sup> of water is known to provide for the underground water, 186.1 km<sup>3</sup> flows through the rivers into the seas, lake and closed basins (URL-2). In Turkey, the water use limit per person is known to be 1555 m<sup>3</sup> / year and expected to be 1000 m<sup>3</sup> / year in 2025 (Akuzum et al., 2003; Akin and Akin, 2007). The European Environment Agency reported that the water shortage was

expected to occur in many regions in Turkey in 2030 (Anonymous, 2005). According to FAO (2002), Turkey was no more a water-rich country and the country experiences water stress. 16% of the total reserve of 112 billion m<sup>3</sup> is used as drinking water, 12% in industry and 72% in agriculture (URL-2). In 2023, Turkey's population was expected to hit the number of 100 million and 16% of the water is expected to be used as drinking water, 64% in agriculture and 20% in industry (Figure 2) (Akuzum et al., 2010). Water is mostly used for irrigation in agriculture both in Turkey and all over the world. Thus, the efficient use of water in irrigation became a necessity.



**Figure 1.** Water cycle

## 2. PURPOSE AND SCOPE OF IRRIGATION

Irrigation is defined as the process of watering plants that do not receive enough amount from the precipitation (Leliart, 1987). Irrigation of plants was discovered in Egypt (Gungor et al., 2002). In Turkey, the historical background of the first irrigation application goes back to the Ottoman Empire in the 19<sup>th</sup> century. Correction of rivers in Schodra and Thessaloniki, the irrigation channels in Medina, the irrigation network in Mosul are some application examples from the Ottoman Empire era (Yildirim, 2008). Plants constantly absorb water through the roots to sustain their visual and aesthetical development. A great amount of water is transferred into the atmosphere due to transpiration and the rest is reserved in the roots. Thus, plants' roots are to contain enough level of moisture (Akuzum and Cakmak, 1992). The main source of the humidity in the soil is the precipitation. In the dry and semi-arid climate regions, the level of the received precipitation is not sufficient enough for the plant during the growing season. Therefore, the moisture needed in the roots is provided from the irrigation (Gungor et al., 2002). In sub-humid lands, the level of the received precipitation exceeds the plants' needs. The sub-humid lands mostly and humid lands often require irrigation systems in case of a temporary change in humidity (Yildirim, 2008). The amount of water to be used in the irrigation of plants should be estimated. Every plant's water demand is different due to its morphological and physical characteristics. Therefore, water consumption for each plant in the irrigation area should be determined (Jensen, 1968). The estimation of plants' water requirements is based on direct measurement techniques or climate data calculations. The direct measurement techniques are mostly expensive however, they produce the most accurate results. Water requirements of the plants that are used in landscape projects are high. The irrigation systems ensure that plants receive the right amount of water contains many nutrients and agricultural chemicals for the optimum levels of growth (Orta, 2009). The common irrigation systems used in landscape projects are seen in Figure 2.

### 2.1. Water Use in Landscape Projects

The efficient use of water plays an essential role in irrigation systems due to the fact that the earth has limited water resources and 65-80% of water is used in irrigation systems (Evsahibioglu et al., 2010). Especially the high levels of water use in green areas entail the efficient use of water (Baris, 2007). To achieve this goal, precautions that save the water are taken. Accordingly, under the title of Water-Efficient Landscaping; some principles are developed which are 'The Efficient Use of Water',

'Limited Use of Water' and 'Natural Landscaping'. Xeriscaping is one of the first approaches that comes with the principles mentioned (Baris, 2007) (Figure 4).



**Figure 2.** Irrigation of ornamental plants

The other water-saving methods:

- Preventing the high amount of water use (Cakmak and Gokalp, 2011).
- Use of low water-demand plants (Atik and Karaguzel, 2007).
- Estimation and calculation of plants' water requirements (Bayramoglu, 2013a).
- Use of the spreading ground covers rather than creating large areas of grass.
- Use of the drip irrigation systems.
- Generation of irrigation programs for different regions in accordance with the meteorological data.
- Use of the deficit irrigation systems during a particular period of time.

### **3. USE OF DEFICIT IRRIGATION**

According to Bayramoglu et al. (2013b), the irrigation systems used in urban green areas have a significant part in preventing the pollution of water resources. Today's irrigation approaches are the full and deficit irrigation systems. The full irrigation systems ensure that the plant receives the full amount of water it requires. Also, the plant's fertility is at maximum levels. However, some plants are negatively affected due to the high amount of water in the soil and the limited transfer of gases between the soil and air. Deficit irrigation is a systematic strategy in which irrigation of plants is limited. Also, it is a commonly used way of providing a minimum amount of water all over the world (Trimmer, 1990; English et al., 1990; Jurriens and Wester, 1994). Trimmer (1990)'s research shows that the supply of water provided is less than the plants' requirements at a rate of 35% in Pakistan. Sarwar (2002) stated that if 60% of plants' water requirements are provided, plants' fertility decreases at the rate of 15%. Demirel et al. (2018) express that proper irrigation systems ensure water-saving and visual quality. Also, the research set an example for landscape projects in Canakkale and other cities. English et al. (1990) state that deficit irrigation increases the revenue in agriculture. The method is used in specific periods of time not to harm the plants. The main goal of the deficit irrigation system is to gain maximum benefit from the irrigation and improve the water use efficiency. The most significant characteristic of the method is that always the same amount of water is provided for the plant and larger areas are watered using the water that was saved during the process. Thus, the revenue per unit of area is increased (English et al., 1990).

The deficit irrigation system creates water stress which results in the reduction of cost. The regions where the price of water is high and water use is limited, the method ensures an increase in profit (English and Raja, 1996). Several researchers state that deficit irrigation assures an increase in profit under particular conditions (English et al., 1990).



**Figure 3.** The deficit irrigation system (URL-1)



**Figure 4.** The deficit irrigation system (URL-2)

Though the deficit irrigation systems cause a decrease in the production, the aim is to ensure the efficient use of water. Potential benefits are listed below (English et al., 1990):

- Increase in watering performance
- Reduction of irrigation costs

The deficit irrigation provides a limited amount of water for the plants. Limitations are arranged both constant and scheduled. Constantly limited arrangements supply a small amount of water, time gaps between watering can be longer and one side of the beds are watered. Scheduled limitations ensure that the plants are not watered in particular seasons when the plants can sustain themselves without water consumption (Cakmak and Gokalp, 2011).

Advantages of the deficit irrigation systems:

- Water saving is ensured therefore, water and labour costs are reduced.
- Larger areas can be irrigated due to the water saved beforehand.
- Production performance, the profit gained from production and the national income increase.
- Drainage costs decrease.
- Providing water for the soil can be problematic at times, therefore the ecological problems in the soil are prevented.
- The amount of water that the soil contains does not rapidly increase. Thus, the benefit gained from the precipitation is optimized. (Biber and Kara., 2005).

In agricultural operations, the deficit irrigation systems are applied to crops, however in landscape architecture, the method is yet to be used in watering plants.

### 3.1. Deficit Irrigation in Landscape Architecture

The rapid population growth leads to the need for urban recreational areas. The maintenance of urban greenery depends on the reinforcement of the irrigational infrastructure (Orta, 2009). Both large and small-scale projects require a well-planned irrigation system to maintain the development of plants which are the key elements for design, therefore, irrigation plays an important role in landscape architecture. The water demand of plants should be met (Altunkasa, 1998). Nowadays; high temperatures and decreasing levels of rainfall lead to the efficient use of water in planting design. Deficit irrigation is still a new research field. There are many articles written regarding the topic abroad.



**Figure 5.** The deficit irrigation system (URL-3)

Bayramoglu et al (2013a) reported that *Rosmarinus officinalis* (Sánchez-Blanco et al., 2004; Singh and Ramesh, 2000), Tahiti Lime (Júnior et al., 2011), *Amygdalus communis* L. (Franco et al., 2000), *Dianthus caryophyllus* L. (Álvarez et al., 2009) show less improvement when the deficit irrigation is applied. However, deficit irrigation is a reliable method in watering plants due to the efficient use of water in today's world with limited water resources.



**Figure 6.** Underground irrigation system (URL-4)

Geerts and Raes (2009), observed the improvement of the plants that receive a limited amount of water in dry climates. Geerts and Raes (2009) state that plants that receive water from a deficit irrigation system do not significantly show less improvement than the ones from the full irrigation system. Therefore, the researchers suggest that the deficit irrigation system strategies should be developed and combined with plant-water efficiency. Debaeke and Aboudrare (2004), also mention that these systems should not be applied in the seasons when the plants are in the maximum growth period, therefore the maximum performance of the production can be ensured.

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## O 28. MAINTENANCE AND PROTECTION OF URBAN TREES

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**ABSTRACT:** Trees are the backbones of nature and help urban life to become more sustainable. Also, trees are significant indicators that define the quality of urban life due to their aesthetical, ecological, psychological, hygienical and multifunctional aspects. Therefore, tree culture in urban life becomes an important area of activity for local authorities. The benefits of trees reflect the real and irreal values of planting in landscape projects. The real value of growing a tree is determined by the cost made in the beginning for a certain period. However, aesthetical, ecological, sociocultural, psychological and hygienical irreal value is greater and more important than the real. The values which could be calculated according to some approach, were indicators of the purpose of urban tree culture.

In this study, it was aimed to demonstrate the functions of urban trees in cities, protection, evaluation and appraisal approach.

**Keywords:** Sustainable environment, Planting, Urban landscape

### 1. INTRODUCTION

Urban trees in traffic islands, parks, gardens, picnic spots, recreational areas and along roads are the most essential elements that contribute to the enrichment of visual quality. Without greenery; a city with impressive architectural structures does not have the characteristics of a site worth living in. Trees are thought to be one of the most important fundamentals that create enjoyable places for people to live in. In urban and rural landscape architecture, trees have multifunctional contributions such as preventing air and noise pollution, minimizing the negative impacts of wind and dust particles, helping the city's image become more dynamic, defining axes for transportation, erosion control, improving the climate conditions, enrichment of the visual quality. Urban planting arrangements especially roadside planting practices require a high level of precision regarding the selection of tree species, planting technique and maintenance process. If the three criteria mentioned are not considered, negative impacts may occur in roadside planting (Krulic, 2004; Turna et al., 2012). Planting arrangements entail extensive and long term maintenance practices due to the fact that trees require proper care such as pruning, watering, disease control. Maintenance of urban trees particularly is a necessity (Turna, 2017). Cities have characteristic ecosystems, therefore, urban trees cope with intense conditions of urban life, unlike the rural trees (Dirik, 1991; Dirik, 1997). The hardships of urban conditions must be identified and precautions must be taken regarding urban tree care. Specifically in roadside planting, pruning of trees is the most important maintenance practice.

### 2. MAINTENANCE AND PROTECTION OF URBAN TREES

Domination of conditions against human nature in inauthentic spaces created without the consideration of the connection between humans and nature is inevitable. Thus, the benefits gained from green areas play an important role in building our future (Dirik, 2008). Trees support nature (Konijnendijk, 2003) and ensure sustainability in urban life. In recent years, trees are thought to be the significant elements that help assess the standards of urban life due to their aesthetical, ecological, psychological, hygienical and functional contributions. Therefore, tree culture in cities is an important area of activity for local authorities.



**Figure 1.** Roadside planting in Frederiksberg (URL-1)

### **3. FUNCTIONS AND IMPORTANCE OF URBAN TREES**

Urban trees have sociocultural, aesthetical, ornamental, psychological, ecological and economic contributions. The assessment of trees is made in accordance with their functions.

#### **3.1. Sociocultural Contributions**

Trees are known to be a cultural symbol. Trees have been symbols of life, continuity and cosmic power and cherished since the Ancient Greeks (Pardo, 2005). The idea of trees representing beauty, courage, resistance and strength in life has been shared internationally (Musselman, 2003; Albian and Berwick, 2004).

#### **3.2. Aesthetical and Ornamental Contributions**

Trees mute the harsh lines of geometric structural forms and create contrast and variety of textures in cities in terms of aesthetical contribution. When planted solitarily, trees create focal points and become ornamental elements. Especially in streets and boulevards, trees along roads establish a sense of depth and perspective. When planted with other greenery, trees surround an area or an object and form a visual frame. Trees define spaces; connect the objects and areas; build a background effect and visual silhouettes; incorporate characteristics into spaces; block the unwanted or private; strengthen the topographical structure.

#### **3.3. Psychological Contributions**

Trees are the most important elements that meet society's psychological and sociocultural needs (Konijnendijk et al., 2004). Urban green areas build a connection between humans and nature by helping people interact with nature and observe the changes in nature. People who are disconnected from nature are likely to experience loss of concentration, aggression, depression and mental breakdowns. Many research shows that accommodation and walking about in green areas can treat cardiovascular and nervous system disorders.

#### **3.4. Ecological and Functional Contributions**

Trees and plants are the backbones of nature. They transform spaces into places worth living in by establishing climate control, infiltration of air, reduction of carbon sequestration, management of soil-water balance, enrichment of water quality, preventing pollution. Trees minimize the harsh conditions in heat islands by shading, balancing out the climate. Climate control ensured by trees helps in the cost reduction of houses' heating/cooling systems therefore, fossil fuel use is decreased (Dirik and Ata, 2005).

### **3.5. Economic Contributions**

People's tendency to spend higher amounts of money in buying a property in green areas and the effort put in growing trees or plants within the property indicate the humans' eternal desire to live in green spaces. The surveys made for real estate agents, building contractors and users confirm this demand. 80% of the real estate agents in the U.S. points out the fact that the sale rate of properties with trees on is 20% higher than the ones without trees on.

## **4. MAINTENANCE OF URBAN TREES**

Urban trees cope with many difficult environmental conditions. Thus, maintenance and protection operations towards urban trees have a significant role in landscape design practices.

- Completion
- Pruning
- Fertilization
- Watering
- Grubbing
- Clearing

### **4.1. Requirement and Purpose of Pruning The Urban Trees**

Pruning is a practice of removal of dead or unwanted branches. Pruning of urban trees has positive impacts on the plant's quality, aesthetic and disease resistance (Ata, 2017). Urban trees do not grow in their natural habitat, therefore; pruning is a necessary step for healthy growth, desired shape and form in specific time periods. If not pruned, the limbs tend to break or fall over and cause accidents. A tree must be pruned from an early age and the pruning should continue systematically (Erdogan, 2014). If not pruned at a young age, pruning as compensation may cause pest development. Pruning ensures the plant's healthy growth, forms its shape and increases the number and quality of flowers (Ata, 2017).



**Figure 2.** Improper pruning



**Figure 3.** Pruning practice in Kars

Pruning is a crucial step in the maintenance of urban trees. Pruning regarding the maintenance of trees includes dead branches, branches with problems or branches that damage each other. Also; pruning is executed for separation of the crown, tree forks, regeneration, gathering of water sprouts. Employment of experienced staff and the use of proper materials lead to a successful practice of pruning, therefore; healthy and productive trees in desired forms.

#### **4.2. Grubbing and Cleaning**

Grubbing and Cleaning practices break the capillary pipes that are formed in the summertime in soil and prevent water loss. These practices stop the competition of nutrients and water between the plants and weeds, thus, maximize the plants' gain. According to climate conditions, grubbing can be performed once or twice a year. The first grubbing of the plants is delicate, shallow and outwardly to prevent the damage of root throats. In the second and third years following planting, grubbing is performed inwardly (Erdogan, 2014).



**Figure 4.** Cleaning (URL-2)

#### **4.3. Watering**

Water transports various nutrients into plants' tissues and evaporates from the leaves hence releases the heat. Therefore, water is essential for plants' lives. Watering practices require extreme precision in the determination of the quality of water, timing and amount. In dry climates, the mistakes in watering cause the death of the plants. Especially in the summertime, watering should be performed on time (Erdogan, 2014).



**Figure 5.** Watering (URL-3)

#### **4.4. Fertilization**

Fertilizers are known to have physical, chemical and biological impacts on the characteristics of the soil. Fertilization increases the soil's capacity to contain water and helps the soil breathe. Also,

fertilizers lead to an increase in the amount of CO<sub>2</sub> and the formation of organic acids. Therefore, the acidity of the soil goes up and nutrients are dissolved for plants to use (Erdogan, 2014).



**Figure 6.** Fertilization sampling

## **5. PRINCIPLES OF URBAN TREE PROTECTION**

It is possible to develop suggestions regarding the protection of urban trees by examination of the case studies abroad. In Geneva, there are 40.000 urban trees of 400 kinds and 2/3 of them are deciduous. In the 1980s, the Conservatory and Botanical Garden of the City of Geneva started the process of taking inventory and listing the trees in two parks "La Grange", "Les Eaux Viven". It is reported that there are 4.200 trees in 30 ha of the place. 30 characteristics are registered for each tree, therefore trees' current conditions and requirements are determined. Switzerland's Garden Association states that it is possible to estimate the economic value of every garden based on the evaluation of each tree. All trees in two parks mentioned before are worth 25 million Swiss Francs. The inventory practices ensure the sustainability of parks (planting, protection, maintenance) (Erdogan, 2014). It is stated that 84% of trees are healthy and 16% are growing old. The replacement schedule of trees is based on the information gathered from inventory data. The collaboration of Switzerland's Garden Association and the University of Geneva emphasize the importance of the urban trees (Erdogan, 2014).

## **6. DETERMINATION OF PROTECTION VALUES OF URBAN TREES**

Though the development of ideas regarding the protection and conservation of urban trees is possible, protection values should be determined. Additionally, the determinations are based on subjective evaluations due to the fact that the health condition, visual quality and resistance level of a tree may differ according to the experts. However, the determination of the protection value plays an important role in the decision-making process. Trees that face intense hardships such as changing environmental conditions, poor soil characteristics, problems of neighbouring trees, negative impacts of infrastructural services must be protected and conserved. In such cases, the performance of the tree depends on total pressure, kind, age and resistance against pressure.

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## O 29. SENSORY GARDENS: DESIGN CRITERIA AND CASE STUDIES

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**ABSTRACT:** In urban life, humans' longing for nature increases persistently. Sound, visualizations, smell are perceived as a whole. Plants have an important role in nature. Plants' colors, textures, smell can be both stimulating and relaxing. Nowadays, to strengthen the bond between humans and nature, designers integrate green into their projects because nature's positive impact on humans is a well-known fact. In this study examined the sensory gardens as a way of natural therapy, the historical process, design criteria and the example of some studies.

**Keywords:** Garden therapy, Landscape, Sustainability environmental

### 1. INTRODUCTION

Gardens are unique forms of connection between humans and nature. Many cultures' perspective on gardens is that they are "the reflection of heaven on earth". Gardens or yards are considered to be small-scaled landscape projects. Nature's positive impact on humans is a well-known fact, therefore gardens themselves can be linked to human behaviour. Besides the psychological impacts the gardens have, some are customized to serve specific purposes as they address directly humans' senses and aim to enrich the users' experiences. These gardens are known as "Sensory Gardens". Worden and Moore (2004) stated that sensory gardens aimed to enhance the user's experience of seeing, smelling, hearing, touching and tasting. Shoemaker (as cited in Access by Design,) asserted that "Sensory gardens could not be designed without considering the human element. Unlike traditional display gardens that were meant to be observed from a distance, sensory gardens draw the visitor in to touch, smell and actively experience the garden with all senses." If these gardens are designed and maintained well, they provide educational and recreational services; the key factors are hardscape elements, colors and textures (Hussein et al., 2013). According to Hussein (2012), sensory gardens were derived from gardens for blind people. The idea behind the sensory garden design was that the gardens should aim to stimulate users' senses and improve their physical abilities (Hussein, 2009). Integrating green into design contributes to users' health improvements (Vries as cited in Hussein et al., 2013 ), environmental education (Hussein et al., 2013), mental and emotional development (Maller and Townsend as cited in Hussein et al., 2013). Stoneham (Hussein, 2010) states that sensory gardens were originated from the 1970s gardens for blind people. These gardens used to be in parks where heavy-scented plants, raised planters and Braille signs. In the 1980s, the idea of being only for the blind started to change due to the fact that blind people did not want to be in segregating facilities. Sensory Trust is an organization that makes outdoor facilities accessible for everyone and aims to create a connection between people and nature. The organization helps improve the health of people with disabilities, their families and their careers (Sensory Trust, 2020).

Jane Stoneham, the director of Sensory Trust, (as cited in Access by Design, 2020) points out that the design guides for sensory gardens are still unclear and the projects rely on the designer's approach and experience. Today, sensory gardens provide for visually impaired users, people with autism spectrum, and elderly with Alzheimer's. Also, in public spaces, sensory gardens are used for the enrichment of people's sensory experience and children's education.



**Figure 1.** Activities with people with autism (Yuruk as cited in Sensoy, 2017, p. 121)



**Figure 2.** Forest school for children with special needs in Duzce - Turkey (URL-1)

## 2. SENSORY GARDEN DESIGN

If designed and maintained well, a sensory garden can serve many purposes. Different purposes bring a broad spectrum of users. Therefore, sensory gardens must have unique characteristics to them. Worden and Moore (2004) stated that “When wheelchair users or children, were the impetus for creating a sensory garden, they should be consulted or input to ensure that their specific needs were met. The ill or weakened can be enlivened and renewed physically, mentally, or spiritually by sensory gardens. Individuals with impairment of one or more of their five senses may find special enjoyment because they may have enhanced perception in their other senses.” Design criteria for sensory gardens were listed as (Worden and Moore, 2004): Plant selection, sight, sound, smell, touch, taste.

### Plant Selection

The selection of plants was a crucial step in landscape design. (Yildirim Birisci et al., 2012,) listed the use of plants:

- Structural material: Blocking the unwanted view, creating a space, forming a sense of direction
- Environmental element: Erosion management, climate control, reduction of air pollution
- Visual element: Creating focal points, connecting the design elements, ensuring transition, incorporation of color

Nontoxic, sustainable and easy-care plants with proper features of color-texture-smell should be used in sensory gardens. The selection of plants for sensory gardens require extreme precision and attention because these gardens aim to address users' senses. Breaking off leaves, flowers or stems, plants' fluids and aromas can propagate easily. Thus, the selection of nontoxic plants was an essential step. Worden and Moore (2004) stated that if maintenance of a plant requires pesticide applications, they should not be used in sensory garden projects. In order to stimulate users' senses, the plants with characteristic features should be selected regarding their appearance, scent, taste and texture. To give an example, mint could stimulate two senses: both smell and taste (Worden and Moore, 2004). This study provided further information about the selection of plants under the subjects as sight, sound, smell, touch and taste (Table 1).

### Sight

Akpınar and Ersözlu (2008) mentioned that in the cognitive learning process, the visual sense was effective in understanding the universe as it provided data for human perception to form. To create visual impact, a designer used every aspect of color. Various psychological impacts of every color, the change of hue in shade and light, the reflection of color and light contribute to the stimulation of senses. Wavelengths reflected back from objects, this way humans could see colors. Perception of colors relies on the light source and environmental factors. In the cool temperate climates, pale colors can be fully appreciated but vibrant ones cannot. On the contrary; in hot temperate climates, vibrant and warm colors can be seen properly, but the pales ones cannot. Therefore, the color of flowers were perceived best at noon (Hannebaum as cited in Birisci et al., 2012). In sensory gardens warm colors such as red, orange and yellow stimulate the senses (Figure 3); cool colors such as blue, purple, white have calming and soothing effect. Flowers are a conventional way of integrating color into the design. Colorful fruit trees, plants and tree trunks enhance the visual quality of space (Worden and Moore, 2004). Partially sided users could see colors in big blocks, thus the placement of plants and hardscape elements need to be done carefully. Furthermore, the use of light can enrich the user experience in sensory gardens. Lighting fixtures, torches and chrome gazing balls contribute to the design (Worden and Moore, 2004) (Figure 4).



**Figure 3.** *Ilex verticillata*, is a shrub with an eye-catching color



**Figure 4.** Chrome gazing balls (URL-2)

**Size and Shape:** Size and shape of the design elements build a variety of perceptions. As in architectural design, in landscape architecture projects; if there is no gradual transition in size, humans are likely to feel misplaced and unsafe. Therefore, the human-scale should always be considered. A gradual change in the size of every design element should be an essential point in projects. Booth (Birisci et al., 2012) asserted that tall trees and shrubs make the eye look high up to the sky and distract from the horizontal elements. Small objects and roads with trees on both sides create focal points, densely planted trees define the space. Linear or curvilinear lines ensured by living fences also help users find their direction. Linear lines are thought to be more formal than curvilinear ones. Curvilinear lines and sloppy compositions are more natural and freeing. Pendulous trees have a calming and soothing effect (Birisci et al., 2012).

**Signage and Labelling:** Fundamentally sensory gardens require labelling components. Brochures and informative posters that introduce the plant within the area enhance user interaction. Color codes for different senses can be extremely useful. Visually impaired users' needs must be considered, therefore signboards with the Braille alphabet should be used as well as the informative audio system (Worden and Moore, 2004).

### Sound

Hardscape and softscape elements are used for the stimulation of users' senses in sensory gardens. Nature always addresses humans' senses. Leaves blowing in the wind, branches swinging, dried leaves on the ground, animals and water enrich the human experience in a garden. Waterfalls, fountains, sprinklers, wind bells and other components contribute to the sense of hearing (Worden and Moore, 2004) (Figure 5).



**Figure 5.** Interactive music element and Deerscare (URL-3)

### Smell

The sense of smell is mostly stimulated in every garden. Some plants have pleasant scents and some do not. The research shows that the sense of smell contributes to visual perception as it helps clarify what is seen. In fact, during memory encoding, the sense of smell is more effective than the sense of sight. Therefore, the two senses are not opponents in the cognitive learning process, they support each other (Akpinar ve Ersozlu, 2008). Thus, sensory garden design criteria are all linked to one another.

### Touch

Every plant has a unique shape and texture (i.e. fruitful and fruitless; soft and firm; needle-leaved, fan-shaped, flaking barked; coniferous, seedy; evergreen, semi-evergreen ones). These varieties help contribute to the sense of touch in sensory gardens. In Turkey, grassed areas are very common also they can be very useful for sensory gardens due to the fact that people can sit, lay down which results in the stimulation of the sense of touch. Toxic plants and the ones which can physically hurt people should be avoided. Worden and Moore (2004) mentioned that during user interaction, plants can be harmed as well. Therefore, longlasting and durable plants should be selected. Especially children enjoy woolly

plants, moss, tree barks, plants' sticky substances, succulent leaves, vegetables such as beans, peas. Many plants have different textures. Roses (*Rosa sp.*), have elegant and soft petals as well as thorns. Buttonwood (*Conocarpus erectus*), have soft, gray leaves and a firm bark. However, spiny plants such as agave and rose can be dangerous for visually impaired users. If these kinds of plants are used, they should be located out of reach (Worden and Moore, 2004).

**Table 1.** The examples of plant function for sensation

 <i>Platycodon grandifloras:</i> <b>Sound</b> - "Inflated buds make a popping sound when squeezed." (Graper, 2019)	 <i>Baptisia australis:</i> <b>Sound</b> - "Seed pods create a rattling sound when shook." (Graper, 2019)
 <i>Agastache chefoeniculum:</i> <b>Smell</b> - "They have black licorice-like scent when leaves are rubbed between the fingers." (Graper, 2019)	 <i>Nepeta mussinii:</i> <b>Smell</b> - "They release a scent when leaves are rubbed between fingers." (Graper, 2019)
 <i>Stachys byzantine:</i> <b>Touch</b> - "The fuzzy, furry foliage and stems appeal to the sense of touch." (Graper, 2019)	 <i>Allium schoenoprasum:</i> <b>Taste</b> - "They are commonly used as an herb to provide a mild, onion-like flavor." (Graper, 2019)

### Taste

Fruits, vegetables, herbs, edible plants and flowers can be used in sensory gardens. Different parts of the tongue detect sweetness, bitterness, sourness, and savories. Many activities can be organized in order to enrich the sense of taste. Small-scaled agriculture training programs, cooking workshops, barbecue and picnic organizations can take part in sensory gardens' agenda (Worden and Moore, 2004).

### 3. SENSORY GARDENS: CASE STUDIES

Hussein et al. (2013)'s research about the two sensory gardens in the Royal School of Deaf and Communication Disorders and Lyndale School expressed the current use of sensory gardens.

<b>Royal School of Deaf and Communication Disorders, Manchester, UK</b>	
RSDCDS's sensory garden has been designed by Sue Robinson and the garden is called Multi-Sensory Millenium Maze. The designer stated that the aim of the project was to offer various sensory experiences to the users (Hussein et al., 2013).	
 Pathways (Hussein et al., 2013)	 Water feature at the Water Central Area (Hussein et al., 2013)
 Exploraway (Hussein et al., 2013)	 Vaporized Trail (Hussein et al., 2013)
 Musical instruments in the Asteroid Arts Garden (Hussein et al., 2013)	 Raised planters at the Water Central Area (Hussein et al., 2013)

<b>Lyndale School, Liverpool, UK</b>		
The least used area is the pathway and slope. The path ends suddenly, therefore it is inefficient. Woodland garden is appreciated regarding its sound experience stimulating features, however it results in the lingering of people and crowd. Thus, circulation problems occur. Due to the slippery surface at the boardwalk of the water feature and <u>inaccessible raised beds</u> , the area has second-lowest number of users (Hussein et al., 2013).		
 Pathway network (Hussein et al., 2013)	 The path ends suddenly (Hussein et al., 2013)	 Water feature (Hussein et al., 2013)
Hussein et al. (2013)'s research states that:		
<ul style="list-style-type: none"> <li>➤ An accessible and effective pathway network enhances the design quality of a sensory garden.</li> <li>➤ Pathways are the most essential elements that invite the users to the sensory gardens.</li> <li>➤ Areas that offer sensory experiences have a higher number of users than the ones with aesthetical design features in them.</li> </ul>		

#### 4. CONCLUSION AND SUGGESTIONS

In recent years, most people started to become visitors to sensory gardens due to their health problems or desire to be in tune with nature. Considering the historical background of sensory gardens, design guidelines and criteria are yet to be defined. Therefore, every sensory garden's design process relies on the designer's approach and experiences. However, recent researches and observations show that the essential point of designing a sensory garden is to offer sensory experiences to the user. Accessibility and safety also are two principles that play a significant part in sensory garden design. Creating opportunities for sensory experience is more important than the design being an aesthetic entity.

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- URL-3:<https://www.buildajapanesegarden.com/japanese-garden-materials/japanese-bamboo-products/bamboo-deer-scarer/> (Erişim tarihi: 25 Nisan 2020)

## O 30. THE LINK BETWEEN URBAN ECOSYSTEM AND TREES IN ROADSIDE PLANTING

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**ABSTRACT:** Playgrounds, parks in neighbourhoods, urban parks, cemeteries, school gardens are considered to be the most common forms of urban green areas. However, these local green areas are seen all over the city. Besides local greenery; trees along the highways and roads play an essential role in creating urban green areas. Thus, trees along highways and the ones in open public spaces contribute to the sustainability of urban green areas as they are the linear forms of greenery. Trees along roads are the most affected by their environment. Therefore, roadside planting requires attention and precision and the effort put into the work must be extreme. In this study the importance of using suitable trees in roadside planting according to trees' purpose and ecological needs were explained.

**Keywords:** *Landscape ecology, Landscape planning, Planting*

### 1. INTRODUCTION

In everyday urban life, open green areas that working people can benefit from are limited. However; streets, avenues, boulevards and traffic islands can be used for recreational purposes both by pedestrians and drivers on a daily basis. Therefore; roadside planting configurations are more efficient, permanent, dominant, aesthetical and functional compared to the other forms of landscaping arrangements (semi-evergreen shrubs, woody-shrubs and spreading ground covers). Thus; the trees in streets, avenues, boulevards and traffic islands are the most essential elements of urban green areas (Kucuk and Gul, 2005).

#### 1.1. Definitions

**City:** Socially developing, a high populated site that provides habitation, traffic, working environment, housing, recreational and entertainment areas for its residents. In cities, a little amount of people conduct agricultural operations and neighbouring is not significant.

**Road:** Significant element built for people to travel along as it affects the growth of the sites nearby.

**Urban Road:** According to Aslanboga (2001), open space elements that regulate transportation for people and vehicles. If combined with planting arrangements, these elements are qualified as green areas. Urban roads are designed for different purposes, they can be solitary or combined with other elements if needed (Kucuk, 2002).

**Traffic Island:** Separative arrangements or gears in between roads as they prevent or restrain vehicles to cross to the other side of the road.

**Planting arrangement (afforestation, reforestation):** The action of creating forests in areas that currently do not have forests.

### 2. FUNCTIONS AND CONTRIBUTIONS OF ROADSIDE PLANTING

**Visual Contributions:** According to Yilmaz (1998), green areas and trees as their dominant elements with various shapes, textures, colours, structures and sizes create eye-catching, diverse spaces. Plant's growth rate and maturity level are the main criteria that contribute to the visual impact. It takes 50-100 years for trees to enter into their maturity stage which means every roadside planting aims to serve the next generations. Whereas, visual impact emerges as a result of the healthy growth of plants. Healthy leaves and density of the branches are the main criteria (Figure 1).

**Scale Impact:** Humans are likely to feel misplaced and under pressure in large areas due to the size difference between humans and the place. When the size difference between humans and the place decreases, they feel safer. To achieve this, plants are frequently used as they scale down the size

difference. Planting a tree or a shrub in a space surrounded by tall buildings ensures the gradual change in size. Therefore, humans form clearer perceptions regarding the area (Korkut et al., 2010)

**Space Impact:** According to Aslanboga and Gunduz (1986), the densely planted trees along roads and in public open areas create the ceiling effect. Celem and Uslu (2006) state that tree crowns define the lines that form the space. The crowns can either sharpen or smoothen the lines. Densely planted trees with thick trunks create the corridor effect whereas the effect fades away with sparsely planted trees.



**Figure 1.** Reference image from Bornova - Izmir

**Contrast or Harmony (Cohesiveness):** According to Celem and Sahin (1996), trees' visual features can enrich the qualities of a place and create a cohesive environment with contrast and harmony. The rough corners of geometric structural elements along the road can be muted with round-shaped trees. The importance of roadside planting derives from densely arranged vegetation rather than the silhouette of plant growth in an open area. A cohesive space with contrast or harmony is determined by the design process. Ekmekci (2007) states that planting in large gaps generates round-shaped crown form and creates contrast with the environment. Ekmekci (2007), also expresses that densely planted trees ensure harmony due to their conical and column-like growth form.

**Variety:** According to Celem and Sahin (1996), seasonal colour change of the leaves, flowers and stems creates variety stimulating a sense of movement in the monotonous environment. Using various shapes and colours in roadside planting has a significant impact on people who live in cities estranged from their natural form. If evergreen plants are used, the canopy effect is created (Ekmekci, 2007).

**Blocking view of the unwanted:** According to Celem and Sahin (1996), signboards along with the other hardscape elements can cause visual pollution in the streets or along the roads. Trees planted along the road are the most effective elements regarding blocking the view of the unwanted created by buildings in a different size or some window displays (Ekmekci, 2007). Visible chaos can also distract drivers. Korkut et al. (2010) state that trees along the roads blocks unwanted views and prevent drivers from distraction.

### **Contributions Regarding Urban Health:**

**Noise Reduction:** The outdoor noise or environmental noise endangers the health and well-being of humans. Loud noises can harm humans physically and mentally. Noise reduction depends on the condition of the atmosphere, the area of sound propagation, the distance between the sound source and the soil, the absorbing capacity of the soil and vegetation condition (Ekmekci, 2007). Yildirim (2000) reported that plants can reduce the noise by the rate of 0,7-10,0 dB depending on the size and position of leaves, density of leaves and branches, also the size and shape of the project area (Celem and Uslu, 2006).

**Psychological Effects:** Ulrich et al. (1993) and Celem and Uslu (2006)'s research regarding the comparison of two images and their effect on the human brain reported that images with trees and other natural elements create a great number of alpha waves in the human brain which was a sign of relaxation.



**Figure 2.** Reference image from Champs-Elysees



**Figure 3.** Reference image from Sydney

### 3. IMPACTS OF TREES ON ECOSYSTEM

According to Baris (2005), the impacts of trees and green areas on the urban ecosystem should be assessed as given below:

**Cooling the planet:** Plants are not capable of reserving heat in their body structures. Therefore, radiation balance occurs in planted areas. On average, 60-75 % of solar energy is used in physical activities. In urban areas without planting, solar energy is used in warming up the air and the buildings. A research done in Berlin suggests that the temperature in a park of 212 ha is 7 centigrade degrees lower than in an area of buildings. Trees' cooling effect is greater at nights due to transpiration. Evaporation of the water that is inside plants requires high temperatures. With evaporation, an average tree loses 1460 kg of water. 860 microjoules of energy are used in this process. The cooling effect that is caused by this amount of energy equals almost five air conditioners. Trees play an important role in saving energy and their benefits are proven. To give an example; the trees and shrubs near buildings decrease the overwhelming effect of high temperatures and cause a reduction of air conditioner costs by the rate of 15-35 %. Therefore, shading plants and facade planting arrangements reduce the air conditioner cost.

**Providing Fresh Air:** The air from urban depression areas is filtered and cooled if it travels through trees and green areas. Thus, trees help the city's ventilation. Every tree works as a refrigerator because the total surface area of their leaves is 10 times bigger than its crown area. The cooling effect of trees is greater than the grass-covered areas. Also, the cooling and filter effects depend on the number of leaves rather than the total area of the green space (Baris, 2005).



**Figure 4.** Urban buffer zone

**Infiltration of Air:** Baris (1998), tests and researches done regarding wind screening state that trees and green areas play an active role in air infiltration. Other than pollens, there is no dust particle produced in vegetated areas. Trees primarily reduce air's carrying capacity. Trees form a windscreen or a living wall. The ones in parks filter 85% of particles and the ones in streets filter 70%. Even in winter when the plants are without leaves, trees filter 60%. Trees can hold dust particles 5-10 times more than the total weight of their leaves. 5-year research done in France shows that 1 m<sup>3</sup> of air in an area without trees contains 3910 bacterias, however, a park nearby has 455 bacterias (Baris, 2005). Trees even when they are without leaves can filter 60 % of dust particles. Trees along the roads are known to hold 7000 particles of dust in 1 lt of air. Aslanboga (1998) reported that sparsely planted areas cause wind speed decrease and large dust particles (i.e. road dust) are filtered. Especially the trees with woolly leaves hold a great amount of dust. Planting with multiple layers (spreading ground cover, shrub, tree) helps dust particles get washed up in rain and hold by soil afterward. However, in sparsely planted areas (i.e. roadside planting), the washed-up dust particles land on the ground, start flying around when dried off. Dust particles held by plants have positive outcomes for humans, but it has negative effects on plant's health; (i.e. difficulties in receiving sunlight, stoma blockage, forced transpiration due to heated solid particles) (Girit et al., 2010).

#### **4. IMPACTS OF URBAN ECOSYSTEM ON TREES**

The urban conditions that affect the plant growth in regard to the works of Aslanboga (1988), Celem and Percin (1988), Gultekin (1988) Atay (1990), Saebo et al. (2003) (Doygun and Ok, 2006):

**Climate:** Reflective surfaces such as buildings and roads cause an increase in night radiation. The industry, vehicles and heating systems create extra heat produce. Urbanization leads to a reduction in airflow speed. These factors cause the microclimate change and the city becomes a heat island.

**Soil:** Buildings and roads covering entire land, urbanization, traffic, deformation of fertile soil, litterfalls not being in the biogeochemical cycling are oppressions on urban soils. Therefore; soil's link to surface water vanishes, the oxygen level decreases, drainage becomes a problem, organic material cannot be regained and the land cannot grow plants efficiently.

**Pollution:** The dust particles from the industry, vehicles and heating systems congregate on the surface of the leaves which causes absorption of sunlight on high levels and tissue burn. The particles also can contain heavy metals that dissolve in rain and enter the plant's body structure through stomas or roots which leads to tissue burn.

**Mechanical Oppressions:** The disintegration of roots during construction and excavation works, sewer lines preventing root growth, parking lot incidents, improperly attached banners, posters and signboards, paving stones blocking roots, and damage caused by pruning are main mechanical oppressions on plant growth.

#### **5. CONCLUSIONS AND SUGGESTIONS**

It is a well-known fact that roadside planting has positive impacts on the ecosystem, both nationally and internationally. Planting arrangements which are made according to principles of urban green areas changes the environment in all aspects. Plants are not only aesthetical entities with their textures, colors, shapes, sizes; but also they are functional elements that prevent air, noise, visual pollution. Air pollution and other environmental issues have various impacts on trees as they are living organisms. City planners, naturalists, landscape architects and environmental engineers should collaborate to prevent urban environmental issues and create a city master plan. In addition, the importance of green areas regarding human health and their environmental value should be introduced to both students and everyone in public.

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## O 31. HAZARDOUS WASTE MANAGEMENT: CASE STUDY OF NORTH MACEDONIA

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**ABSTRACT:** Hazardous waste is the most complex type of waste and in the same time its management is very difficult and complicate. This waste produces a great risk to the environment and human health. It may be in different physical states, such as gaseous, liquids, or solids. Considering a very large types and sources of hazardous waste its management is very complex and needs different measures and activities during all life cycles, from its origin to final recovery or disposal. There are very different types of hazardous waste such as: electrical and electronic, battery, chemical, medical, radioactive etc. The biggest portion of this waste is generated by different industrial process, but also from other business, public and health services, households, transport, education and science, and many other sources. Hazardous waste management has to be based on the principles of precautionary, prevention, high quality, sustainability, polluter has to pay, recycling and recovery and high level of environmental protection. However, a key point for environmentally friendly hazardous waste management is its minimization. North Macedonia as a country, which has just start negotiation with the European Union for becoming a full member state, is just on beginning of the establishment efficient and effective hazardous waste management. On this way, it faces with a number of difficulties. There is significant progress in the sectors of electrical and electronical waste and waste from batteries where there are transposed a part of EU regulation and it is establishing collective operator's schemes, but in other sectors such as chemical, radioactive and medical waste, additional measures and activities has to be done in the near future. Additional problems arising from such as named historical "hot spots" from the industry and especially mining sector. Improving hazardous waste management in the country needs significant financial funds. Also it has to be considered that small countries such N. Macedonia is not able to establish completely autonomy treatment of hazardous waste. It has to be done on a wider base with cooperation with international community. The main goal of this paper is to analyze the conditions with hazardous waste management in N. Macedonia and to give some proposals.

**Keywords:** Hazardous waste, management, environment, protection, regulation.

### 1. INTRODUCTION

Hazardous waste is the most complex waste type for management (Mereki et al., 2020). This waste type seriously threats environment and human health (Misra & Pandey, 2005). North Macedonia as a state with candidate state for full membership of the European Union, since 2004 has been making efforts to harmonize its legislation and standards with the EU legislation and standards in the sphere of environment and waste as an important part of the environment (URL-1). The problem appears with its practical implementation (ECE/CEP/186, 2019). In 2004 was adopted Law on waste management and in 2005 was adopted Law on environment. In the period of 2010 – 2016 were adopted some laws that regulate specific waste sort such as: Law on packaging waste, Law on batteries, Law on electronic and electrical waste and many other laws. These laws were detailed in 85 sub law acts (URL-2).

EU legislation in the sphere on the environment consist of more than 400 legal acts and in waste sector about 120 legal problems (EU, 2019). In this occasion, we will mention some of them. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, known as Waste framework directive, that is the most important directive in waste sector in the EU, because it covers all waste activities (URL-3). Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste. Directive 2010/75/EU of the European Parliament and of the council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Directive 2000/76 on the Incineration of Waste. Commission Regulation (EU) No 1357/2014 of 18 December 2014 replacing Annex III to Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives Regulation (EC)

No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (Dri et al., 2018).

The small countries like Macedonia have a number of problems in the sector of hazardous waste. It is not easy to establish a system of waste recovery and waste treatment of hazardous waste. Following the Basel convention of transboundary movement of hazardous waste, the country has to seek waste treatment for some types of waste in the development countries (Hogg & Vergunst, 2017).

For waste treatment of hazardous waste there is a need of significant financial resources and an important part of them are from foreign donors at the first place EU (URL-4). That a significant portion of hazardous waste has to be export in the countries that have a high level of technologies for treatment of this waste type. In N. Macedonia, according the regulation municipal waste is responsibility of local government and hazardous waste is competence of central government.

## 2. METHOD

There is a testament of some types of hazardous waste in Macedonia such as: medical waste, which mostly incarnation on very old fashion technology incinerator, asbestos waste which land field, low-level radioactive waste. All waste treatment is performed on an unsatisfactory manner. The only solution for satisfactory waste management of hazardous waste is its minimization as much as possible. There were used and analyzed statistical data both from North Macedonia and from European Union.

## 3. RESULTS

Table 1 and table 2 present amount of incinerated medical waste and generation of hazardous waste in N. Macedonia. Other tables present the data of generated and processed hazardous waste in European Union.

**Table 1.** Collected and incarnated medical waste in Drisla, year, 2000 – 2014, in tons

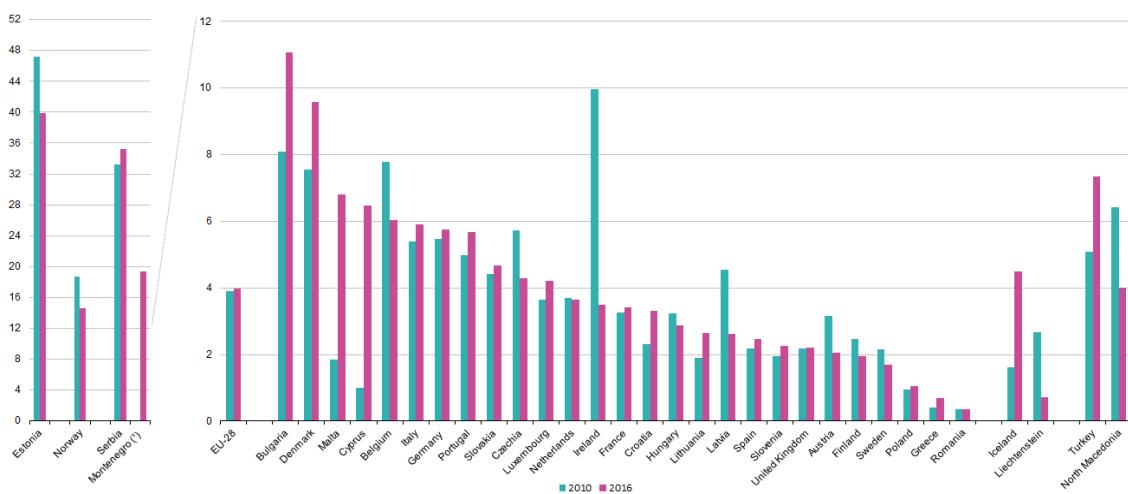
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
114	231	248	255	322	375	327.	327	358	416	458	469	501	748	725

**Table 2.** Amount of hazardous waste generated in N. Macedonia in tons from 2014-2018

2012	2013	2014	2015	2016	2017
72.000	74.000	72.000	79.000	75.000	77.200

**Hazardous waste generated, 2010 and 2016**

(% share of total waste weight)



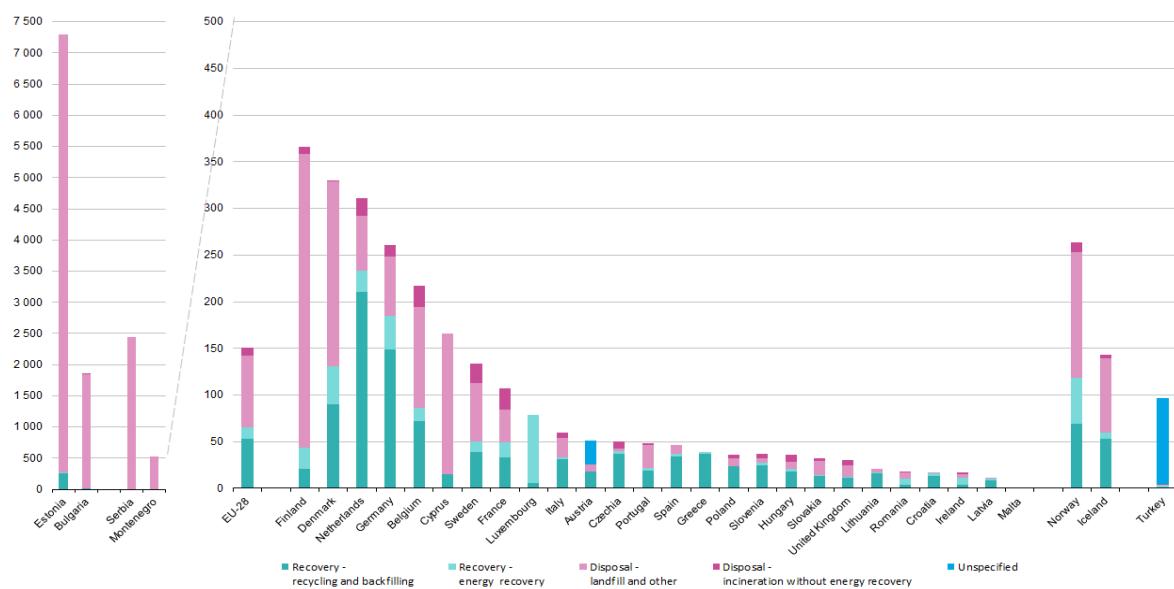
Note: The two parts of the figure have different scales for the y-axis.

(\*) 2010: not available.

Source: Eurostat (online data code: env\_wasgen)

#### Hazardous waste treatment, 2016

(kg per inhabitant)

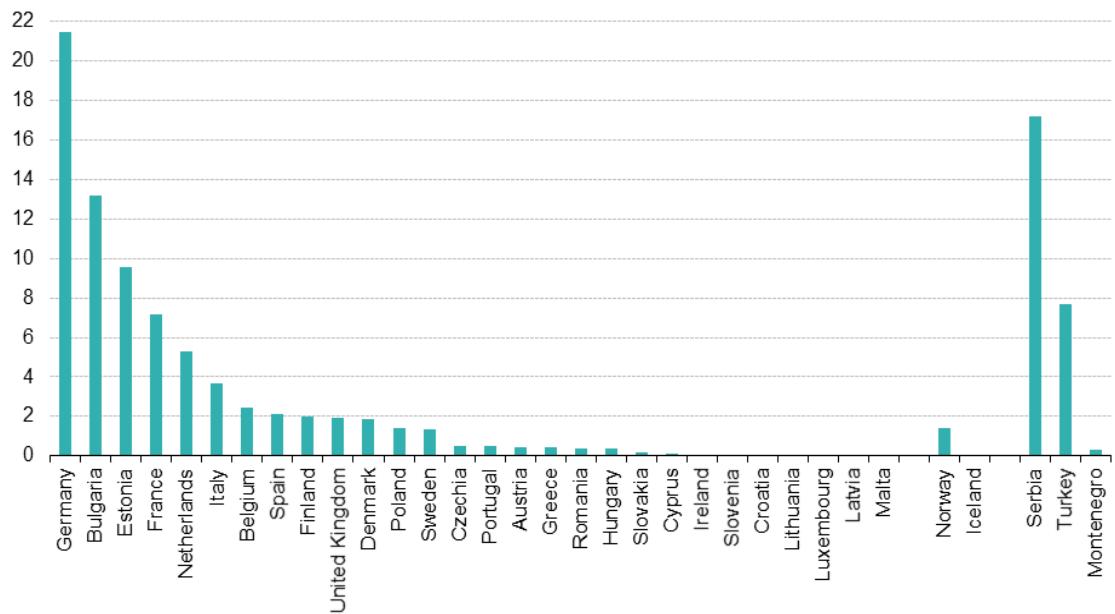


Note: the two parts of the figure have different scales for the y-axis.  
Source: Eurostat (online data code: env\_wastrt)

eurostat

#### Hazardous waste treatment, 2016

(thousand tonnes)



Source: Eurostat (online data code: env\_wastrt)

eurostat

## 4. DISCUSSION

Waste classification in hazardous or not hazardous waste depend on the classification and labelling of dangerous substances and preparation that ensures application and implementation of equal or at least very similar principles over the whole life cycle of materials. Hazardous waste is a waste that contains substances with one or more characteristics such as toxicity, flammability, Infectivity, carcinogenicity, mutagenicity, properties for release of toxic gases in contact with water, air and soil and other characteristic. In N, Macedonia, for management of hazardous waste is responsibility of central government while for management of non hazardous waste is responsibility of local government units.

Waste and in the frame of this hazardous waste is one the biggest environmental problems in N. Macedonia/ (Sapuric et al., 2015).

The above mention tables show some figures about waste generation and treatment in N. Macedonia and European Union. It is visible that there are big differences between some EU countries. Also it obvious that N. Macedonia faces with a number of problems and in the future has to make much bigger efforts to improve hazardous waste management. Even the country has signed and ratified Basel Convention for trans boundary movement of hazardous waste and its disposal (URL -5 ) and has transposed a significant part of EU regulation. N. Macedonia faces with a number of problems in the sphere of hazardous waste management. The above mention tables present the trend of increasing of hazardous waste generation, which is not, followed with adequate waste treatment in the EU especially in some new EU countries. However, it is obvious that the EU as a community with high level of standards has been acting in the direction to mitigate the differences between the countries. Opposite the situation in N. Macedonia is very dramatic because hazardous waste generation it is not followed with increasing of treatment of this waste type. A very big problem is that this waste very often is mixed waste, with different types of hazardous waste or other non hazardous waste types. This disables selection and separation as a pre - condition for properly hazardous waste treatment.

Additional problem appears from the historical “hot spots” where a significant quantity is dumped from abandoned mines and heavy industry plants from the transition period that are not in functions more than 25 years. A small part of this hazardous waste is transported and processed in some developed country such as Germany, Switzerland and Holland. EU and other international donors provided the costs for transport and waste treatment. However, in the future there is a need of at least 500 million Euros that has to be provided from the international donors, at the first place from the EU, but also for state budget in the next 5-6 years. This is a big challenge for the country.

The waste classification in hazardous or not hazardous waste depend on the classification and labelling of dangerous substances and preparation that ensures application and implementation of equal or at least very similar principles over the whole life cycle of materials.

The biggest portion of hazardous waste management in N. Macedonia is based on land filling which is the last favourable waste treatment and incineration. Also land filing is not completely environmentally friendly and incineration is performing in the plant with old fashion technology.

In the future, hazardous waste management in N. Macedonia has to be significantly improved and based at the first place on waste minimisation and reduction and after that on preparing for reuse, recycling and other recovery eg. energy recovery and on the last on disposal only for the part of waste which cannot be treated.

The situation with hazardous waste management in the country can be estimated as still very poor and has to be improved in the next 5 years.

## **5. CONCLUSION**

Hazardous waste causes serious threats for the environment and human health. This produces a need for its management, which is based on high-level environmental standards. The standards have to be stipulated in a very precise and detailed regulation. Hazardous waste management in N. Macedonia is still not developed. N. Macedonia as a country with candidate status for the membership of the EU faces with a number of problems in the area of hazardous waste. The most part of this waste type is lad filed in an inappropriate way and a very big portion is dumped on a “temporally sites” waiting for export in the countries where it can be treated in the installations with high level of standards. A part of hazardous waste is incinerated in a plant with old technology. The recycling and other forms of waste recovery are very poor. For the improvement of hazardous waste management has to be provided financial resources from the EU funds and other international donors, but also the central government has to provided financial resources. All mention above means that there is a need of undertaking of intensive measures and activities in the next period.

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- URL-5 <https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>

## O 32. WATER LOSSES AND LEAKAGE IN DRINKING WATER SYSTEMS

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**ABSTRACT:** The description of the water loss can be defined as the difference between the water that cannot be explained and charged, that is, the amount of water supplied to the drinking water line and the amount of water used by users. It is resulted by water leakages and losses in the pipes in the drinking water line and also unauthorized network connections and water meters that are recorded and/or read incorrectly. These losses leak to underground from cracks of the pipes, from pipe connection points or water structure of infrastructures like valves. Since water pipes are generally buried under the ground, it is very difficult to determine the place of the water leakages, losses and the amount of water leakages due to damages of the pipes. In this study, improvement and development of the studies on the water leakages and losses will be surveyed and investigated.

**Keywords:** Drinking Water Networks, Physical Water Losses, Water Use, Pipe Leakages

## O 33. DESIGN OF SPILLWAY DESIGN

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**ABSTRACT:** Spillways are structures that have an important place in the project cost of a dam and have important functions related to the security of the dam. The labyrinth spillway concept involves reducing the reservoir water level by increasing the effective length of the spillway crest with various forms applied on the plate, increasing the discharge that can be discharged at a certain lake level, or passing a constant stream with smaller crest water loads. These weirs can also be considered as alternatives that provide advantages within the topographic boundaries. In addition, easier construction and more reliable operating conditions compared to classical controlled spillways are other advantages. Spillway length, crest height and spillway capacity are important parameters in spillway design. Application of the labyrinth spillway is also important for available dams as it can be applied to constructed and under operation dams by increasing spillway length and dam capacity. During the last decade application of the labyrinth spillways show increasing trend. In this study, improvement and development of the labyrinth spillways will be surveyed and investigated.

*Key words:* *Labyrinth spillways, spillway design, dam spillway, spillway capacity.*

## O 34. THE ROLE OF CALIXARENES IN THE ENVIRONMENTAL SCIENCE

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**ABSTRACT:** The removal of toxic species from the polluted environment has been the matter of concern for the scientists in all over the world. The host-guest chemistry provides versatile approaches in this regard. Recently; More significant efforts have been made to synthesize materials with high selectivity for ions/molecules, which are of great interest for many analytical/industrial purposes and for recycling the resources as well as for waste water treatment. For example, the use of synthetic materials in sensing of ions by ion selective electrodes (ISE) and/or remediation of toxic substances from aqueous environment are interesting fields of research Thus, different strategies have been impelled to search for molecular structures that can serve as building blocks for the production of selective sophisticated functional materials. Cosequently, these building blocks could be modified by anchoring space oriented various groups, in such a way that they delineate a suitable binding site and act as nano-robotics according to the desired field/approach. Among other polymeric functional materials, calixarenes [1-2] are a class of host molecules that can easily be modified; thereby leading to nanoporous materials with selective host-guest properties [3-5]. Their application in diverse areas of electroanalytical chemistry as well as separation science and technology in particular makes them a better choice for extraction, chromatography, membrane and sensor technology etc. Herein, different aspects of calixarenes, their synthesis and application in separation and sensing of ions and or neutral molecules will be discussed.

**Keywords:** Calixarene, Complexation, Sensor technology, Separation science, Supramolecular chemistry.

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## O 35. BASICLY STATISTICAL ANALYSIS AND SUSCEPTIBILITY PROPERTIES OF HEAVY METAL POLLUTION IN SURFACE SEAWATER

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**ABSTRACT:** Since approximately 3/4 of the world is covered with seawater, the seas are referred to as the easiest waste disposal site. Especially in the metropolitan, the wastewaters are thrown directly into the sea or drained after a certain purification process. Various chemicals in seawater affect both marine life and indirectly human life. In the bays, this situation occurs in more seriously, due to insufficient bay inner water flow and continuous the wastewater throwing by mankind. The inner bay of Izmir, which is the studied field in this study, is known as the part between Sasalı / Karşıyaka coastline and Güzelbahçe / Bayraklı. In terms of depth, the inner bay is suitable for sea transportation and is used very intensely. There is constant ferry transportation and an international port operates in this region. There are also several streams pouring into the inner bay. Therefore, the inner bay can be exposed to continuous pollution, and chemical waste pollution can be observed intensely in the inner bay. In this study, the magnetic susceptibility values and elemental analysis of the samples taken from the surface waters of the inner bay coastline were performed. In addition, various basic statistical data were examined. Although there are various heavy metal ions and transition elements, intense contamination was not observed in the inner bay waters.

**Keywords:** Statistic, susceptibility, bay, pollution.

## O 36. INVESTIGATION OF AIR QUALITY IN THE PROVINCE OF KARAMAN CITY CENTRE

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**ABSTRACT:** Karaman, which has a very old historical background and mixes different economies and cultures, has cradled many civilizations. Karaman is geographically located in the south of Central Anatolia region. The period of the Republic of Turkey took its name Karaman. It became the 70th province of Turkey on June 15, 1989. Economy and industry developed in Karaman, which has fertile lands, based on agriculture. There are modern industrial facilities that employ a large number of labour force in Karaman city centre. It can be accepted that it has a great industrial potential during last 20 years. The total area of 886,900 ha of Karaman province; 228,820 ha of it (26%) is flat, and 653.645 ha of it (74%) is mountainous. The population size is 250.000 people. 35% of biscuit production and 20% wheat production of Turkey is produced by Karaman industry. As with many developed cities in Turkey, which are used fossil fuel consumption for heating in cold winter, air pollution is observed. Vehicle exhausts in traffic and industry are other important sources of pollution in the city centre. In Turkey, in March 2020, Covidien-19 measures thus markedly obvious improvement in air quality. The Saharan dust event, which occurred after the virus measures, especially PM pollution increase was observed.

*Keywords:* Air quality, Pollution, Karaman province, Covidien-19 measure

### 1. INTRODUCTION

The change in the basic composition of atmospheric gases is primarily energy production and burning of fossil fuels used in vehicles (Kampa and Castanas, 2008). The pollution of atmospheric air is explained by the presence of one or more substances in the ambient air in values and times above natural excesses (Seinfeld & Pandis, 2006; Seinfeld & Pandis, 2008). Plants producing NO<sub>2</sub> are also produced as NO more than oxidized rapidly with ozone or other radicals in the atmosphere. On the other hand, Oozon in low-level atmospheric layers is created by many reactions that produce volatile organic compounds and NO<sub>2</sub>, a process initiated by short-wavelength sunlight. Carbon monoxide, on the other hand, is an incomplete product of combustion of organic carbon materials (Kampa and Castanas, 2008).

Recently, particulate matter (PM) for air pollution, especially substances smaller than 2.5 µm, have been the focus of most outdoor pollution studies with the ability to penetrate living tissue and to induce local and systemic effects (Nemmar et al., 2013). . Although there are many reasons for air pollution, it is possible to examine them in two main groups as a result of air pollution due to natural causes and various activities performed by people. Air pollution feature damages human health and the environment. In Europe, many air pollutant emissions have been significantly reduced in recent years, resulting in improved air quality in the region. However, the current concentrations of air pollutants are still quite high and problems with air quality are reported to continue. An important part of its population in Europe lives in areas where air quality standards are exceeded, especially in large cities: nitrogen dioxides pose serious health risks in terms of ozone and particulate matter pollution. One or more of the 2010 emission limits has been exceeded for four major air pollutants in various countries. Therefore, reducing air pollution is still important (Seinfeld & Pandis, 2008).

The long-term goal of the European Union is to achieve air quality that will not create unacceptable impacts and risks on human health and the environment. The European Union operates at various levels to reduce pollutant levels and reduce exposure to air pollution: Regulated laws; In addition to sectors responsible for air pollution, it collaborates and researches with international, national and regional authorities and informal organizations. The environmental policies of the European Union aim to reduce exposure to air pollution by setting air quality limit values and target values and reducing emissions. As

part of these efforts, in late 2013, the European Commission adopted the Clean Air Quality Package proposal, which includes new measures to reduce air pollution (URL-1).

In the incident in London, about five hundred people died in 1873 due to heavy fog, and again more than two thousand people died in 1880 (Heidorn, 1979), and even though more serious measures were taken in the following period, air pollution was about five thousand in 1952. Welded death has occurred. The deaths in Meuse Valley, an industrial area in Belgium in 1930, Pennsylvania in the USA in 1948 and London in 1952, were effective in revealing the seriousness of the problem and legal regulations (Jun, 1980). Meteorological and topographic conditions can strongly influence the spatial and temporal variability of air pollution in cities. The particles are injected mainly through diesel engine fuel combustion transport, industrial processes, agriculture and coal combustion for different purposes (Ünal et al., 2011).

In London, about five hundred people died in 1873 due to heavy fog, and more than two thousand people died in 1880 (Heidorn, 1979) and these events took place more seriously in the following period. The deaths in Meuse Valley, an industrial zone in Belgium in 1930, in Pennsylvania in the USA in 1948 and in London in 1952, were effective in revealing the seriousness of the problem and making legal arrangements (Jun, 1980). Meteorological and topographic conditions can strongly influence the spatial and temporal variability of air pollutant in cities. Particles matter are mainly injected by diesel powered fuel combustion transportation, industrial processes, agriculture and coal burning for different purposes (Unal et al., 2011).

Air pollution is associated with a broad spectrum of acute and chronic illness, such as lung cancer, chronic obstructive pulmonary disease (COPD) and cardiovascular diseases. In the year 2016, ambient air pollution was responsible for 4.2 million deaths. Worldwide, ambient air pollution is estimated to cause about 16% of the lung cancer deaths, 25% of chronic obstructive pulmonary disease (COPD) deaths, about 17% of ischaemic heart disease and stroke, and about 26% of respiratory infection deaths (URL-2). Environmental problem increases due to world population and fossil fuels increases. Land cover areas changes from natural to agricultural areas food production. Automation and mass production lead to increase in industry and mining produce environmental problems especially air, land and water pollution. Bio-systems that settle in natural and waste areas as a result of excessive consumption, wastes lead to increasing microbe diseases in contact with human beings worldwide.

Viruses pandemics become whole worldwide and serious spreads around people. Last Covid-19 is being important problem and necessary to protect all nations on World. Mainly, virus pandemic disputed from city of Wuhan, China and infecting all world. Nowadays virus infectious diseases are spreading fast than before years (Zhu et al., 2020). Increasing human contact which increase the spread rate.

WHO reported that more than 14 million confirmed cases, including more than 600 thousand deaths end of June, 2020 worldwide (URL-3; URL-4). Emerging infectious diseases continue to infect and reduce human populations. The COVID-19 pandemic infection has spread to about 110 countries. According to the WHO, countries must detect, test, treat, isolate, trace every contact, and mobilise their citizens in the response.

## **2. METHOD**

### ***Research area***

It is included The records shows that Karaman and its surroundings was settled in 8000 BC. Karaman province is located in the Central Anatolia region. Konya is located in the north, Ereğli in the east, Mersin, Silifke in the southeast and Antalya in the west. Its height above sea level is 1033 meters, the southern region of the region is covered with the Taurus mountains parallel to the Mediterranean Sea. The passing of the highway and railway connecting Central Anatolia to the Mediterranean has also had a great impact on today's economic life on the historical silk road. Karaman is one of the important cities of our country in terms of geographical location, agricultural and economic activities. Karaman is a typical Anatolian city built on a flat land extending from the skirts of the Taurus Mountains to the Konya Plain. Separated by individual hills from the Konya Plain, this plain is an alluvial plain consisting of reeds and marshes on its side, which opens in the east-west direction with light inclines towards the east. The surface area of Karaman province is 8,924 km<sup>2</sup> and ranks 2<sup>nd</sup> after Konya among the provinces of the Konya Plain Project (KOP) Region after Konya. Karaman province has total 892,400 ha area; 230,358 ha (25.8%) is flat, 658,039 ha (73.7%) is mountainous and 4,003 ha (0.4%) is wetland.

Climate and vegetation of Karaman province are diverse. Typical Central Anatolian climate type in this province is generally hot and dry in summer; winters are seen in cold and snowy continental climate. This climate type is seen in the parts of the province in Central Anatolia Region. These parts are the regions where Karaman Centre district, the towns and villages of this district and the towns of Kazimkarabekir and Ayrancı. However, in the western and southern parts of the province, the summers of the Central Taurus Mountains and the valleys where this river is deeply split by the tributaries are dry and hot in the summer; The Mediterranean climate is mild and rainy in winters. Precipitation is usually snow in winter; In the spring months it is in the form of rain mean of the last 50 years (URL-6).

According to 2019 Address Based Registration System data, the central city population is 106,000 and the total population of Karaman is 253,279. The population growth rate is 4.5 for 2019. There are 6 districts, 16 towns and 154 villages within the city borders. The area of Karaman province is 8,869 km<sup>2</sup> and it has 1.13% of the country's territory. There is an agricultural land of 233,527 ha.

### **Data**

Air quality values for four sampling station in Karaman city centre. Measurement data in the form of hourly averages obtained from the stations are monitored via a private network by transferring them to the Data Operation Center located in Gölbaşı, Ankara of the Laboratory, Measurement and Monitoring Department of the Ministry of Environment and Urbanization. In this center, validation study is performed on the data by considering the calibration and alarm information of the devices. Accordingly, monthly and annual reports are prepared with the data evaluated and the raw data obtained from the monitoring network are published simultaneously on the address [www.havaizleme.gov.tr](http://www.havaizleme.gov.tr). Verified data is transferred to the website after the data validation works done at the end of each month. Measurable parameters for Karaman air quality station are PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, O<sub>3</sub> and CO, but available data enough quality for this investigation are PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, and CO. If the data not be measure or available less than 80%, it is not suitable calculation and statistical test for the study.

### **Data period**

In addition to comparison of 2020 epidemic period and before, effect of seasonal conditions on air quality, 2020 epidemic period data and normal period of 2018 and 2019 data were also compared if any relation with air pollution to understand the effect of time period of seasons. Period 1 is before the Covid-19 measures (between January 1 and March 15). Period 2 is after the Covid-19 struggle started (between March 16 and April 15). R-program, an open code statistics program, was used to create the distribution maps of the data. Daily air pollutant data of 01.01.2018-15.06.2020 compared with Covid-19 measures period (URL-7).

## **3. RESULTS AND DISCUSSION**

Residential heating and traffic, which are among the important sources of air pollution, are among the issues that should be taken into account when determining the air quality of the city along with the negative weather conditions caused by some meteorological events (Mayer, 1999). Diesel vehicles are also the main source of PM emissions when it comes to road transport, but the difference in relation to petrol vehicle is much less than for NO<sub>x</sub>, as PM emissions are also generated from brake and tyre wear and from road abrasion. Fuel consumption for heating purposes constitutes a large share in sulphur oxides and particulate matter emissions (Tayanç, 2000; Özden *et al.*, 2008; Koçak *et al.*, 2011). Especially in winter, fuels whose content is not fully known can have an adverse effect on air pollution (Taşdemir, 2002; Enteş & Yarimtepe, 2012).

Urbane airborne particulate matter is a variable mixture of numerous classes and subclasses of contaminants. Particle properties and their associated health effects differ by size. The World Health Organization (WHO) estimates that urban air pollution contributes to approximately 800 thousand deaths and 4.6 million infections worldwide (WHO, 2002). Particles consist of a core to which numerous other compounds, organic as well as inorganic are associated, e.g. nitrogen oxide reacts to form nitrate and sulphur dioxides to form sulphates. These secondary particles do have diverging toxicity from the original particle (Schlesinger & Cassee, 2003).

Sulphur dioxide (SO<sub>2</sub>) is a gaseous by-product of the combustion of fossil fuels that certain coals, liquid fuels and natural gas contains sulphur. Exposure to SO<sub>2</sub>, even at low level is linked to increased bronchoconstriction in people with asthma, and reduction in lung function has been observed at higher

concentrations. Long-term exposure to SO<sub>2</sub> has been associated with decreased pulmonary function and increased mortality (Krewski *et al*, 2000).

Any region where the industry is high developed, provincial centres where traffic is heavy and settlements where winter is cold, low-quality fossil fuel consumption affects quality of life especially in people with respiratory diseases. As explained by the World Health Organization (WHO), 91% of the world population lives in places where air quality limits are exceeded. However, according to WHO data, 4.2 million people die every year due to air pollution (URL-8). In the Turkey, Istanbul (5,851), Bursa (3,098) and Ankara (2,139) were the first three provinces with the highest number of deaths due to air pollution. These were followed by İzmir (2,518), Konya (2,082), Manisa (1,957), Mersin (1,628), Balıkesir (1,452), Adana (1,417) and Antalya (1,226) respectively (URL-8).

Seeing how pollutants change over time is very important in analysis. Situations where the density of pollution increases, decreases or reaches the highest level can be observed with the help of graphics. In addition, the simultaneous increase and decrease of two different pollutant parameters is also important in terms of determining the pollutant source. The time change graph of the pollutants must be given in figures.

Daily mean values of PM<sub>10</sub> Karaman city centre sampling station for time period from beginning of January 2018 to middle of June 2020. PM<sub>10</sub> values of Karaman city centre were generally less than 100 µg/m<sup>3</sup> and annual mean values about 50 µg/m<sup>3</sup> that were lower than national air quality limits of Turkey. When looking at the figure 3, it is not very easy to group the all data, that many factors may be considered to be effective. While the amount of fuel plays an important role in the winter season, PM from all vehicle exhausts covers the entire season. However, meteorological factors changing throughout the year are as effective as emission sources.

SO<sub>2</sub> daily mean values can be seen for Karaman city centre sampling station for time period from beginning of January 2018 to middle of June 2020. Less than 0.03% of daily mean SO<sub>2</sub> values were 100 µg/m<sup>3</sup> for Karaman city centre and annual mean values about 20 µg/m<sup>3</sup> that were lower than national air quality limits of Turkey. When looking at the figure 4, SO<sub>2</sub> daily mean values were higher during cold winter period, because using fossil fuels for heating system in residents. While the amount of fuel plays an important role in the winter season. Fluctuations of SO<sub>2</sub> daily mean values may be explained with fluctuations meteorological factors for the sampling period. Main emission source of SO<sub>2</sub> is fossil fuels for the investigation region. Very low amount may be raised from industry and transportation.

Carbon monoxide values are only available after June 2019 for statistical analysis, before this time data are not enough to use for CO daily mean values can be seen for Karaman city centre sampling station for time period of investigation. Daily mean CO values were higher comparing with the other parameter for Karaman city centre. Annual mean value was about 600 µg/m<sup>3</sup> and maximum value was 2000 µg/m<sup>3</sup> that were lower than national air quality limits of Turkey. When looking at the figure 5, CO daily mean values were higher during winter period, because usage of fossil fuels for heating system is increasing residents, while the amount of fuel effect an important role in the winter season. Changing of CO daily mean values may be explained with changing meteorological factors for the sampling period affect dispersion of air pollutants. Main emission source of CO is fossil fuels for the investigation region and other sources were from industry and transportation.

Daily average data about NO<sub>2</sub>, which is the 4<sup>th</sup> parameter measured as air pollutants in Karaman city centre, can be seen in Figure 6. The pollutant with the most missing data among the measured air pollutant parameters is NO<sub>2</sub>. Exhaust gases of vehicles in traffic can be cited as the main source of NO<sub>x</sub> for the research area. According to the available data, it is very difficult to get an idea about the NO<sub>2</sub> change according to the seasons because the data is insufficient for the region.

PM<sub>10</sub> values show that PM<sub>10</sub> values decreased during pandemic measures taken in 2<sup>nd</sup> period middle of March and middle of May 2020 comparing 1<sup>st</sup> of January to 15 March 200 (1<sup>st</sup> period). PM<sub>10</sub> values were decreased with covid-19 measures and then return to normal levels of region.

The SO<sub>2</sub> values in as air quality values for Karaman city centre sampling station during first 6 months of 2020. They show that SO<sub>2</sub> values are mostly lower than 20 µg/m<sup>3</sup>, after end of February, they were decreased less than 10 µg/m<sup>3</sup>. Comparing between before and after pandemic outbreak measures, it is difficult to see significant differences. Because, is the source of SO<sub>2</sub> values was accepted as fossil fuels usage for heating system, with increasing ambient temperature, there is not important SO<sub>2</sub> emission source. All value is lower than Turkish national and European Comity limits.

SO<sub>2</sub> values for Karaman city centre sampling station during first 6 months of 2020 that show the CO values are mostly lower than 1500 µg/m<sup>3</sup>, for the first 6 months of 2020. After February, they were decreased less than 600 during µg/m<sup>3</sup>. Comparing between before and after pandemic outbreak measures, it is clear to see significant differences decreasing values. The source of CO values was accepted as fossil fuels usage for heating system and vehicle in traffic, with increasing ambient temperature, there is important decrease for heating system but traffic emission source is still available. All values are lower than Turkish national and European Comity limits for first 6 months of 2020 year.

Emissions sources and amount are air pollution in ambient air. Fluctuation of air pollutant concentration in short time show different factors may effect on air quality. The topographic structure and climatic features of a region are as effective as emission sources in the formation of air pollution. Specially during the winter months, there is increase in the emission levels with the temperature decreases. However, the negativity caused by meteorological conditions causes lower than expected levels of air quality. Using the data of the existing air quality monitoring station in the Karaman city centre: it is seen that the air quality increases and then returns to normal levels during the period when curfew is restricted for measures taken due to the Covid-19 outbreak for PM<sub>10</sub> and CO. The restrictions that cause the reduction of vehicle exhaust emissions, which are important factors in the formation of some air pollutants, are thought to be effective in improving the air quality.

However, particulates such as sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and ozone (O<sub>3</sub>) are the leading substances that are known to pollute the air. Sulphur dioxide (SO<sub>2</sub>) and Nitrogen Oxides (NOx) are the primary causes of acid rain. It occurs when these gases react in the atmosphere with water, oxygen and other chemicals to form various acidic compounds. Sunlight increases the rate of most of these reactions. The particulate matter in question is classified as PM<sub>10</sub> and PM<sub>2,5</sub> by size. The most dangerous of air pollutants is known as PM<sub>2,5</sub>. Covidien-19 measures in Turkey after middle of March 2020 were markedly obvious improvement in air quality in second period of this study. It was seen the positive effects Covid-19 measure on air quality in the city centre it has been found to be examined in PM<sub>10</sub> parameters.

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## O 37. HOMOGENITY AND TREND ANALYSIS OF ANNUAL TEMPERATURE CHANGE IN KONYA KARAPINAR BASIN

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**ABSTRACT:** Homogeneity and trend analysis are two important features of hydrological meteorological time series. In this study, Karapinar meteorological station (station No. 17902), located in the Konya basin in Turkey, with an average annual temperature trends of meteorological parameters and homogeneity analyses were performed. The annual average temperature data were evaluated statistically and the presence of a trend and hydrological change point, if any, was investigated. The data of average annual temperature of 56 years has been provided by the General Directorate of Meteorology (MGM) and if the data are random among themselves or not was determined by using Run Test. Annually change was determined by Pettitt and Standard Normal Homogeneity test methods. Annually temperature change was determined 95% confidence interval. Both methods gave consistent results in determining the annual average temperature variation. For trend analysis, Sen's T Test, and Spearman's rho (SR), Test Statistics methods gave consistent results. These tests were examined according to the 0.05 significance level.

**Keywords:** Konya Basin, Trend analysis, Standard normal homogeneity test, Pettitt test

## O 38. TECHNOLOGY, ENVIRONMENTAL SUSTAINABILITY AND THE ETHICS OF ANTHROPOHOLISM

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**ABSTRACT:** Technology has immensely shaped our society, economy and environment. The quest for new, better and smarter ways to human development has always been a key driver of technological advancement. However, this technological drive has transformed humans into slave owing to its devastating effect(s). Hence several philosophers of technology have described technology as alienating because it causes humans to lose their connection with other species in nature - resulting in environmental degradation. As human civilisation faces unprecedented environmental challenge(s) in the face of the negative impact of technology on human societies, it (technology) can still be and remain useful. Tackling the ensuing environmental challenges threatening humanity is not simply a matter of reducing or increasing technological use, but rather a clarion call for re-thinking the way technology is being developed, deployed and employed. This study investigates how environmental sustainability can be achieved by humans even while applying technology to the environment. It agrees with several environmentalists that anthropocentric attitude which sees the environment only as a storehouse for human exploitation with the use of technology is the major reason behind environmental degradation. The research, therefore, proposes that humans need to adopt the ethics of 'anthropoholism', which sees the environment as having inherent value and humans as a caretaker of the environment. The work posits that since anthropoholism emphasizes humanity as a part of nature, such that humans cannot exist independently of the environment, it could offer the ethical framework that technological tools should be developed and applied with the 'live and lets live' attitude towards sustainability of the environment. This study employs the contextual analytical and critical approach to arrive at its conclusions.

**Keywords:** Anthropoholism, Technology, Environmental Ethics, Environmental Sustainability.

## O 39. INCREASING CARBON DIOXIDE AVAILABILITY IN MICROALGAE CULTIVATION SYSTEMS BY USING TRIETHANOLAMINE

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**ABSTRACT:** In this study, we investigated the use of triethanolamine (TEA), a well-known carbon dioxide ( $\text{CO}_2$ ) capturing chemical, to increase  $\text{CO}_2$  availability in microalgae growth media. Microalgae culture used in the study was a mixed culture, in which the dominant species were determined by microscopic analysis as *Chlorococcales* order of the *Chlorophyceae* class (i.e. *Scenedesmus* sp., *Chloroccum* sp.). The non-toxic triethanolamine concentration was determined by measuring the specific growth rates of microalgae cultures grown in BG11 medium spiked with 1, 2, 5, 10, 20 and 40 mM TEA. It was observed that the growth rate started to drop at TEA concentrations higher than 20 mM. the biomass growth rate as well as nitrate and phosphate consumption rates of microalgae at 20 mM TEA concentration were observed to be similar to those grown without any TEA addition. Based on GC-FID analysis, a decrease in TEA concentration was detected after 6th day of the growth period, but a separate study indicated that this decrease could not be associated with abiotic oxidation, biosorption or sorption by microalgae. Using pre- $\text{CO}_2$  loaded BG11 mediums with 20 mM TEA concentration resulted in higher biomass production rates compared to those without TEA addition, when the cultures were not aerated during cultivation. When the cultures were subjected to aeration, the biomass production rates of the cultures with and without TEA addition became close to each other. It was found that most of  $\text{CO}_2$  loaded in the medium released within a few days of the growth period. Further studies are being conducted to reveal  $\text{CO}_2$  release mechanisms from  $\text{CO}_2$  loaded TEA solution to microalgae medium.

**Keywords:** Carbon dioxide capture, microalgae, alkanolamine, triethanolamine, biomass production

### 1. INTRODUCTION

Carbon dioxide ( $\text{CO}_2$ ) emissions from large stationary sources, such as fossil fuel-fired power plants, cement kilns, refineries, and manufacturing facilities, contribute significantly to the increase of  $\text{CO}_2$  level in the atmosphere. The current approach to reduce  $\text{CO}_2$  emissions from these large point sources is to use amine-based post-combustion  $\text{CO}_2$  capture systems followed by sequestration of the captured  $\text{CO}_2$  into underground geological structures such as saline aquifers after transporting at high pressure via pipelines (Plaza and Pevida, 2019).

Amine-based  $\text{CO}_2$  capture systems include an absorption unit in which flue gas  $\text{CO}_2$  is absorbed into aqueous amine solutions by forming an intermediate compound, and a stripping unit in which the aqueous amine solutions are regenerated by stripping  $\text{CO}_2$  from the intermediate structure using heat or pressure-swing method. The  $\text{CO}_2$  released from the stripping unit is then compressed to 100 to 150 bar for industrial use or geologic sequestration (Rochelle, 2009). Although amine-based  $\text{CO}_2$  capture processes could capture more than 90% of  $\text{CO}_2$  from flue gas streams, there are still some remaining challenges regarding the high energy penalty of the process and the limited use of high-purity  $\text{CO}_2$  captured in other industrial processes (Rochelle, 2009; Bara, 2012). Currently, installation of an amine-based  $\text{CO}_2$  capture system to an existing power plant is estimated to increase the electricity usage in the plant by 75–80 % (Idem et al., 2006). In addition, the high-purity  $\text{CO}_2$  produced from flue gas has also limited usage due to relatively low  $\text{CO}_2$  demand (about 230 million tonnes per year) in various industrial applications, such as urea manufacturing, oil recovery, beverage production, metal fabrication, cooling and fire suppression (IEA, 2019). Furthermore, despite of the extremely large storage capacities of existing saline aquifers, geological sequestration has still several uncertainties and risks associated with long-term  $\text{CO}_2$  storage due to possible  $\text{CO}_2$  leakages and long-term maintenance and monitoring requirements (Anderson, 2016).

An alternative to the current approach is to assimilate  $\text{CO}_2$  emissions from flue gases biologically by using photosynthetic microorganisms, such as microalgae. It is already known that microalgae is highly capable of utilizing flue gas  $\text{CO}_2$  as an inorganic carbon source to produce new biomass. Capturing and assimilation of  $\text{CO}_2$  by microalgae offer some advantages compared to the current approach, including low energy and chemical requirements, and production of commercially viable

biomass. Yet, this technology has also some drawbacks to be overcome before its full implementation. For example, effective delivery of gaseous CO<sub>2</sub> into the algal ponds is still a challenging task. Since, typical algal ponds are designed as shallow in order to maximize light penetration, when CO<sub>2</sub>-rich flue gas is bubbled into such algal ponds, most of the CO<sub>2</sub> delivered escapes to the atmosphere, and only between 10 and 30% of the supplied amount could be utilized by microalgae (Li et al., 2013; Apel and Weuster-Botz, 2015). In addition, from practical perspective, it is difficult to find specific locations where sufficient and low-cost sources of both CO<sub>2</sub> and nutrient solution (wastewater, etc.) are located in close proximity to each other. Therefore, flue gas CO<sub>2</sub> must be compressed and transported from the CO<sub>2</sub> point source to the algal pond, which would increase operational costs drastically. It must also be taken into account that low or no usage of captured CO<sub>2</sub> during the night or winter periods when algae have no or low photosynthetic activity would lower the overall utilization of CO<sub>2</sub> in the process (Benemann and Oswald, 1994).

A viable solution to the drawbacks associated with the use of gaseous CO<sub>2</sub> in microalgae CO<sub>2</sub> assimilation process might be to supply CO<sub>2</sub> into microalgae media in the form of dissolved bicarbonate/carbonate by absorbing flue gas CO<sub>2</sub> in aqueous solutions using conventional absorption processes. This alternative could reduce the CO<sub>2</sub> loss encountered when gaseous CO<sub>2</sub> is used directly; furthermore, could decrease CO<sub>2</sub> transportation and storage costs substantially. Both microalgae and cyanobacteria are capable of uptake of bicarbonate ions through their membranes using a special enzyme called carbonic anhydrase. Earlier studies showed that various microalgae and cyanobacteria species could reach significant biomass production rates when bicarbonate salts (mostly sodium bicarbonate) are used as a sole carbon source instead of gaseous CO<sub>2</sub> supply (White et al., 2012; Chi et al., 2014; Kishi and Toda, 2017). Furthermore, different types of aqueous amine solutions were used in several studies to deliver bicarbonate ions to microalgae without affecting biomass growth rates up to certain amine concentrations (Choi et al., 2012; Kim et al., 2013; Sun et al., 2015; Sun et al., 2016). In these studies, mostly aqueous alkanolamine solutions were used to capture the CO<sub>2</sub> gas delivered to the growth medium by diffusers. Alkanolamines, which have long been used to remove CO<sub>2</sub> from flue gases in industrial processes, are chemical compounds that contain both hydroxyl and amino functional groups on an alkane backbone. They are classified into primary, secondary and tertiary alkanolamines based on the number of the attached amine group. CO<sub>2</sub> capture by amines can be described by two different mechanisms: (1) for primary and secondary alkanolamines, the mechanism involves a carbamate formation through reactions with CO<sub>2</sub> (Caplow, 1968), (2) for tertiary alkanolamines, the amine group acts as a base catalyst, increases the reactivity of water towards CO<sub>2</sub> and consequently forms bicarbonate ions by reacting with CO<sub>2</sub> (Donaldson and Nguyen, 1980). In earlier studies involving the use of alkanolamines for microalgae growth, the aqueous amine solutions were mixed with growth media in different proportions while supplying CO<sub>2</sub> to the media in gaseous form (Choi et al., 2012; Sun et al., 2015; Kim et al., 2013). In our study, we differed from these earlier studies by focusing on absorbing CO<sub>2</sub> in aqueous amine solutions in a separate gas absorber unit, and then feeding the CO<sub>2</sub>-loaded amine solutions with growth medium. Furthermore, in our study we monitored the change in the amine concentration in the microalgae cultivation medium to determine whether the amine compounds are subjected to biotic or abiotic degradation during the cultivation step. The fate of the amine compounds has not been the subject of the earlier studies.

In addition, the earlier studies on using aqueous amine solutions to deliver CO<sub>2</sub> to microalgae cultivation systems seemed to have focused on how to increase CO<sub>2</sub> utilization efficiency of conventional CO<sub>2</sub> delivery systems, rather than how to integrate current amine-based CO<sub>2</sub> capturing systems with microalgae cultivation systems. The present study, on the other hand, aims to investigate the effect of using CO<sub>2</sub> loaded amine solutions on microalgae cultivation process in comparison with conventional gaseous CO<sub>2</sub> delivery systems in order to see feasibility of integration of these two very different processes (CO<sub>2</sub> absorption and CO<sub>2</sub> assimilation by microalgae).

## 2. MATERIALS AND METHODS

### 2.1. Aqueous amine solution

In this study, triethanolamine (TEA), a tertiary alkanolamine, was used to prepare the aqueous amine solution for capturing CO<sub>2</sub>. A tertiary alkanolamine was selected to capture CO<sub>2</sub> because tertiary alkanolamines are expected to result in less pH changes after addition to the growth medium compared to primary and secondary alkanolamines which contain higher number of hydroxyl groups. Furthermore,

previous studies showed that tertiary alkanolamines have less toxic effect on microalgae compared to primary and secondary alkanolamines, which produce toxic carbamate intermediates during reactions with CO<sub>2</sub> (Kim et al., 2013; Rayer et al., 2014). The aqueous TEA solutions were prepared by using analytical grade triethanolamine purchased from Sigma-Aldrich (USA).

## **2.2. Culture media and microorganisms**

A mixed microalgae culture was used in this study. The culture was obtained by inoculating the water samples collected from nearby water bodies to a standard BG11 medium (Rippka et al., 1979). After an acclimation period, the dominant species in the culture was determined as *Chlorococcales* order of the *Chlorophyceae* class (i.e. *Scenedesmus* sp., *Chloroccum* sp.). The same culture was successfully used in our previous studies (Keris-Sen et al., 2014; Keris-Sen et al., 2019). The mixed culture was cultivated in the laboratory, in a 5-L glass tank, under a light intensity of 150  $\mu\text{mol photon m}^{-2} \text{s}^{-1}$  in photosynthetically active radiation (PAR) spectrum, at 12 h light - 12 h dark illumination cycle and at 25 °C ± 2. The air diffusers located at the bottom of the tank both provided sufficient CO<sub>2</sub> to the culture and enhanced nutrient and light availability throughout the tank.

## **2.3. Determination of non-toxic TEA concentration**

The non-toxic triethanolamine concentration was determined by measuring the specific growth rates of microalgae cultures grown in BG11 medium spiked with 1, 2, 5, 10, 20, and 40 mM TEA. The experiments were conducted in duplicates, in 500 mL glass reactors, under a light intensity of 150  $\mu\text{mol photon m}^{-2} \text{s}^{-1}$  in PAR spectrum, at 12 h light - 12 h dark illumination cycle and at 25 °C ± 2. The growth of microalgae in the reactors was monitored on daily basis by measuring the optic density of the samples at a wavelength of 682 nm with a UV-VIS spectrophotometer (Thermo Scientific). The spectrophotometric analysis was calibrated with respect to total dissolved solids (TSS) measurements of the mixed culture according to the Standard Methods 2540-D (APHA, 2005).

The effects of the non-toxic TEA concentration on nutrient consumption of microalgae cultures were also determined by monitoring nitrate (NO<sub>3</sub><sup>-</sup>) and phosphate (PO<sub>4</sub><sup>3-</sup>) concentrations in the growth medium. The nitrate and phosphate concentrations were measured using an ion chromatography system (Shimadzu Prominence) equipped a conductivity detector and an anion-exchange column. The samples of 5 mL were taken from each reactor daily and the samples were filtered thorough 0.45 μm syringe filter before injected into the column.

## **2.4. Determination of TEA degradation**

Since TEA is a nitrogen containing organic compound, it is expected to be susceptible to biodegradation by microalgae during the cultivation period. Furthermore, TEA could also be stripped and/or degraded by abiotic environmental conditions like the oxidative environment created in the reactor by aeration. Thus, TEA concentration during microalgae growth was monitored daily by taking 2 ml samples from each reactor. Two control reactor sets were run simultaneously in order to distinguish the degree of degradation caused by biotic and abiotic factors: (1) two identical reactors filled with BG11 medium spiked with same TEA concentration and aerated at the same rate as the reactors containing microalgae culture, (2) two identical reactors filled with BG11 medium spiked with the same TEA concentration as the reactors containing microalgae culture.

TEA concentrations in the samples taken from the reactors were filtered thorough 0.45 μm syringe filter and analysed by gas chromatography (GC) by using an Agilent 6890 N series gas chromatograph equipped with a flame ionization detector (FID), a DB-5HT capillary column (30 m x 0.53 mm I.D. x 0.1 μm), a hydrogen generator (Shimadzu), and an auto-injector. The temperature in the column was set initially to 150 °C for 1 min, then it was ramped to 200 °C at 65 °C min<sup>-1</sup> and then it was ramped to 330 °C at 40 °C min<sup>-1</sup>, and finally it was hold for 3 min. The total run time was 9 min. The detector temperature was 335 °C, and the air and hydrogen flows to the detector were set as 450 mL min<sup>-1</sup> and 45 mL min<sup>-1</sup>, respectively. In each analysis, 1 μL of sample was injected into the inlet module at 260 °C and the injected sample was spilt at a ratio of 1:10 before entering the column. The carrier gas in the column was helium at 1.7 mL min<sup>-1</sup> flow and at 80 kPa constant pressure, while the make-up gas was nitrogen.

## 2.5. Comparison of CO<sub>2</sub> delivery approaches

The investigation of the effect of using CO<sub>2</sub> loaded TEA solutions on microalgae cultivation process in comparison with conventional gaseous CO<sub>2</sub> delivery systems was performed by setting up four types of reactor sets with changing parameters as depicted in Table 1.

**Table 1.** Experimental parameters for each reactor setup

Parameters	Reactor Set No			
	R1	R2	R3	R4
50 mg L <sup>-1</sup> initial biomass concentration	√	√	√	√
BG11 medium (including no sodium carbonate)	√	√	√	√
375 mL medium volume	√	√	√	√
150 µmol m <sup>-2</sup> s <sup>-1</sup> PAR illumination	√	√	√	√
Addition of CO <sub>2</sub> -loaded TEA	√		√	
Aeration at 50 mL min <sup>-1</sup> with air containing CO <sub>2</sub>			√	
Aeration at 50 mL min <sup>-1</sup> with air containing no CO <sub>2</sub>		√		

All reactor sets were run in 500 mL glass reactors (including 375 mL of BG11 medium), under a light intensity of 150 µmol photon m<sup>-2</sup> s<sup>-1</sup> in PAR spectrum, at 12 h light - 12 h dark illumination cycle and at 25°C ± 2. All experiments were conducted in duplicates with an initial biomass concentration of 50 mg L<sup>-1</sup>. Additionally, reactor sets R1 and R3 were spiked with CO<sub>2</sub>-loaded TEA solutions. The CO<sub>2</sub>-loaded TEA solution was prepared by passing analytical grade CO<sub>2</sub> gas (at 99.9% purity) for 2 hours through a gas washing bottle which includes 2 M TEA solution. Then, the CO<sub>2</sub>-loaded concentrated TEA solution was diluted with BG11 medium before starting up the reactors. Different from than the reactor set R3, R1 was aerated at 50 mL min<sup>-1</sup> flow rate by a diffuser, but to prevent CO<sub>2</sub> input to the system, the air was pumped to the reactor after passing through a gas washing bottle including 1 N NaOH solution. By doing this, it was aimed to compare the system with TEA to the conventional CO<sub>2</sub> bubbling system (reactor set R2) by adding the mixing effect coming from the aeration itself. The reactor set 4 was executed as a control experiment.

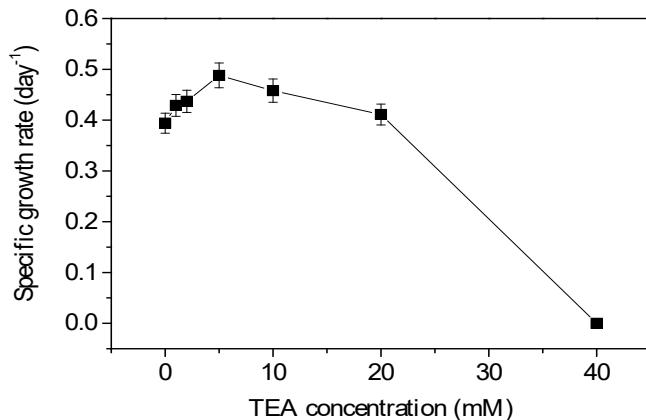
Along the cultivation period, microalgae growth and nutrient consumption in the reactors were monitored on daily basis with the spectrophotometric and the ion chromatographic methods explained in earlier. In addition to them, total organic carbon (TOC) and total inorganic carbon (TIC) contents in the reactors were measured by using a TOC analyser (Shimadzu) by taking 5 mL samples on daily basis. The change in the temperature and pH of the growth medium were also followed daily using a multi-parameter meter (Mettler Toledo).

## 3. RESEARCH FINDINGS

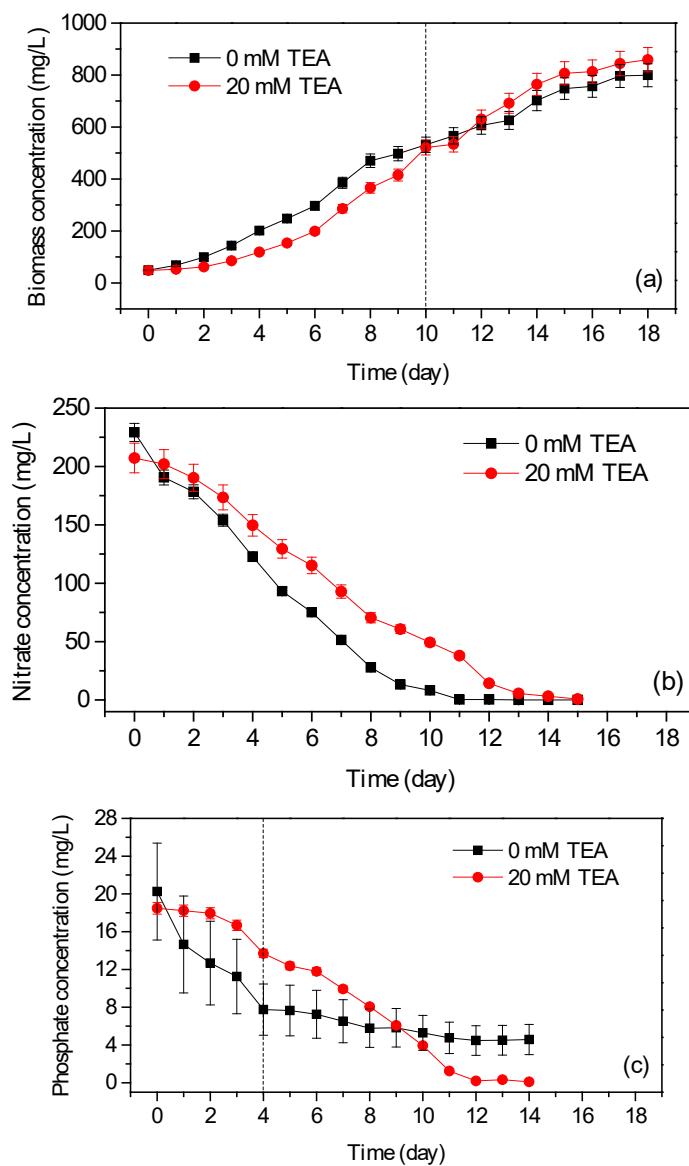
### 3.1. Determination of non-toxic TEA concentration

The specific growth rates of microalgae cultures grown in BG11 medium and spiked with 1, 2, 5, 10, 20, and 40 mM TEA are illustrated in Figure 1. As depicted in the figure, the specific growth rates started to drop significantly at TEA concentrations higher than 20 mM. Although the highest growth rate occurred around TEA concentration of 5 mM, still high growth rates were observed at the high TEA concentration of 20 mM. Since the objective was to maintain high TEA concentration to be able to increase the CO<sub>2</sub> capturing capacity of the system, subsequent experiments were performed at 20 mM TEA concentration.

The effect of 20 mM TEA content in the growth medium on biomass production and nutrient consumption of the microalgae was also determined by a separate set of experiments and the results are presented in Figure 2.



**Figure 1.** Specific growth rates of microalgae cultures for different initial TEA concentrations in the growth medium



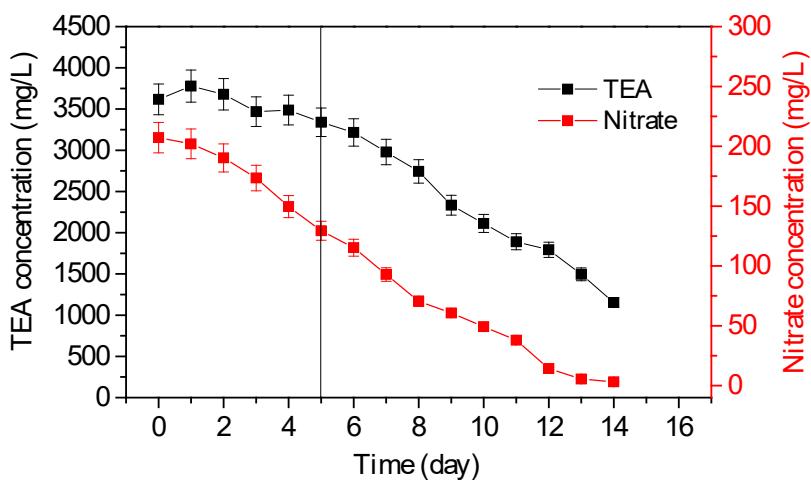
**Figure 2.** Comparison of the cultures grown in growth mediums including 0 and 20 mM TEA in terms of (a) biomass growth, (b) nitrate, and (3) phosphate consumptions

Figure 2a indicates that the biomass productions of those cultures with and without TEA addition have had quite similar biomass production rates. Although, the culture with 20 mM TEA showed a lower growth rate than those of the control culture in first 10 days, after an adaptation period, the TEA containing culture caught the biomass concentrations of the control culture. In overall culture period, both cultures reached similar daily biomass production rates ( $28.3 \text{ mg L}^{-1} \text{ day}^{-1}$  for the control culture,  $26.0 \text{ mg L}^{-1} \text{ day}^{-1}$  for the culture with 20 mM TEA).

For nutrient consumption rates, similar patterns were observed between the two cultures. Although nitrate consumption rate of the control culture seemed to be higher, both cultures depleted their nitrate content at the same time (Figure 2b). Both cultures encountered a lag period for phosphate uptake (about 3 days) (Figure 2c). At the end of the experiment, the culture with 20 mM TEA consumed all phosphate content while the phosphate concentration in the control culture remained at about  $4 \text{ mg L}^{-1}$

### 3.2. Determination of TEA degradation

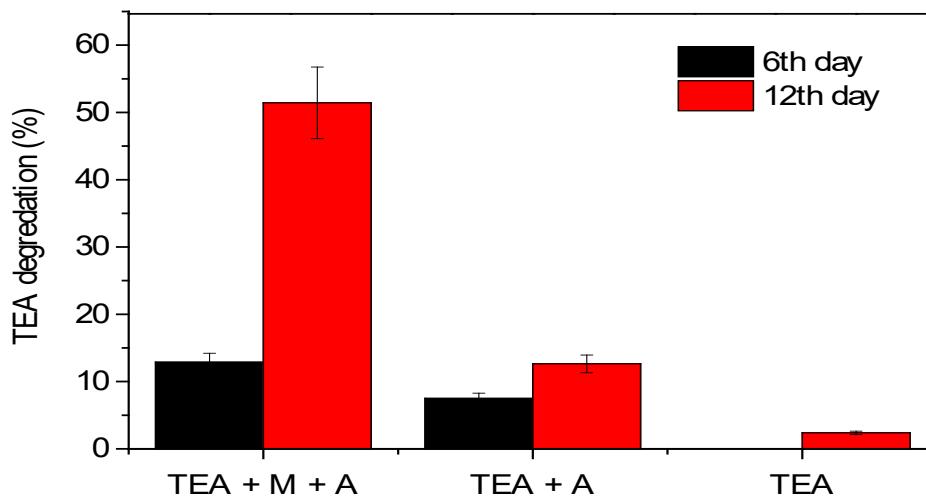
TEA concentration in the growth medium was monitored during the growth experiments. The results are presented together with the results of nitrate concentration in the growth medium in Figure 3.



**Figure 3.** The change in TEA concentration in the growth medium in comparison with the nitrate consumption during microalgae cultivation

The TEA concentration remained stable for the initial 5 days and then started to drop. Since TEA has nitrogen groups in its molecular structure, it is plausible to expect that microalgae might change their nitrogen source from nitrate to TEA. However, the results show that the nitrate consumption rate didn't slow down after the 5<sup>th</sup> day, indicating that nitrate was still the preferred nitrogen source.

Two control experiments were carried out along with the growth experiments to reveal the reason for the drop in the TEA concentration. Percentile TEA degradations in the growth experiments and in these two control experiments were determined after 6 and 12 days of operation and compared with each other (Figure 4). The results reveal that TEA degradation in reactors with no biological activity was quite low. Even after 12 days of aeration, the TEA degradation reached about 10% only. On the other hand, the TEA degradation reached about 50% at the 12<sup>th</sup> day in reactors containing microalgae culture. Furthermore, in the first 6 days, the TEA degradation was only 12%, but the degradation accelerated during the second 6 day reaching 50%. These results could be explained by a possible heterotrophic biodegradation activity by microalgae and/or any other heterotrophic microorganism that might acclimate to the TEA and the growth medium.



**Figure 4.** Comparison of TEA degradation during microalgae cultivation (M) and aeration (A) compared to blank TEA solution after 6 and 12 days of operation

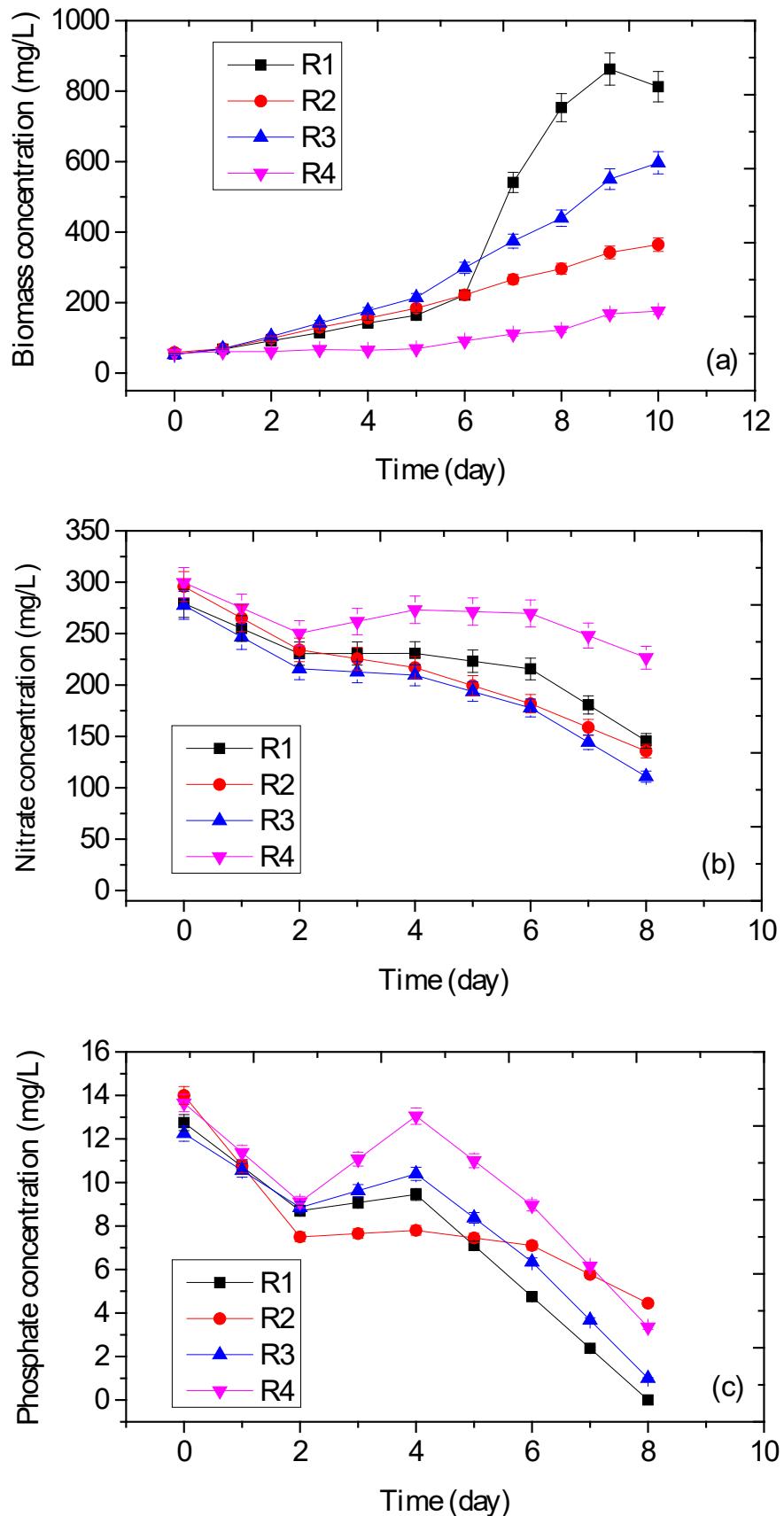
### 3.3. Comparison of CO<sub>2</sub> delivery approaches

Another set of experiments were performed to distinguish the effect of TEA usage in the growth medium to the microalgae growth compared to those that could be achieved using the conventional CO<sub>2</sub> delivery approach. The results of the microalgae growth and nutrient consumption for four experimental sets, as presented in Figure 5a, indicate that both conventional aeration and TEA addition increased growth rates compared to the control culture in Reactor 4. When the CO<sub>2</sub>-loaded TEA system is aerated (as in R1), the growth rate dropped due to disturbance by aeration (compared to R3). The rapid increase in biomass concentrations after the 6<sup>th</sup> day in R1 may be contributed to possible heterotrophic activity in the medium, as was seen in previous experiments. The specific growth rates corresponding to the CO<sub>2</sub>-loaded TEA system in the reactor 3 and the gaseous CO<sub>2</sub> delivering system in the reactor 2 are very close to each other (Table 2). When the nutrient utilizations are compared, it is obvious that compared to control reactor (R4), the other three reactor sets have similar nutrient uptake rates (Figure 5a and 5b). Only difference can be seen on phosphate consumptions. While almost all the phosphate content in the TEA-added systems (R1 and R3) was consumed within 8 days, the final phosphate concentration in the aerated system only reached half of its initial phosphate concentration.

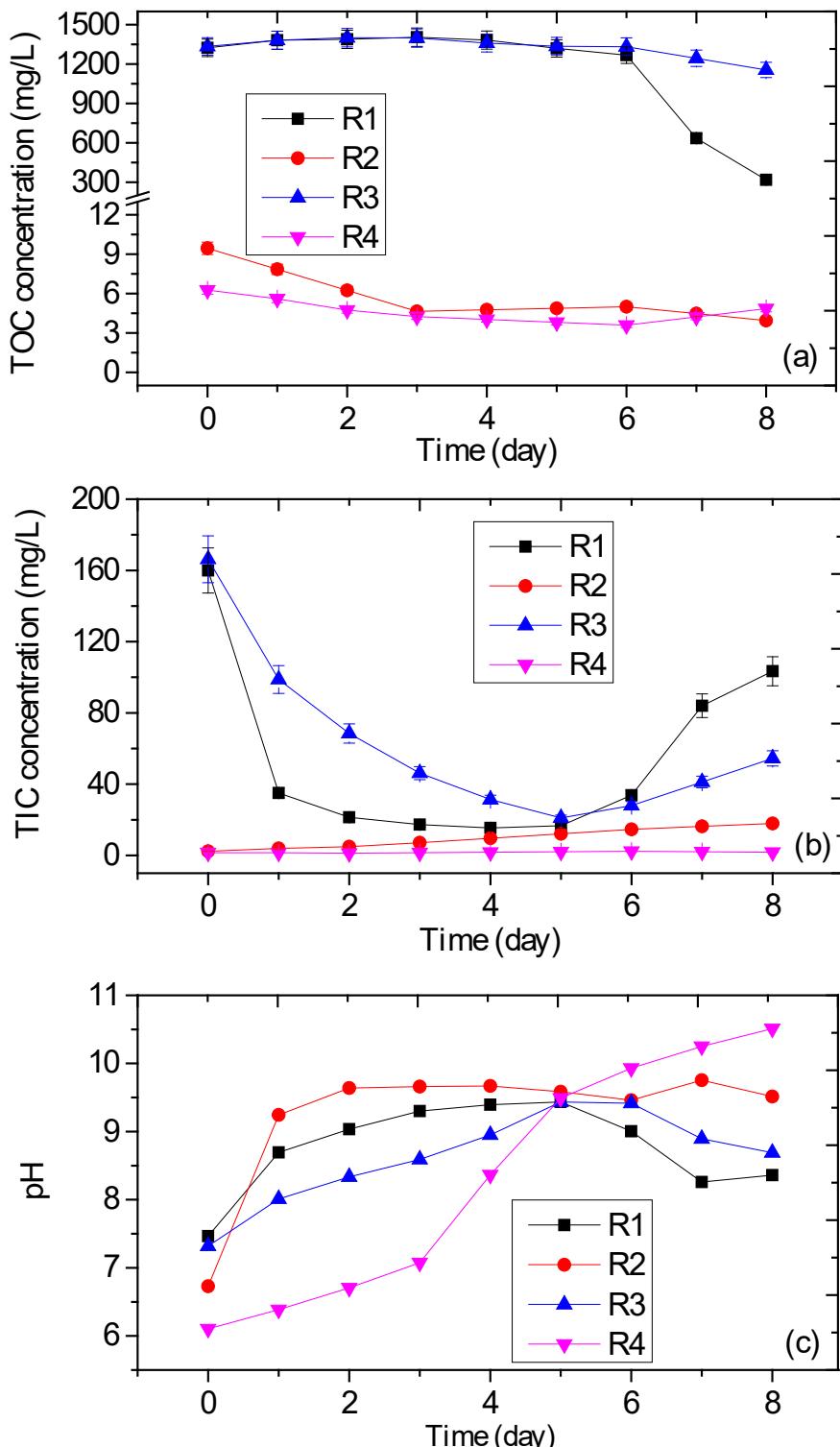
**Table 2.** Specific growth rate and corresponding lag period for each reactor

Reactor No	Specific growth rate (1/day)	Error ( $\pm$ )	Lag period (day)
R1	0.27	0.06	1
R2	0.33	0.05	1
R3	0.36	0.06	1
R4	0.26	0.04	5

During these experiments, total organic carbon (TOC) and total inorganic carbon (TIC) concentrations in the reactors were monitored to elucidate CO<sub>2</sub> utilization mechanisms. These results are presented in Figure 6 along with the pH measurements of the reactors. The very high TOC concentrations measured in TEA-added systems (R1 and R3) can be attributed to the organic carbon coming from the 20 mM TEA addition. These high TOC concentrations remain stable for 6 days, however, the TOC concentration in R1 starts to drop after the 6<sup>th</sup> day. As brought forward earlier, this drop in TOC levels may be the result of accelerated heterotrophic activity and degradation of organic carbon in the system, as depicted by the increase in TIC concentration in Figure 6b.



**Figure 5.** Comparison of the cultures grown in different reactors in terms of (a) biomass growth, (b) nitrate, and (3) phosphate consumptions



**Figure 6.** Comparison of the cultures grown in different reactors in terms of (a) TOC concentration, (b) TIC concentration, and (c) pH of the growth medium

Figure 6b demonstrates that the CO<sub>2</sub> captured by the TEA solution is released rapidly in aerated reactor sets (R1) while CO<sub>2</sub> release is delayed in non-aerated reactor sets (R3). This observation indicates that an acid-base equilibrium is formed between TEA and CO<sub>2</sub> when these are brought into contact at high CO<sub>2</sub> concentrations in the air (flue gas). However when the CO<sub>2</sub> loaded aqueous solution is added to a systems open to the atmospheric conditions (which means in equilibrium with a low CO<sub>2</sub> partial pressure) the CO<sub>2</sub> captured by the TEA could escape to the atmosphere in order to reach the new

equilibrium. Since TEA is a weak base, when it is in equilibrium with CO<sub>2</sub>, they both behave as a buffer system and reduce the pH increase during microalgae growth (Figure 6c). However, this loose interaction between TEA and CO<sub>2</sub> can cause rapid decarbonisation of the system. Further studies should be conducted to understand the parameters affecting the CO<sub>2</sub> releasing mechanism when CO<sub>2</sub>-loaded TEA solutions are mixed with growth media.

#### 4. DISCUSSION AND CONCLUSION

This study investigates the use of TEA, a well-known CO<sub>2</sub> capturing chemical, to increase CO<sub>2</sub> availability in microalgae growth media. It was found that TEA addition to a certain concentration could enhance inorganic carbon availability in microalgae bioreactors and could result in a similar biomass productivity compared to those obtained by conventional gaseous CO<sub>2</sub> delivery systems. It was observed that due to high carbon content of TEA, a heterotrophic activity might be seen during the microalgae growth. Therefore, open growth systems can be an unsuitable option for operating systems using TEA as CO<sub>2</sub> transporter. It was also found that most of CO<sub>2</sub> loaded in the medium released within a few days of the growth period. Thus, CO<sub>2</sub>-loaded TEA could serve as a CO<sub>2</sub> transporter to microalgae cultivation system without affecting growth conditions of microalgae species. However, this release causes rapid decarbonisation of the system as it does in CO<sub>2</sub> bubbling systems. Thus, further studies are being conducted to reveal CO<sub>2</sub> releasing mechanisms from CO<sub>2</sub> loaded TEA solutions to microalgae media, and to increase CO<sub>2</sub> utilization efficiency of the proposed approach.

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## O 40. PHOSPHATE REMOVAL FROM WASTEWATER BY USING CATIONIC COMPOSITE HYDROGELS

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**ABSTRACT:** Wastewater treatment and making it reusable is of great importance especially considering global warming and limited water sources on earth. One of the water pollutants is phosphate pollution caused by domestic wastes such as detergents and this pollution increases alg blooms, which leads to decrement in water quality. In this study, which is thought that anionic phosphate pollution can be easily removed with the help of cationic materials, the composite hydrogels consisting of positive charged polymeric 3- acrylamido- trimethyl ammonium chloride and chitosan were prepared. After various characterization tests, phosphate uptake capacities of the composite materials were determined. With the phosphate holding capacities attaining up to 124 mg / g and its reusability up to 5 cycles, it was observed that the composite hydrogels have a potential to use for phosphate removal as an adsorbent.

**Keywords:** Hydrogel, Composite, Phosphate, Water Treatment.

### 1. INTRODUCTION

Wastewater treatment and making it reusable has a great importance when it is considered to global warming and limited water resources on the earth. Currently, a number of different methods are applied in water treatment, from chemical precipitation to ion exchange, from electrochemical treatment to membrane technology and adsorption (Bisht et al. 2017). Among them, adsorption has attracted a great attention in terms of easy application and low cost (Volesky, 1997). It is well known from the literature that a high number of substances have the ability to serve as an adsorbent by removing the various pollutants such as heavy metals, textile dyes and the others etc. from wastewater.

Adsorbents can be classified into the two main groups: natural and synthetic adsorbents. Zeolit, clay and perlite, which are inorganic origin and also chitosan, cellulose, resin and hard fruit shell which are organic origin can be given as an example for natural adsorbents. Synthetic adsorbents, on the other hand, can be expensive in some cases, and because of their synthetic origin, their potential to harm the environment can be mentioned. However, they have the advantage that they can be designed with the desired feature. Many polymeric substances can be given as an example for the synthetic adsorbents (Demir and Yalçın, 2014).

Considering these points, especially in recent years, the synthesis of organic / inorganic hybrid hydrogels and its use in removal of impurities from wastewater is a remarkable subject. It is well known that the use of such materials in wastewater treatment has given promising results. For example, in many studies carried out with these hybrid hydrogels consisting of the combination of natural adsorbents such as montmorillonite clay, chitosan and cellulose with the synthetic adsorbents such as polyvinylalcohol, polyacrylic acid and polymethylmethacrylate etc. and they have shown their applicability for water recycling process, producing high adsorption capacities reaching sometimes 99% for several cationic pollutants (Moreno-Sader et al., 2019; Mohseni et al., 2017; Bunhu et al., 2016; Maskawat Marjub et al., 2019; Abdeen et al., 2015; Godiya et al., 2018)

Similar to the cationic ones, also various anionic pollutants can be removed from wastewater by using adsorbents, as well. For this generally the substances with cationic property are benefited. In the literature, there are different studies, investigate the adsorption of several anionic pollutants such as anionic dyes, nitrate, nitrite, cyanide, perchlorate, and fluoride ions etc. (Yang et al., 2020; Anees and Jishna, 2017; Moghadam et al., 2018; Ilgin et al., 2020; Zheng et al., 2014; Xie et al., 2010; Arcos-Arévalo et al., 2016). In these studies, polystyrene functionalized with triethylamine groups and quaternized chitosan has been drawn attention as an adsorbent.

In addition to the abovementioned anionic ones, phosphate is also the one of the anionic pollutants and is caused by domestic wastes such as detergents, leading to decrement in water quality by increasing algae blooms. Generally the adsorbents having cationic groups on their surface are used for effective phosphate anions. In the literature there are some examples for this. In particular the ones with amine

functionalized and quaternary amine groups have received great interest about this issue (Shen et al., 2015; Wu et al., 2017; Yousif et al., 2015)

In this study it was aimed at preparation of an effective cationic adsorbent for removal of phosphate anions from water. In order to enhance the adsorption capacity of the adsorbent, it was attempted to incorporation of chitosan into poly(Acrylamide-co-3-methacrylamido-N,N,N-trimethylpropan-1-aminium chloride) (p(AAm-co-MAPTAC) network and in this way it was synthesized semi-IPN hydrogels composed of poly(Acrylamide-co-3-methacrylamido-N,N,N-trimethylpropan-1-aminium chloride) (p(AAm-co-MAPTAC) and chitosan. With these prepared cationic hydrogels, it was created a synergetic effect.

The new hydrogels prepared with the abovementioned purpose were also exposed to several characterization test to better understand their adsorption behaviour.

## 2. MATERIAL AND METHOD

### 2.1. Materials

Acrylamide (AAm), 3-methacrylo propyl trimethyl ammonium chloride (MAPTAC) and N,N-methylene bisacrylamide (BAAm), which were used as main monomer, comonomer and crosslinker, respectively and also chitosan, which was used as linear polymer were all bought from Aldrich Chemicals (Milwaukee, WI, USA). Ammonium peroxydisulfate (APS) and sodium meta bisulfite (SMBS), which were employed as redox initiator pair, were purchased from Merck (Darmstad, Germany). Acetic acid and sodium hydroxide, used for preparation of the hydrogels and also sodium dihydrogen phosphate for adsorption experiments, were supplied by Aldrich Chemicals (Milwaukee, USA). Ammonium molybdate tetra hydrate, tin chloride dihydrate and glycerine, which were used for determination of the amount of phosphate ions, were all purchased from Aldrich Chemicals (Milwaukee, WI, USA).

### 2.2. Preparation of hydrogels

Poly(AAm-co-MAPTAC)-chitosan semi-IPN hydrogels were prepared by using free radical polymerization in presence of chitosan, utilizing BAAm as crosslinking agent. The synthesis schema was depicted in Figure 1. Briefly, predetermined weights of AAm and BAAm were dissolved in aqueous acetic acid solution (1% wt.) under magnetic stirring. MAPTAC, APS and SMBS were then inserted into the mixture in turn and obtained pre-gel solution were poured into the air-tight glass tubes in water bath at 35 °C for 24 hours. After 24 hours, the hydrogels were removed from the tubes and cut into as discs. To prevent chitosan molecules from dissolution in water, the gel discs were immediately immersed in 1 M NaOH solution and allowed to neutralization for one hour. Afterwards, they were taken from the basic solution and transferred into deionized water for purification. The fully swollen hydrogels were dried in freeze-dryer and named as MX-CY, where X and Y represent the molar ratio of MAPTAC and the weight of chitosan, respectively. The hydrogel compositional ratios are tabulated in Table 1.

**Table 1.** The hydrogel compositional ratios.

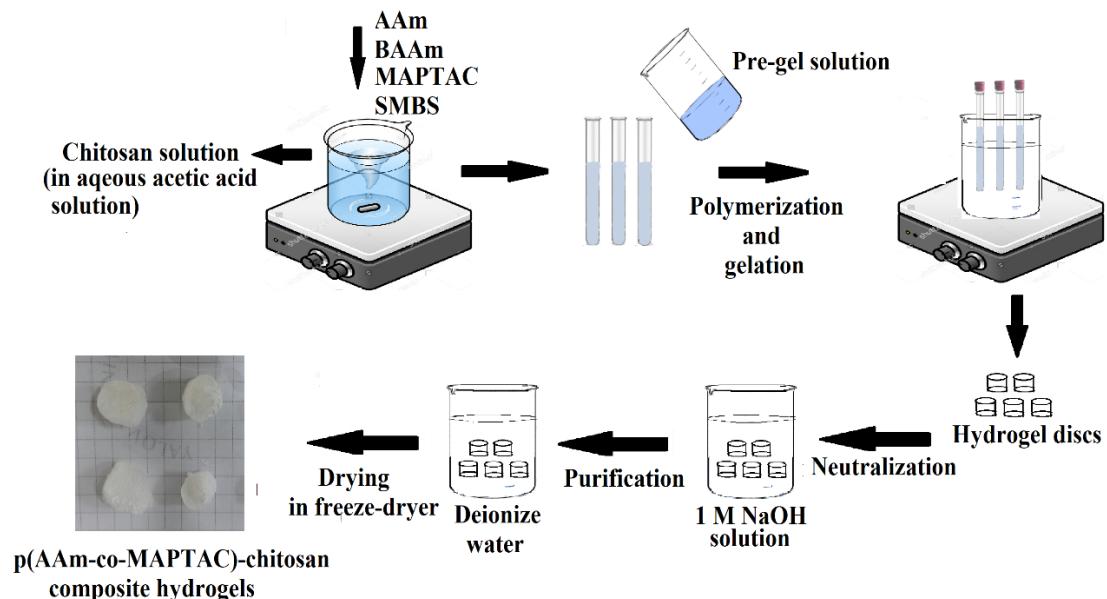
Hydrogel	AAm ( $\times 10^{-2}$ mol)	MAPTAC ( $\times 10^{-2}$ mol)	BAA ( $\times 10^{-4}$ mol)	Chitosan (g)
A-5M-0.1C	0.95	0.05	1.67	0.1
A-5M-0.2C	0.95	0.05	1.67	0.2
A-10M-0.1C	0.90	0.10	1.67	0.1
A-10M-0.2C	0.90	0.10	1.67	0.2

### 2.2. Swelling measurements of the hydrogels

To find the swelling capacities of hydrogels, the dry gel samples were placed in deionized water and weighed at certain intervals until they reached a constant weight, which means swelling equilibrium. The swelling degrees of the hydrogels were calculated by using the following equation:

$$Sw = \frac{m_s - m_d}{m_d} \quad (1)$$

where  $S_w$ ,  $m_s$  and  $m_d$  show the equilibrium swelling percent, weights of swollen and dry hydrogels, respectively.



**Figure 1.** Synthesis schema of the p(AAm-co-MAPTAC)/chitosan hydrogels.

### 2.3. Mechanical tests of the hydrogels

The gel strengths of the hydrogels were identified by employing compressing test. The swollen samples having approximately 1 cm of the length were subjected to uniaxial compression by using Zwick/Roell Z1.0 universal testing machine (Zwick GmbH&Co.KG,Ulm,Germany) equipped with a 50-N load cell at a compression rate of 3 mm/min. The compression was maintained up to 60% of the deformation ratio and the compression force values versus the deformation percentages were monitored.

### 2.4. Adsorption tests of the hydrogels

To study the adsorption capacity of the hydrogels, it was utilized from batch-adsorption technique. According to this technique, the dry hydrogel discs of which weights are about 0.1 g were immersed in 100 mL of 50 ppm of  $\text{PO}_4^{3-}$  solution, and both the initial concentrations and those at certain time intervals were determined by using the standard molybdenum blue spectrophotometric method at 690 nm (APHA-method-4500-P) (American Public Health Association. 1999. Standard methods for the examination of water and wastewater. Washington DC). The phosphate adsorption capacity of the hydrogels were calculated as  $q_e$  (mg/g) by using the following equation (Eaton et al., 2005) :

$$q_e = \frac{\sum(c_i - c_f)x V}{W} \quad (2)$$

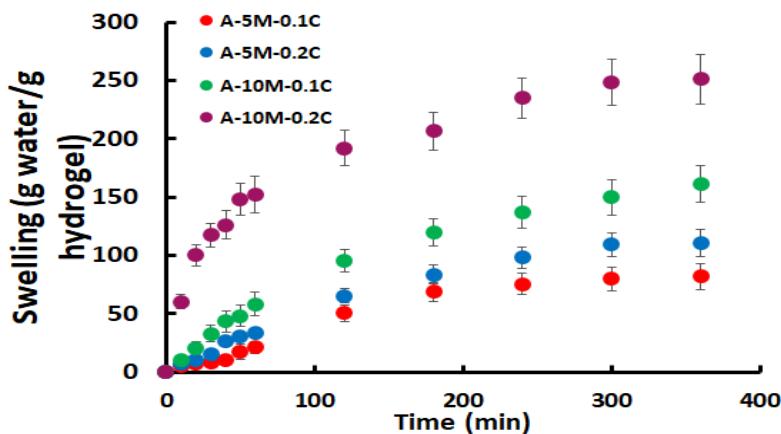
where,  $c_i$  and  $c_f$  show the phosphate concentrations in the solutions at initial and t time (mg/L), respectively. V and W denote the volume of the phosphate ion solution and the dry weight of the hydrogel, respectively. To find out the adsorption isotherm models of the hydrogels, the adsorption measurements were repeated with different  $\text{PO}_4^{3-}$  concentrations (50, 500, 300, and 450 ppm).

## 3. RESULTS AND DISCUSSIONS

### 3.1. Swelling behaviour of the hydrogels:

The swelling degrees of the hydrogels are seen in Figure.2 as a function of time. As seen in the figure, the all hydrogels continue to swell for approximately six hours and reached a plateau which means to swelling equilibrium.

It was found that the maximum swelling degree was achieved with A-10M-0.2C hydrogel had a value of 251.21 g/g. The test results showed an increase of both the MAPTAC and chitosan ratios in the hydrogel composition resulted in increment in the water adsorption capacities. When these two parameter was analysed separately, it can be stated that the effect of chitosan on the swelling extents of the hydrogels was more obvious in the hydrogels containing 10% of MAPTAC. This can be attributed to high ionic content of the main matrix of the A-10M hydrogels. Most probably due to fact that the high ionic content of A-10M hydrogels enables the hydrogel more extended, which leads to better distribution of chitosan chains in this matrix. It seems that at this combinational ratio, chitosan chains were homogenously distributed and their functional groups, especially amine groups, were open form which are ready to capture more water molecules. The maximum swelling degrees of the hydrogels are given in Table.2



**Figure 2.** Swelling curves of the hydrogels in deionized water at 25 °C.

### 3.2. Mechanical behaviour of the hydrogels:

The gel strengths of the hydrogels were presented in Table 2 together with the maximum swelling degrees. As seen in the table that the hydrogels were observed to withstand to the compression force up to 1.11 N as maximum.

**Table 2.** Maximum swelling degrees and compressional strengths of the hydrogels

Hydrogel	Maximum Swelling Degree (g/g)	Maximum Compression Strength (N)
A-5M-0.1C	82.15	0.72
A-5M-0.2C	111.08	1.11
A-10M-0.1C	131.41	0.62
A-10M-0.2C	251.21	0.40

The test results indicated that the lowest gel strength was exhibited by A-10M-0.2C most probably due to its high swelling degree, which generally cause the hydrogel to have poor mechanical property. According to the results it can be infer that both MAPTAC and chitosan contents create lower maximum compression strength. However, interestingly, an increase of chitosan in the hydrogels having 5% of MAPTAC resulted in reduction in gel strengths. This fact can be attributed to increased polymer density with the rise in chitosan content. In fact the same trend was not observed for the hydrogels having 10% of MAPTAC. This different result might be linked to great adsorption capacity of A-10M hydrogels, which possibly generates highly expanded network and thus, lower the polymer density. Therefore, most probably increase of chitosan content did not cause to rise in polymer density and thus leads not to lower gel strengths.

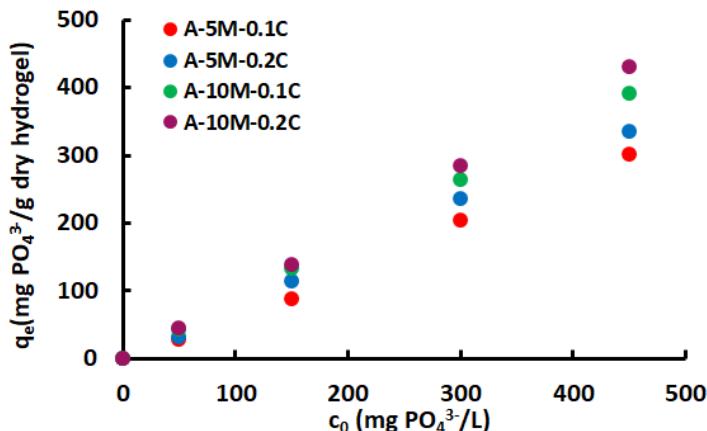
### 3.3. Adsorption behaviour of the hydrogels:

The hydrogels were found to have high phosphate adsorption capacities ( $q_e$ ) as expected from the high number of cationic groups they have (Figure.3). It is seen from the figure that the hydrogel adsorb more amount of phosphate ions as the initial concentration of the outer solution increases.

To find out the adsorption behaviour of the hydrogels and to determine their maximum adsorption capacities ( $q_m$ ) the mostly used two adsorption models (Freundlich and Langmuir isotherm models) were employed. They are expressed as the following equations, respectively:

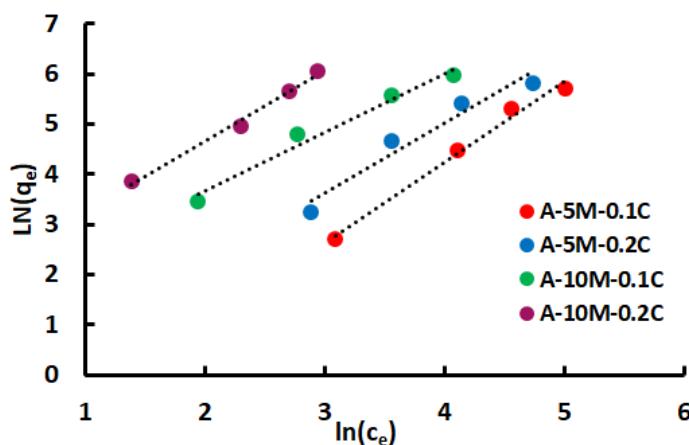
$$LN(q_e) = LN(K_F) + \left(\frac{1}{n}\right) LN(c_e) \quad (3)$$

$$\frac{1}{q_e} = \left(\frac{1}{K_L q_m}\right) \left(\frac{1}{c_e}\right) + \left(\frac{1}{q_m}\right) \quad (4)$$



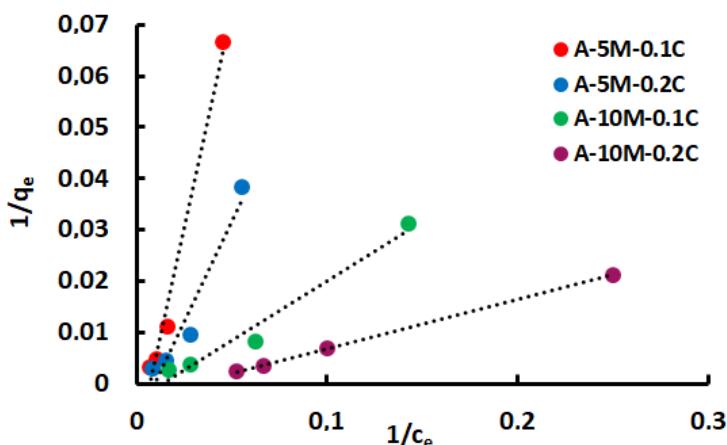
**Figure 3.** Adsorption capacities of the hydrogels ( $q_e$ ) depending on the different initial concentration of phosphate ions ( $c_0$ ).

According to the Freundlich adsorption model, described as Equation.3, the plots of  $LN(q_e)$  versus  $LN(c_e)$  yield straight lines, of which slope and intercept values are equal to the inverse of the adsorption intensity ( $1/n$ ) and logarithmic form of the Freundlich adsorption capacity ( $LN(K_F)$ ), respectively. The isotherms prepared by applying the experimental results to this model were shown in Figure 4. Also the calculated Freundlich constants and the related parameters are seen in Table 3.



**Figure 4.** Freundlich isotherms of the hydrogels.

On the other hand also Langmuir isotherms model was examined for the adsorption behaviour of the hydrogels. For this the related expression which is seen in Equation.4 was employed. Basis on this model, it is seen that the plots between  $1/q_e$  and  $1/c_e$  produce straight lines of which slope and intercept values give the Langmuir isotherm constants ( $K_L$ ) and the maximum adsorption capacity ( $q_m$ ), respectively. In order to the applicability of the adsorption behaviour of the hydrogels for this model, the plots between  $1/q_e$  and  $1/c_e$  were prepared and used for calculation of Langmuir isotherm constants ( $K_L$ ) and the maximum adsorption capacity ( $q_m$ ). (Figure 5). Also the calculated Langmuir constants and the related parameters are seen in Table 3.



**Figure 5.** Langmuir isotherms of the hydrogels.

**Table 3.** Freundlich and Langmuir constants of the hydrogels.

Hydrogel Type	FREUNDLICH MODEL			LANGMUIR MODEL		
	n	K <sub>F</sub>	R <sup>2</sup>	q <sub>m</sub>	K <sub>L</sub> × 10 <sup>-3</sup>	R <sup>2</sup>
A-5M-0.1C	0.619	0.109	0.9887	81.97	7.14	0.9857
A-5M-0.2C	0.720	0.587	0.9463	133.33	9.56	0.9424
A-10M-0.1C	0.856	3.821	0.9747	322.58	13.32	0.9734
A-10M-0.2C	0.711	6.367	0.9921	357.14	29.07	0.9999

The correlation coefficients ( $R^2$ ) of the Freundlich and Langmuir models are seen to close to one, which indicates that the both models fit to the experimental results, well. It is known that this result mostly occurs when the adsorption capacity of an adsorbent is too high kile in the case of this study. Most probably, for this reason the both model was well correlated with the experimental results. On the other hand, it was found that Freundlih adsorption capacity ( $K_F$ ) was ranged between 0.109 and 6.367, increasing with increment in the ionic content of the hydrogel. This means that the more cationic content a gel has, the more phosphate ions are adsorbed. As to Langmuir model, the model gave the maximum adsorption capacities of the hydrogels, which rise with positively charged groups, as expected. It was understood that A-10M-0.2C hydrogel had a maximum adsorption capacity of 357.14 mg/g.

#### 4. CONCLUSIONS

In this study a composite hydrogel carrying of strong cationic groups were successfully synthesized for phosphate adsorption. The hydrogels were found to have great swelling degrees ranged between 82.15 and 251.21 g/g, increasing with increment in both MAPTAC and chitosan amounts. The mechanical test results, on the other hand showed that the hydrogels withstand to 1.11N as maximum, depending on its compositional ratios. The present p(AAm-co-MAPTAC)-chitosan composite hydrogels have exhibited great phosphate adsorption capacity reaching up to 357.14 mg phosphate ion per gram of dry hydrogel. This result suggests that the poly(AAm-co-MAPTAC)-chitosan hydrogels are promising candidates for use an adsorbent for removal of phosphate anions from wastewater.

**Acknowledge:** This study has been financially supported by Yalova University Scientific Research Projects Coordination Department (Project no. 2018.AP.0010).

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## O 41. XENOTRANSPLANTATION TECHNOLOGY AND ITS POTENTIAL EFFECTS ON THE ENVIRONMENT

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**ABSTRACT:** Scientific research is currently geared towards making xenotransplantation a clinical procedure. Most articles and books have been written challenging xenotransplantation from the moral, religious and medical perspectives. However, little or no attention has been given to the potential threat of xenotransplantation to the environment. This work through critical reasoning takes up this daunting challenge of exposing the inherent potential threats that xenotransplantation could pose to the already degrading environment. It recommends a halt in the research on xenotransplantation to avoid its potential threats to humans and the environment at large.

**Keywords:** environment, xenotransplantation, effects, population, degradation.

**O 42. THE ECOSYSTEM COMPLEXITY AND THE OVERLAP BIOACCUMULATION INDEX (OBI) AS A TOOL FOR THE MANAGEMENT OF MARINE ECOSYSTEMS**

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**ABSTRACT:** In this survey we have built, for the first time, the control charts for the metal's bioaccumulation in two selected biomonitor (mollusks) in the Beagle Channel (southern Patagonia). We have then determined the range of overlaps of metal concentrations and the overlap bioaccumulation index (OBI) with respect to the upper (OBI-L) and lower (OBI-L1) bound of the overlap range. For this purpose, we applied the probabilistic Johnson's method (1949). The use of OBI as an integrated tool in marine environmental management consents to identify the specific biomonitor (or biomonitor) needed for a particular condition of contamination that can arise from natural or anthropogenic activities. The second aim is to analyze the theoretical and practical implications of the OBI index and its relative guidelines for the environmental management. Marine ecosystems are complex systems. According to the Ashby's Law (1957, 1958), the understanding of a complex system (requisite variety) depends on the information variety owned by the observer. In view of this, here we propose to conceptualize the wide set of biomonitoring knowledge capacity as an open and evolutionary endowment of information variety supporting the environmental management. These theoretical and practical implications will be fully debated.

**Keywords:** Biological monitoring, Beagle Channel, *Mytilus chilensis*, *Nacella (P) magellanica*, Baseline metal levels, Johnson's method, Control charts, Environmental performance, Information variety

## O 43. HAZARD IN FOODS; BISPHENOL A AND ITS DETERMINATION

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**ABSTRACT:** In our age, the main factors of many health problems such as cancer, obesity and sugar are chemicals used in foods. Many scientists are working on the determination methods for pesticides, hormones, preservatives and food additives that can be found in foods. Bisphenol A is an inner surface coating material used in cardboard milk and metal preserve cans and is also a toxic chemical. However, the transition rate of this substance to food, which also causes hormonal disorders, changes depending on the oil and water content and acidity of food, ambient temperature, contact surface and duration. Sensitive and selective determination of this substance, which is found in water, food, as well as in the blood and urinary systems in the human body, is possible with various separation and determination methods. High-performance liquid chromatography (HPLC), gas chromatography (GC), high-performance liquid chromatography with mass spectrometry (HPLC-MS), gas chromatography with mass spectrometry (GC-MS), liquid chromatography coupled with mass spectrometry (LC-MS), capillary electrophoresis and electrochemical techniques can be used as the determination methods for Bisphenol A. For these kinds of determinations, the use of solid phase extraction and molecularly imprinted polymer materials is highly effective in selective separations.

**Keywords:** Bisphenol A, Food analysis, Human health.

## O 44. CHEMICAL CLASSIFICATION OF DISINFECTANTS AND APPLICATIONS IN OUR LIVESLASSIFICATION LOCAL AREA BASED CLIMATIC DATA USED

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**ABSTRACT:** Disinfectants are not the cleaning reagents such as soap or detergents. They are hygienic materials prepared with the composition of various chemicals. In general, it can be possible to classify in many different formats of them, but they are studied in two main groups, such as organic and inorganic disinfectants. Chemistry classification of them is phenolic, chloride, iodide, aldehyde, alcohol, quaternary ammonium derivatives, hydrogen peroxide, and ethylene oxide. In high-level disinfection applications, aldehyde, hydrogen peroxide, and chloride type structures are used. In contrast, alcohol, phenol, ammonium salts, and iodine solutions are enough for lower disinfectant applications. Soap, iodide and alcohol solutions are the best antiseptic reagents for hand and skin. Soap is formed fatty acid ester of the sodium or potassium hydroxide and served the purpose in the removal of dirt and organic materials from the body. Iodine solution is the good primer tissue and skin disinfectant. The alcohol solution has a good inhibitory effect on many microorganisms, micro bacteria, fungi and various viruses. It is not hazardous to use as both antiseptic and surface disinfectant compared to many other chemicals.

**Keywords:** *Organic disinfectants, hygienic materials, chemical classification of disinfectants.*

## O 45. CORONAVIRUS IMPACT ON THE TOURIST SECTOR IN ALBANIA

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**ABSTRACT:** Tourism is one of the most important sectors of the economy. According to a study conducted by the World Travel & Tourism Council (2019) in 185 countries around the world, tourism represented 10.4% of global GDP; 10% of employment, 6.5% of global exports and contributed 3.9% of global growth in 2018. Tourism is also a priority for the Albanian economy, overall contribution of tourism to the country's economy for 2019 is estimated at around 14.3% of GDP. Employees in this sector for 2019 reached about 100 thousand, with an increase of 26% in the third quarter compared to the second quarter. According to some INSTAT projections (2018), in 2025 employees in this sector will reach 220 thousand or about 20.4% of total employment, with an average increase of 2% per year. However, with the spread of Covid19 in the country, the tourism industry will have a resizing, the negative impact on this sector will be high. UNWTO estimates that tourism could decrease by 20-30% by 2020, which in monetary terms is a loss of \$ 300 billion to \$ 450 billion. This decline in this sector is higher than in 2003 caused by the SARS virus or in 2009 by the global economic and financial crisis. Our goal in this document, based on the above facts, is to study the impact that Covid19 has on Albanian tourism sector. In order to carry out the study in question, we will analyze the tourism sector in Albania and the complementary activities related to it. As a methodology for conducting the study will use descriptive statistics and statistical projections. The results expected from this study suggest that also in Albania the 2 main sectors this pandemic will damage the most are: tourism and transport. This decline will be only in the short term as a positive upward trend is expected by the third quarter and on. This study will be organized as follows: a brief introduction; a paragraph on the review of literature and various opinions on tourism, a synthetic methodology, a statistical analysis, closing and some final conclusions.

**Keywords:** *Tourism, Economics Growth, COVID-19, Albania*

### 1. INTRODUCTION

We are in a sanitary emergency, where the objective of many countries is to protect the system so that the level of infection does not get out of control as it turned out in Northern Italy, the UK or Spain.

Apparently, in the early days, it seemed that this sanitary crisis would be exogenous to economic functioning. The strategy implemented to protect the economy, that of lockdown, led to a significant slowdown in economic activities. This strategy, instead of producing antibodies, caused the current system to spread the instability virus with devastating effects on the countries' economies where Albania is expected to be among the most affected ones, with the largest economic decline (-10%) since the beginning of the economic transition in the 1990s.

The most affected sector by this crisis in Albania, as in any other country in the world, will be the tourism sector, which has a significant direct impact on the domestic economy and the behavior of foreign currency. Tourism is also considered a re-balancing factor thanks to its growth and the indirect impact it has on many sectors of production and to the multiplier effect it generates in income and employment (Busetta and Ruozzi, 2006).

While worldwide tourism for 2020 was expected to increase significantly, wherein Albania it was expected that the comprehensive contribution of tourism to the country's economy would reach over 15% of GDP in 2020, COVID-19 severely damaged this sector.

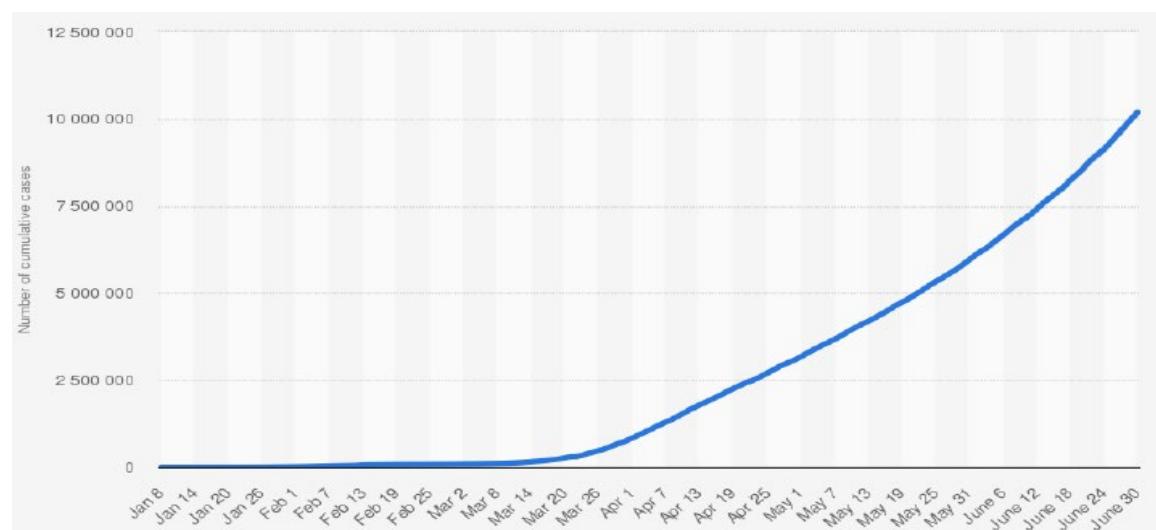
Worldwide, according to some preliminary estimates, global airlines may lose more than 110 billion \$ in sales (Riley, 2020) due to the suspension of human movements. Large losses will also have accommodation or transport structures (Strielkowski, 2020).

Based on the above facts, our objective in this paper is to study the impact that COVID-19 has on the Albanian tourism sector. To carry out the study in question, we will analyze the tourism sector in Albania and the complementary activities related to it. As a methodology for conducting the study, we will use descriptive statistics and statistical projections.

The expected results from this study suggest that even in Albania the two main sectors that this pandemic will harm mostly are tourism and transport. This decline will be only in the short term as by the end of the third quarter it will be a completely different reality. Tourism like any other sector of the economy will start to have positive growth. The organization of the study will be as follows: after this brief introduction, there will be a paragraph on the review of the literature and various opinions on tourism, followed by a synthetic methodology to continue with statistical analysis, closing with some conclusions.

## 2. THE IMPACT OF CORONAVIRUS ON THE ECONOMY

In December 2019, when the Albanian Ministry of Finance and Economy presented the draft budget, Albania's economic growth for 2020 was expected to be 4.1%, while public debt would reach 62.2% of GDP<sup>1</sup>. With the spread of the COVID-19 pandemic in Italy, it was noticed that economic growth could change, as lockdown in Italy would affect disrupt global value chains, and would be created delays in the purchase of machinery and raw materials from China. However, although the number of those affected in the world was increasing day by day, as can be seen from graphs 1 and 2, Albania seemed a safe place with sporadic cases of infections.



**Figure 1.** Number of cumulative cases of coronavirus (COVID-19) worldwide from Januar 8 to June 30, 2020 by day. Source: Statista, 2020

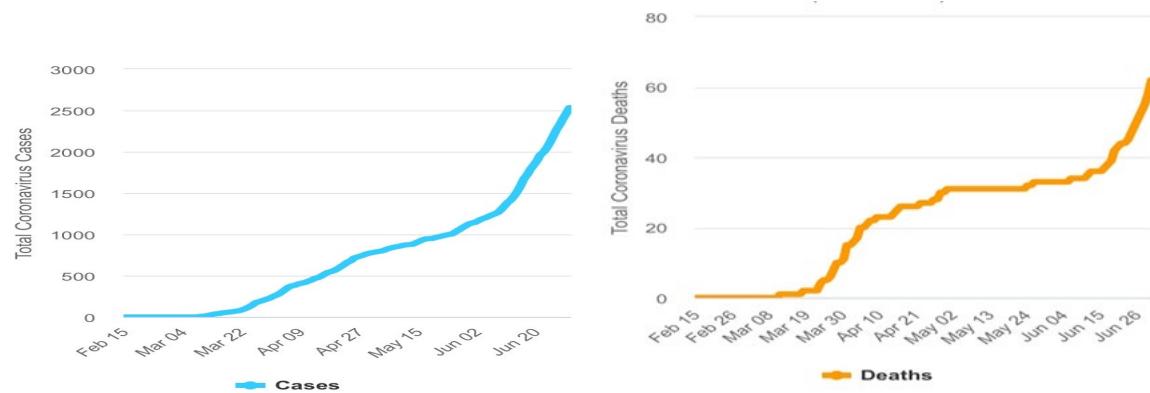
While the International Labor Organization issued the first forecasts for the closure of jobs globally, which could be higher than those caused by the financial crisis of 2007-2009<sup>2</sup>, in Albania again there was no talk of recession but lower economic growth. While over 60,000 employees left the system and will probably reach 200,000 by September, according to ILO, 50% of the economy was shut down, generating a monthly cost of 650 million \$, and the first predictions were that the economy would fall by at least 1.5 billion \$ if no measures were taken to curb this economic crisis<sup>3</sup>. According to the IMF, the global economic decline is expected to fall from 3.5%, while that of Albania to 9.5%<sup>4</sup>. Albania's public debt is expected to reach 74% from 64% in 2019.

<sup>1</sup><http://financa.gov.al/ministrja-denaj-projektbuxheti-2020-mbeshtet-reformat-per-rritje-ekonomike-te-qendrueshme-dhe-sektoret-prioritare/>

<sup>2</sup>ILO Monitor: COVID-19 and the world of work. Second edition Updated estimates and analysis, 07/04/2020; ILO Monitor: COVID-19 and the world of work. Fourth edition Updated estimates and analysis, 27/05/2020

<sup>3</sup>Muco, K., The economic costs of coronavirus and some measures that can be taken, 16/03/2020 <http://www.Panorama.com.al/848667-2/>; Muço, K., Coronavirus kneels economy, thousands of jobs will be closed in June, 14/04/2020, <http://gazetashqiptare.al/2020/04/14/koronavirusi-gjunjezon-ekonomine-eksperti-klodian-muco-skenari-mundshem-mijera-te-papune-ne-qershor/>

<sup>4</sup>IMF, World Economic Outlook Update, June 2020: A Crisis Like No Other, An Uncertain Recovery June 24, 2020



**Figure 2.** Total cases and total deaths in Albania Source: Statista, 2020

In addition to the direct costs, this crisis caused by the COVID-19 pandemic will also have indirect costs such as: Mental Disorders; Pessimism; Panic and Depression, consumption reduction for some products and future behavior. To curb the costs of economic downturn and the economy as a whole, according to the IMF, various countries had to finance the economy by at least 9.5%<sup>5</sup>, and Albania, like many Balkan countries, spent much less. This is probably one of the reasons why the negative effects on the economy will be so high. Unemployment may rise again and labour market conditions may further deteriorate given that a notable share of the workforce live abroad (around 30% of the population)<sup>6</sup>. According to the latest World Bank report, the country's poverty rate could increase by 40% if the baseline scenario is taken into account. In the worst-case scenario, however, this rate could go up to 44%<sup>7</sup>.

**Table 1.** Budget support measures adopted by Western Balkan Countries

Country	Total	Percent of GDP
Albania	0.4	2.4
B & H	0.4	2.3
Kosovo	0.2	2.8
Montenegro	0.05	1
North Macedonia	0.2	2
Serbia	3.2	6.7

Source: Ministry of Finance, World Bank staff calculations, (Note: the estimates include budget support in 2020 but not guarantees, announced until April 22).

### 3. THE IMPACT OF COVID-19 ON TOURISM

The tourism industry has seen steady growth in recent years. In 2019, the number of tourists increased to 1.5 billion, an increase of 0.5 billion in only the last 8 years (UNWTO, 2020). Expectations were that this number would continue to rise throughout 2020, but after the spread of the COVID-19, the tourism industry is going through a severe crisis that is provoking the decline of the stock market in all sectors. The tourism industry is among the most affected (Ashikul et al., 2020). Hotels, airlines, or cruise ships have already stopped in most parts of the world.

Human history has been filled with infectious diseases that have caused millions of deaths, ranging from the Black Plague to Sleeping Disease or the Spanish Flu (Strielkowski, 2020). Only by the last

<sup>5</sup>Muço, K., Coronavirus kneels the economy, thousands of jobs will be closed in June, 14/04/2020, <http://gazetashqiptare.al/2020/04/14/koronavirusi-gjunjezon-ekonomine-eksperti-kloidian-muco-skenari-mundshem-mijera-te-papune-ne-qershori/>

<sup>6</sup>OECD, the Covid crisis in Albania, 29 june 2020, <https://www.oecd.org/south-east-europe/COVID-19-Crisis-in-Albania.pdf>, p-6.

<sup>7</sup>World bank, projected poverty impacts of Covid-19, 7 june, 2020.

one, in four months died about 21 million people, with the same number of victims caused by the first world war in four years (Oxford et al., 2002).

Even a pandemic of a coronavirus is not the first time this has happened. The first case was that of acute respiratory syndrome SARS when it first broke out in the province of Guandong, China in November 2002 and began to spread rapidly across South East Asia, infecting 8,000 people and causing 774 deaths in 26 different countries around the world (Wilder-Smith, 2006). Under such conditions, the World Health Organization declared Guangzhou and Honk Kong as high-risk tourist destinations (Jamal and Budke, 2020). This led to a slowdown in the number of tourists from other areas (Zeng et al., 2005). But as can be seen from the table below, the decrease in the number of tourists this year was relatively low by only 3 million or -0.4% compared to the previous year.

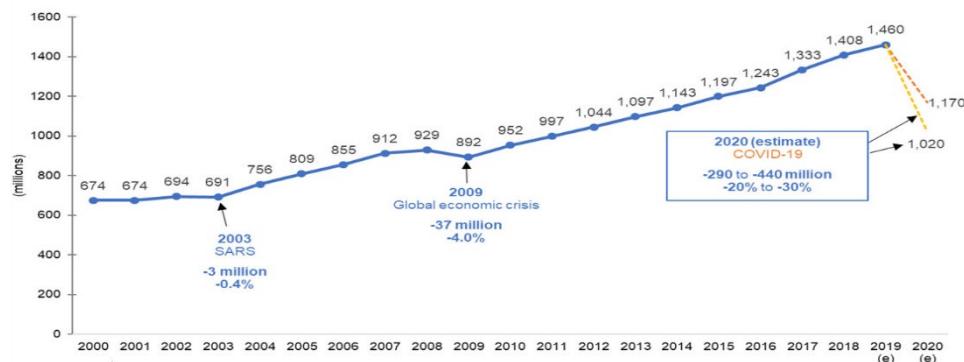


Figure 3. Evolution of the number of tourists over the years. Source: UNWTO, 2020 (note: (e) estimate

Unlike SARS, the COVID-19 virus is much more aggressive and has spread rapidly around the world. The World Health Organization stated on March 19 that it is a global pandemic. Currently, there are 10,819,762 confirmed infections, 519,272 deaths in 213 different countries (data as of 02/07/2020).

The solutions adopted by different countries to deal with the situation are heterogeneous (Pinguillem and Shi, 2020), however, two policy lines can be identified, that of strengthening sanitary structures and that of lockdown to isolate the virus (Hamzelou, 2020; Piguillem and Liyan, 2020). The latter, in addition to the debate over the positive or negative effects on the preservation of human life (Sardar et al., 2020), has a very serious impact on the economy and tourism. As for the latter, according to some estimations, global companies alone will lose about 113 billion \$ from sales, or about 15 times more than in the case of SARS (Riley, 2020). Tourism will be one of the most affected sectors, UNWTO predicts that the decline of the tourism sector globally will be around 20-30% by 2020.

The influx of safe tourists for 2020 will consist mainly of people who have been affected by the virus and who have passed it or acquired immunity (Bacon, 2020) even though there are some people whose virus has returned (they are sick again) see e.g. (Leussink & Swift, 2020). Moreover, even if the phenomenon of reinfection was not present, the accommodation structures or flight companies would still find it difficult to identify the recovered (immunized) from those who may have been affected but have no signs. Of course, technology can help in this aspect<sup>8</sup>. However, for poor countries like Albania, technological solutions can be costly.

### 3.1. The impact of COVID-19 on tourism in Albania

The tourism industry in Albania is one of the main factors that contribute to the country's economy. According to data from the WTTC, in 2019 in Albania should host around 5.7 million foreign tourists. This year only 3.99 million foreign tourists are expected to be hosted (estimate by representative tourism association Albania). Employees in this sector for 2019 reached about 100 thousand, with an increase of 26% in the third quarter compared to the second quarter. According to some INSTAT projections (2018), in 2025 employees in this sector will reach 220 thousand or about 20.4% of total employment, with an average increase of 2% per year. As regards the contribution of the tourism sector and that of

<sup>8</sup>In Hong Kong they have started using quarantine localization bracelets, in China color applications are being used to identify the status of the person paying in Alipay and Wechat, in India seals are used with quarantine expiration date, etc. See: Strielkowski, W. COVID-19 recovery strategy for tourism industry, p.2.

travel to Albania's GDP, instead, it is expected that for the 2019 rise to 27.3%, up 5.2% compared to last year. This year the drop is expected to be 35% lower than 2019 (estimate by representative tourism association Albania).

While the direct contribution of the tourism sector to the country's GDP in 2018 was 4.6%. Also in this year, the tourism sector has contributed to around 286,000 new jobs. While in 2020 will probably be only 90,000. In 2018, the total contribution of the tourism sector to the occupation of the country - considering also the jobs indirectly supported by the industries - amounted to 25.2% of total employment. But with the spread of coronavirus in the country, the tourism industry has had a strong impact, people around the world have been asked to stay at home to protect themselves from coronavirus and a large proportion of foreign tourists have cancelled bookings while locals do not visit different tourist sites within the country during the weekends<sup>9</sup>.

Regarding the tourist typology of the country, Albanian tourism is mainly based on summer tourism with about 60 days of tourism that extends to 80% of the coastline. Except this Albania has also the cultural tourism of groups starting from April to October. Based on these facts and according to different estimates we can say that summer tourism will experience a drop of 35%. Whereas cultural tourism is having a 20% suspension of bookings according to the representatives of the Touristic Operator Association. According to experts, Coronavirus will completely paralyze the tourism sector by the end of June. At the moment, all bookings have been cancelled until the end of June and part of the individual bookings until the end of August.

According to INSTAT (2019), about 17% of the total number of tourists visit Albania during the period from March to June. Taking in consideration that this period Albania has been under lockdown because of coronavirus, and contribution of tourism for 2020 would be about 5.2% of GDP seems that tourism will lose in this period roughly 143 million euros. This prediction is according to the optimistic version, while according to the pessimistic version, the booking cancellations will continue for the following months and the decrease will be about 30% or about 260 million euros. The indirect fall for the economy as a whole is estimated at up to 1.5 billion euros (Muço, 2022). It is understood that, as Galbraith says, the only function of economic forecasting is to give more credibility to astrology (URL). In this context, we can say that nothing is certain, that the performance of the tourism industry will depend on the performance of the COVID-19 virus, on government support policies and on the decision of local consumers to spend some savings on summer vacations regardless of the situation, and above all that these consumers/tourists spend their holidays in Albania and not abroad, so we need economic patriotism.

#### **4. CONCLUSIONS**

This paper has analysed the economic situation of Albania after the spread of the COVID-19 pandemic. From this analysis, it emerged that the most affected sector of the economy will be that of the tourism industry. In Albania, accommodation facilities, restaurants, and some services closely related to summer tourism will be further impacted.

Specifically, closing the borders will significantly reduce the arrival of foreigners from abroad, which last year was about 6 million tourists. On the other hand, patriotic tourism will shrink significantly. This is because, over 60 thousand people have lost their jobs and over 100 thousand others have had salary reductions, so fewer Albanians will go on vacation this year. Keeping social and physical distances, not attending indoor facilities will certainly lead to an increase in the price of many services in the tourism sector.

Many potential investors who had planned to invest in this sector are re-evaluating their projects as such crises can severely damage the economic situation of companies investing in tourism. Therefore, in the future, it is expected that there will be less investment in this sector.

According to some estimates, it will take at least 1 year for many hotels to recover the losses caused by this pandemic (many entrepreneurs have rented structures). While for the air transport sector it will take at least 3 years to reach the same level of flow of people that they had before the pandemic started.

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<sup>9</sup>See the interview of president of the tourism hotel association: <https://www.faxweb.al/industria-e-turizmit-me-goditura-nge-pandemja-covid-19-topuzi-situata-eshte-e-erret-garancia-sovrane-ne-sektorin-tone-e-pamundur/>.

Concluding, we can say that this pandemic, in addition to direct and indirect costs, will lead to changes in people's behaviour in the future and will make it more difficult for the Albanian tourism sector to function, which is considered a priority for the country's economic development.

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## P 1. MEASUREMENT OF PAVEMENT ROUGHNESS IN ALBANIA ROAD NETWORK USING DIFFERENT EQUIPMENT

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**ABSTRACT:** The Albanian Road Authority (ARA), is an independent, public institution in Albania, whose purpose is to construct and maintain roads network. It belongs to the Ministry of Infrastructure and Energy and is the legal owner of the roads and has the authority to execute the construction of infrastructures on demand from the ministry. The national road network in Albania is 3945 km length. Based on the data provided by ARA, a segment of 1332 km is under the maintenance by WB project, and rest under the responsibility of ARA. All roughness data collected based on IRI (The International Roughness Index) but different equipment and application are used to evaluate pavement quality for the national roads network. This poster aims to assess the different equipment used on pavement data collection conditions and to make a comparison between them. All equipment has been used in recent years in some of the national road maintenance projects funded by the World Bank and ARA. Based on pavement roughness data collection verification through field survey and desk review, for all used equipment is confirmed that one of them fulfils all conditions without the need of buying other equipment.

**Keywords:** Data collection equipment, comparison, roughness.

### 1. INTRODUCTION

A large number of documents have been used to conduct this study. These documents belong to a long time from the years 2000 to 2020. The reviewed documents include various reports, contracts, and materials produced by both the client and the contractors. These contracts are part of various Albanian road network maintenance projects during these 20 years. The projects are funded by various donors and the Albanian government and are supervised by prestigious companies and studios in the field of road maintenance. The fact that different devices have been used in these projects for the same purpose is also the purpose of this study. This paper examines all the equipment used over the years for the maintenance of the Albanian road network, bringing a clear panorama of the possibility for the use and selection of the best of them.

### 2. MATERIAL AND METHOD

This paper focuses only on the comparison of different equipment that bases on a survey of pavement condition by the use of the International Roughness Index (IRI) (Sayers, M.W.; Karamihas, S.M. , 1998) (Christopher R. Bennett, et al., 2007). This equipment (Dynatest RSP 5051 MkIII, MiniROMDAS, PaveProf-V2, RoadLab\_Pro) is used in the pavement data collection in several important projects in Albania for about 20 years. The results are compared to provide some recommendations and evaluations on the use and quality of equipment used in the quality of the pavement data collection.

#### Equipment descriptions

The equipment and applications used in this study are Dynatest RSP 5051 MkIII, MiniROMDAS, PaveProf-V2, RoadLab\_Pro.

**The Dynatest RSP 5051 Mk-III** Road Surface Profilometer measures several indices and characteristics including the longitudinal profile, International Roughness Index (IRI), transverse profile, rutting, macrotexture, and geometrics (cross fall, gradient, and radius of curvature). The RSP has a unique "Stop & Go" functionality enabling the equipment to operate efficiently in urban areas, at traffic lights, stop signs, junctions and roundabouts, making it an ideal tool for data collection on both urban and rural networks. Dynatest RSP 5051 Mk III consists of a Windows-based control program installed on a laptop PC A Data Processing Unit (consisting of a single board computer and three lasers,

two accelerometers, and one camera (Anonymous, 2020 e). It used to collect road data on the entire Albanian road network by ARA. The equipment in 2009 updated by Dynatest experts.

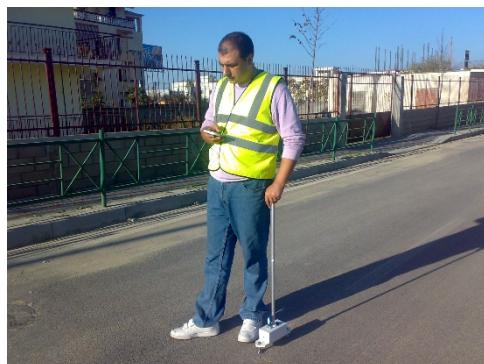
Currently, the equipment is owned by ARSH. It is not used for the simple reason that the vehicle in which it is installed is intended only for this device and has a defect that has not yet been repaired. This has made it possible for ARA not to use it. At the same time, the staff trained for their use is no longer part of ARA.



**Figure 6.** Dynatest RSP 5051 Mk III

MiniROMDAS has been developed as a cost-effective and modular system designed to collect road and pavement data using any vehicle (Anonymous, 2014 a).

The MiniROMDAS equipment system is divided into three parts, as follows: 1. Z 250 Reference profiler, 2. Odometer 3. Roughness meter. The system needs to be calibrated before performing the data collection. To calibrate the roughness meter in ROMDAS systems normally are used two types of data. Those are bump integrator reading and roughness value, using the Z-250 reference profiler. Reference profile surveys are generally done for calibrating or validating a roughness measurement system (e.g. the ROMDAS bump integrator) (Anonymous, 2020 f) Z-250 reference profiler recommended to calibrated at the beginning in office, while odometer and roughness meter calibration must be carried out in the certified service of the company that purchased the device. Z250 is a Class 1 device (Christopher R. Bennett, et al., 2007) that collects high-accuracy profiles to calculate road roughness (IRI). MiniROMDAS was used to Monitoring and Supervision of the Four Output and Performance-Based Road Maintenance Contracts in Albania, which was a Pilot Project Funded by the Government of Albania and the World Bank for about 385 km data collection in Tirana, Kukes and Tropoja Districts in years 2009. Currently, the equipment is owned by ARSH but the staff trained for their use is not part of ARA



**Figure 7.** Z 250 Reference profiler



**Figure 8.** Assemble the MiniROMDAS

**PaveProf V2** is a modular system that uses laser sensors to measure pavement profiles for applications such as highways and runways. It measures surface roughness, at highway speeds, and to international standards. The inherent flexibility, accuracy, and reliability of PaveProf V2, helps to deliver improved highway and runway surfaces and reduces the risk of accidents which can result from poor surface conditions (Anonymous, 2019 d).PaveProf V2 is a single laser and accelerometer system

used to collect road data on the Albanian road network in the frame of the World Bank Project Results Based Road Maintenance and Safety Project (RRMSP) on data collection in along the most of national road network. The objectives of the Results-Based Road Maintenance and Safety Project for Albania are to: (a) maintain the condition and improve the safety of the Borrower's primary road and primary-secondary road networks, and (b) strengthen sustainable and efficient road asset management and safety practices, for the benefit of road users (World Bank, 2015).

The PaveProf-V2 used to collect road data on the Albanian road network has been installed and calibrated directly by the manufacturer. Production company representatives have trained staff on data collection and processing. With the completion of the project in December 2021, the equipment becomes the property of ARA, which should take measures to train its staff.

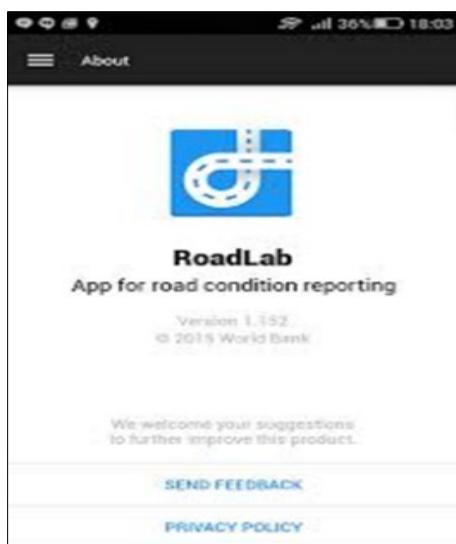


**Figure 9.** PaveProf-V2

**RoadLab\_Pro**, which is designed as a data collection tool for an engineer by the World Bank in collaboration with Beldor Center, SoftTeco, and Progress Analytics LLC. (<http://progressana.com>). The RoadLab\_Pro app estimates the road roughness based on kinematic and GPS sensors in Smartphones. To use the app, the mobile device has to be placed on a stable surface, preferably mounted vertically and tightly to the vehicle windshield (Anonymous, 2016 b). With accelerometers on smartphones, this app evaluates road conditions, map road networks, detects major road bumps, and reports road safety hazards. Users can even upload a picture of potholes, black spots, or road accidents, etc. with a simple tag.

No training needed is required for running this app. All data collected can be emailed to the user address or uploaded to the Dropbox account when Wi-Fi is available.

“Technical Assistance for monitoring, communication and visibility of Transport Sector with Focus on Roads” (Anonymous, 2016 c) and “Regional and Local Roads Connectivity” (World Bank, 2018) are two Projects that used RoadLab\_Pro on data collection of about 1500 km entire Albania national road network for both projects on years 2018-2019.



**Figure 10.** RoadLab\_Pro

### 3. RESEARCH FINDINGS

There are many technologies for collecting data on the road. These range from low cost to high cost, and from very accurate measurements to approximations. The challenge is to choose the right technology given the needs of the data and the environment in which it will be used. The experience gained during this study makes clear some of the parameters that should be considered in the selection of equipment for data collection. In this paper, it is observed that different types of equipment collect data in different ways and with different qualities. The experience gained during this study makes clear some of the parameters that should be considered in the selection of equipment for data collection. In this paper, it is observed that different types of equipment collect data in different ways and with different qualities. Base on my experience and characteristics of each equipment, Table 1, represent details and scale levels for all of the equipment.

**Table 3.** Current state and characteristics of equipment

Issues	RSP 5051 Mk III	Mini ROMDAS	PaveProf-V2	RoadLab_Pro
Digital DMI	Yes	Yes	Yes	Yes
GPS	Yes	No	Yes	Yes
Video	Yes	No	No	No
WB Class	Class I	Class III	Class I	NA
IRI (data collected by)	3 lasers	Bump Integrator	1 laser	Bump Integrator
Data/ Speed	"Stop & Go"	10-100 km	7-115 km/h	> 15 km/h
Section length	10-100 m	only 100 m	10-100 m	only 100 m
Export data	5	5	5	5
Data format	xls; xlsb; erd; pro; dot; jpg	mdb	csv or erd	kmz, xlsx
Assembly/Installation	2	3	2	5
Operation& Maintenance	5	4	5	5
Calibration	2	3	2	No need
Data /Processing	5	4	5	5
Training needed	Yes	Yes	Yes	No
Availability today	use by ARA	NA	Use by contactor	Free

Scale Level
1.Very Difficult
2.Difficult
3.Moderate
4.Easy
5.Very Easy

### 4. CONCLUSIONS AND DISCUSSION

Regarding Assembly and Installation, Calibration, Operating Staff, Training, Data Collection Speed, Survey Reference Equipment, Maintenance, Cost of Equipment, and Comparability among them, it is up to managers to select which of the equipment response to the demands and needs of their road management systems. The decision to select the right equipment for road data collection is not only about the economic opportunity or quality of data collection but also with the vision of the manager

regarding the Road Assets Management System. In terms of what needs to be collected, roughness (IRI) is one of the key attributes used for road management and its quality is very important. If the data collected is complemented by Video-logging, managers can make sensible investment decisions. Based on pavement roughness data collection, verification through field survey and desk review, only for RSP 5051 Mark III is confirmed satisfactory level compliance with others used equipment. ARA needs to train staff and certifies them. The RSP 5051 Mark III equipment has been mounted in a vehicle that has been imported specifically for this purpose. ARA must maintain and provide parts for this vehicle.

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## P 2. ODD WESTERN BARK BEETLE (*XYLEBORUS DISPAR* F.) - A NEW PEST IN UKRAINE

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**ABSTRACT:** The beetle damages all deciduous trees, gnawing at the woods, develops mainly in soft breeds and fruit trees (apple, pear, plum, cherry, etc.), rarely - in solid species (including walnut). In Ukraine, it is widespread in the Crimea, the Steppe, and the Forest-Steppe, while rarely occurring in Polissya. In addition to the above-mentioned fruit crops, there is a problem with whole woodlands being destroyed by beetles and bark beetles. In particular, the bark damages a number of forest crops such as ash, beech, oak, hornbeam, birch, alder, etc. Beetle bark causes a significant influence on growth and development, as well as the resilience of trees to the effects of other negative factors. This, in turn, leads to a decrease in quantitative and qualitative indicators of crop yields. The problem lies in the complexity of controlling and protecting plantations against bark beetles. These beetles are referred to as xylobionts, also called secondary stem pests, due to the belief, that they only inhabit dying trees. The study of disease caused by bark is very important. There is too little data on natural diseases. Well known the negative impact of *Bacillus subtilis* and the species of *Pseudomonas chlororaphis*. Important steps in preventing the emergence and fight against bark beetle odd western are: preventing the process of weakening the trees; avoiding flooding of plantations (drainage on flooded areas) regular monitoring is important in orchard gardens.

**Keywords:** Bark beetle, Fruit trees, Protection, Monitoring.

### P 3. ASSESSMENT OF THE SNOW PRODUCTS USING IN-SITU DATA

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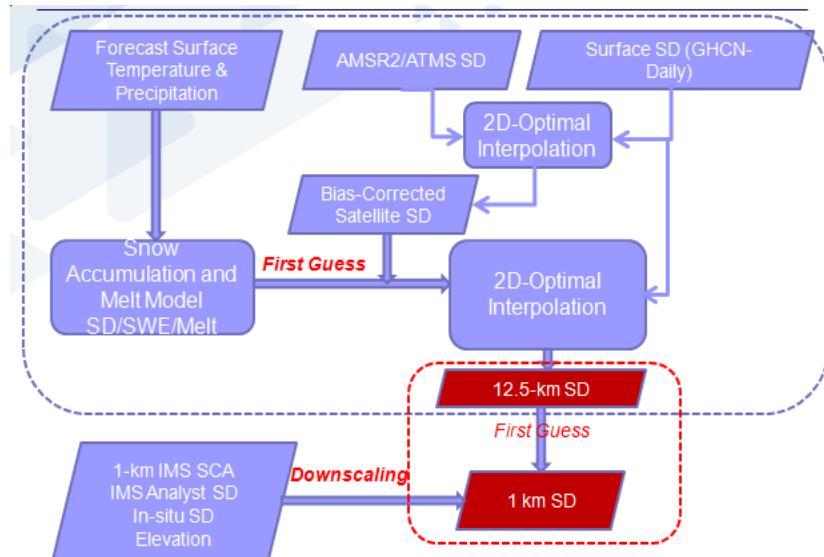
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**ABSTRACT** Ecology is the study of the complex ways that living things interact with their environment. Deciduous plants handle the lack of water by shedding their leaves, which tend to evaporate water into the air. During cold winter months, most deciduous plants drop their leaves and go dormant. Evergreen plants keep their foliage, but their leaves and needles have a thick, waxy coatings to reduce water loss. In areas that receive frequent snow and may have cold weather year-round, such as in the Arctic, plants have adapted in other ways. Trees may grow close to the ground or grow in shapes that help them shed heavy snow more easily. Plants may hold onto dead leaves for insulation or use deep snow like a blanket to protect against the cold. Some evergreens also have a special valve in their cells. This valve automatically seals off individual frozen cells to prevent a chain reaction of freezing. Satellites are well suited to the measurement of snow cover because the high albedo of snow presents a good contrast with most other natural surfaces except clouds. NOAA has a variety of snow products including those based on satellite passive microwave sensors such as JPSS AMSR2 and ATMS. Snow information: Snow Cover Area, Snow Depth and Snow Water Equivalent (SWE) - is an important input to numerical weather and climate prediction models. The objective of this project is to evaluate the performance of satellite-based snow products over regions that have sparse in-situ data. Of special interest and mountain regions and remote areas including those over US and elsewhere. To accomplish the goal of the project, the following activities will be carried out: Collect regional historical snow data not available via public networks. Do a quantitative evaluation of the snow products use in-situ data.

**Keywords:** Ecology, assessment, snow products, snow information

#### 1. INTRODUCTION

Current NOAA's National Centers for Environmental Prediction (NCEP) operational weather prediction models rely on snow depth observational data for their land surface model initializations. A new snow depth analysis system based on the optimal interpolation method of station and satellite-based snow depth is being developed with improved spatial resolution and utilization of multiple sources of observational data. Figure 1 presents a high-level diagram of the new blended analysis scheme and its components that will generate two *global* snow depth products for NCEP models: at 12-and 1-km resolution. Provided below are summary description and results for bias-correction and snow melt and accumulation model, the latter being developed to generate initial snow depth estimates.



**Figure 1.** The new snow depth analysis scheme (by C. Kongoli)

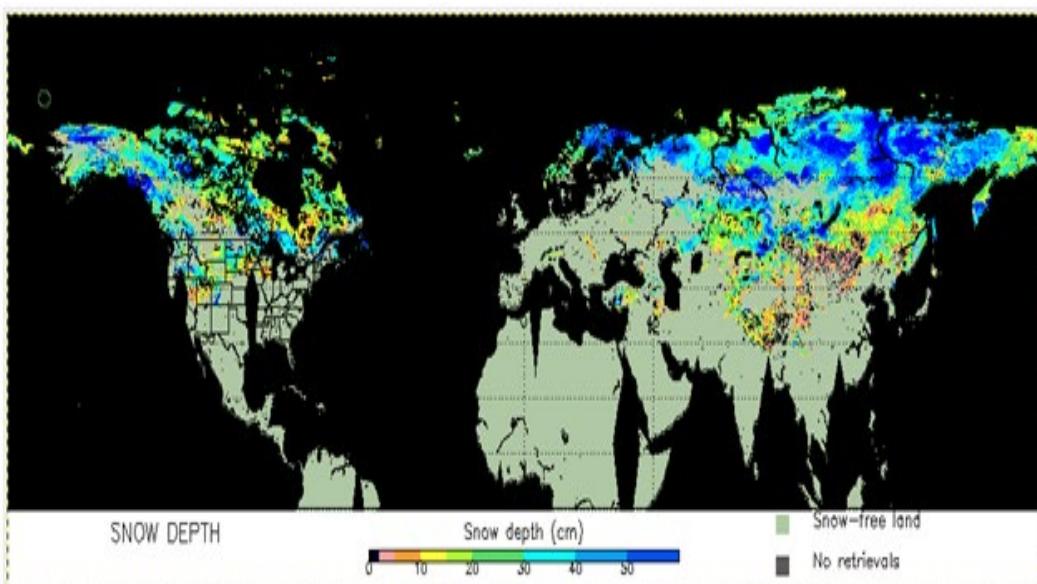
## 2. MATERIAL AND METHODS

### Bias Correction of Satellite-derived Snow Depth

Bias correction should be an essential component of any satellite monitoring algorithm. Thus, it is imperative that new satellite bias correction methods for snow depth be developed and tested to improve utilization of this precious observing system. A brief description of the method is provided below:

The method is applied to AMSR2 snow depth using optimal interpolation following the study by Liu et al., 2015. In this application, the satellite snow depth is the first guess, and a correction factor is computed for each valid AMSR2 snow depth value using surrounding in-situ snow depth (in a box approx. 300 km in size) for days prior to the analysis day. Adjustments are thus computed dynamically from the in-situ data collected in the previous days and applied to satellite snow depth at analysis time.

Station snow depth measurements are extracted from the Global Historical Climatology Network (GHCN). Figure 2 shows an AMSR2 snow depth map over Northern Hemisphere (top) on January 1, 2017 and the bias-corrected AMSR2 snow depth (bottom). Overall the AMSR2 product shows a reasonable large-scale snow depth distribution. The largest corrections and improvements occur over Northern Europe, western Siberia, along the north-west coast of US/ Canada and over Alaska.



**Figure 2.** AMSR-2 Snow Depth before (top) and after (bottom) bias correction applied to in-situ data from GHCN-Daily using optimal interpolation (by C. Congoli).

### 3. RESULTS

Reasonable first guess estimates are especially important in areas with sparse snow depth or erroneous satellite data. The snow model developed also computes snow density, snow water equivalent and liquid water and ice content, which would be useful to have for future expansion, e,g, to global SWE estimations. The model developed here was adopted from existing methods. However, putting together a snow model and testing it in a short time is a major accomplishment. A brief description of the model is provided below:

The snow model is a one-layer model driven by precipitation and temperature inputs at hourly or daily intervals. Routines include snow accumulation, compaction, melt and refreezing. Melt and refreezing rates are computed using a simple degree-day factor approach, as in the operational seNorge model (Solantra, 2012). Compaction is modeled using Anderson (1976) parameterizations. Model prognostic outputs are snow depth, density, SWE, ice and liquid content.

Testing of the model was carried out using daily snow observations at a first-order station located in Dane County Regional Airport, Madison, Wisconsin over a 16-year period (2000-2016). Data were obtained from the Midwestern Climate Center (<http://mrcc.isws.illinois.edu/>). A correction factor of 1.3 was initially applied to solid precipitation inputs to account for gauge under-catch. This value was taken from Kongoli and Bland (2000) study, which included long-term testing of a detailed snow model. It was found that a correction factor of 1.1 improved overall statistics compared to the previously established mean value of 1.3. A melt degree-day factor of  $5 \text{ mm day}^{-1} \text{ }^{\circ}\text{C}^{-1}$  was found to produce reasonable snow depth simulations during melt. The values reported in Solantra (2012) gave unrealistic results: much delayed ablation and snow disappearance. Figure 3 shows daily time series of modelled versus measured snow depth at the Madison, Wisconsin first-order station between January 1, 2000 and December 31, 2016. Snow depth evolution is simulated well. Bias is -2.1 cm and Root Mean Square Error (RMSE) is 7.6 cm.

### 4. CONCLUSIONS

Satellites are well suited to the measurement of snow cover because the high albedo of snow presents a good contrast with most other natural surfaces except clouds.

*Acknowledge. Evaluation of JPSS satellite and blended snow products, project NOAA, 2018-2019, USA;*

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#### P 4. CHEMICAL CHARACTERISATION OF ESENTIAL OIL FOR NATURAL AND CULTIVATED SALVIA OFFICINALIS FROM NORTH ALBANIA

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**ABSTRACT:** This study present chemical data on essential oil samples of natural and cultivated *Salvia Officinalis* plant populations from North Albania. *Salvia Officinalis* is a widespread plant that is native in Mediterranean area and almost in all Albania territory. It is part of *Lamiaceae* family. Areal parts of *Salvia Officinalis* have been used since ancient times in culinary, cosmetics and traditional medicine. Sage has different properties (antiseptic, aromatic, carminative, estrogenic, stimulant, etc) and thought to have positive effects in human brain functions. *Salvia Officinalis* plants from Tropoja (five samples from natural habitat and four samples from cultivated areas) were selected in June 2019. The air-dried plant samples were cut in small pieces (1-2 cm). They were subjected of hydro-distillation for 4 hours using Clevenger type apparatus, recommended to European Pharmacopoeia, to obtain *Salvia Officinalis* essential oil. The chemical composition of the essential oils was obtained using GC/FID technique. VF-1ms capillary column (30 m x 0.33 mm x 0.25 um) were used for separation of its compounds. Main constituents (20 compounds) were found from 92.6% to 98.7% in all studied sage samples from Tropoja (North Albania) whether it was cultivated or natural plants. Their profile was the same between two population and similar to other studies from Mediterranean and Balkan area. It was as follow: alpha-Thujone > Camphor > Cineol > beta-Thujone > Camphene > Alfa-Humulene > beta-Caryophyllene > alpha-Pinene. Alpha-Thujone (the main constituent) was found in higher percentage in cultivated *Salvia Officinalis* plants because of agricultural areas used for their grow and farmer work. Plant harvesting time can influence in differences between constituents in sage samples.

**Keywords:** *Salvia Officinalis*, Essential oil, alfa and beta Thujone, Camphor, Cineole, GC/FID.

#### 1. INTRODUCTION

In this study, natural and cultivated *Salvia Officinalis* plants from Tropoja, North Albania, were chemically characterized by using GC/FID technique. Albania is a reach country with medicinal plants due to appropriate Mediterranean climate. Around 3,200 various medicinal herbs, of which 350 species are exported ensuring that Albania develops its position as an important exporting country (Asllani, 2004). It's the largest exporter of *Salvia officinalis* and many other herbs mostly in Germany, USA, France, etc. The export of medicinal plants is important for Albanian economy. After 90' the medicinal herbs industry is decreased. Before 90' Albania earned about 3-4 times more than recent years. The green export success could help to improve the precarious economic situation, especially in rural areas. Local wild medicinal herbs have been seen as a means of overcoming a short-term emergency rather than as a stable economic sector. Wild plants collection and their farming is a considerable potential for developing the medicinal herbs industry. Collection areas and types of medicinal herbs according to their value should be clearly defined by the authorities and also keep statistics on volume, prices and trading companies (Kathe et al, 2003).

*Salvia officinalis* population is a member of Lamiaceae family. It is native to the Mediterranean region and has naturalized in many places throughout the world. *Salvia officinalis* population is widespread in all Albanian territory. Albania is one of the main exporters of its (plant and essential oil) all over the world (Asllani, 2004; Kathe et al 2003). *S. officinalis* plants have been used since ancient times for snakebites, increasing women's fertility, and more. Also, it was called *Salvia salvatrix* (sage the savior). Sage is recommended as a diuretic, hemostatic, emmenagogue, and tonic. Areal parts of sage have many notable plant-derived chemical compounds, essential oils, minerals, vitamins that are known to have disease preventing, and health promoting properties. The prime biologically active component of common sage appears to be its essential oil. It contains mainly ketones;  $\alpha$ -thujone, and  $\beta$ -

thujone. In addition, sage leaf contains numerous other compounds, including cineol, borneol, tannic acid; bitter substances like cornsole and cornsolic acid; fumaric, chlorogenic, caffeic and nicotinic acids; nicotinamide; flavones; flavone glycosides and estrogenic substances. Altogether, these compounds were known to have counter-irritant, anti-inflammatory, anti-allergic, anti-fungal and anti-septic properties (Kamatou et al 2008).

The main constituent, alfa-Thujone is GABA and Serotonin (5-HT3) receptor antagonist (Akhondzadeh et al 2003). It improves mental concentration, attention-span and quickens the senses; hence sage infusion has long been recognized as "thinker's tea." Fresh sage leaves are a good source of antioxidant vitamin such as vitamin-C. Vitamin C helps in the synthesis of structural proteins like collagen. Its adequate levels in the body help maintain integrity of blood vessels, skin, organs, and bones. It scavenges harmful, pro-inflammatory free radicals from the body.

## 2. MATERIAL AND METHODS

### Sampling of *Salvia officinalis* from North Albania

*Salvia Officinalis* plants were selected in five natural stations and four cultivated areas of Tropoja region in altitude between 1200-1600 m above sea level. Sampling procedure was realized in June 2019. Areal parts of plant samples were air dried in a dark room.

### Isolation of *Salvia officinalis* essential oil

Dried plant material (50 g of *Salvia Officinalis*) was subjected to hydro-distillation for 6 hours, using a modified Clevenger-type apparatus to produce essential oil based on European Pharmacopoeia 3<sup>rd</sup> Edition. 2 ml Toluene was added to the balloon for isolation of *Salvia officinalis* essential oils. The oil was dried by anhydrous sodium-sulphate ( $\text{Na}_2\text{SO}_4$ ) and kept sealed in dark glass vial at +4°C until use.

### Apparatus and chromatography

Gas chromatographic analyses of *Salvia officinalis* essential oil were realized with a Varian 450 GC instrument equipped with a flame ionization detector and PTV injector. The temperature of PTV injector was 280°C. 1 ul of *Salvia officinalis* essential oil diluted in Toluene was injected in splitless mode. FID temperature was held at 280°C. Nitrogen was used as carrier (1 ml/min) and make-up gas (25 ml/min). Hydrogen and air were flame detector gases with 30 ml/min and 300 ml/min, respectively. VF-1ms capillary column (30 m x 0.33 mm x 0.25  $\mu\text{m}$ ) was used to separate compounds of *Salvia officinalis* essential oil. The oven temperature was programmed as follows: 40°C (held for 2 minutes) to 150°C (with 4°C/min), after that to 280 °C with 10°C/min and held for 2 minutes. The identification of the compounds was based on comparison of their Kovats indices (KI), their retention times (RT) and literature (Adams, 1995; David et al., 2010, Bozin et al., 2006). A mixture of n-alkanes from n-octane (C8) to eicosanes (C20) was used for calculation of Kovats indices (KI).

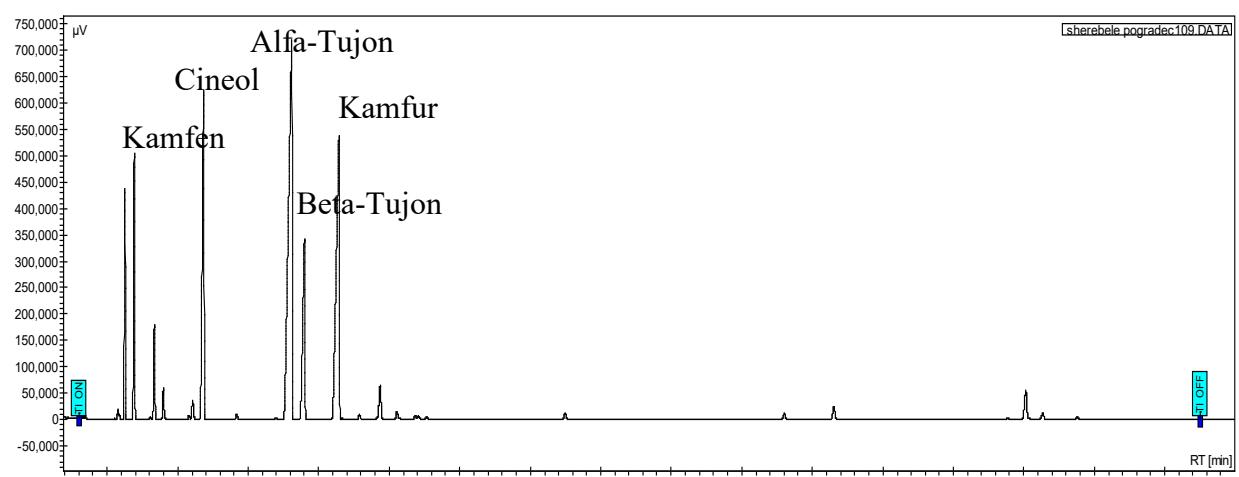


Figure 1. Main compounds of natural *Salvia Officinalis* essential oils from Tropoja

### 3. RESULTS AND DISCUSSION

Natural and cultivated *Salvia officinalis* samples from North Albania were analyzed, by using GC/FID technique. The data present average of 20 main compounds that were identified for all analyzed samples in both types. Note that, in chromatograms of *Salvia Officinalis* essential oil samples were detected more than 120 compounds. The peaks lower than 0.01% was not considered in this study. Percentage of 20 main compounds in all analyzed (natural and cultivated) *Salvia Officinalius* essential oil samples from North Albania was shown in Table 1. Their total in natural and cultivated samples was respectively 97.5% and 98.8%. It was observed the same profile for all analyzed samples (natural and cultivated). Profile of analyzed components for natural and cultivated *Salvia officinalis* samples was: alfa + beta-Thujone > Camphur > Cineole > Humulene > Camphene > beta-Caryophyllene (Figure 2). *Salvia Officinalis* essential oils were found to have higher concentrations for the total of alpha and beta-Thujone which are the prime biologically active component (Figure 3). The cultivated samples were shown the higher concentrations of these compounds (39.9%) because of these plants are grown in agricultural areas while natural samples in mountain areas (36.0%). Alfa-Thujone was the main component for both samples type (30.3% for natural and 35.6% for cultivated sage samples). This could be connected with the geological factors, the latitude, humidity, the harvesting time, etc. Camphor was the second compound with 19.1% for natural and 17.4% for cultivated samples. Cineole was found the third compound with 9.4% for natural and 9.7% and cultivated samples. The main group for both sample types were monoterpenes. Their total were 89.8% for natural and 91.5% for cultivated samples (Figura 4). Sesquiterpenes (beta-Caryophyllene and alpha- Humulene) were found in high percentage in natural samples with 7.7%. Their content in cultivated samples was 7.3%. Figure 5 shown percentages of monoterpene groups in natural and cultivated *Salvia Officinalis* samples. The main group between monoterpenes was oxygenated (Cineole, Linalool, alpha-Thujone, beta-Thujone, Camphor, Borneol, Terpilen-4-ol, alfa-Terpineol, Bornil acetat) that were found from 68.2% (natural) to 71.8% (cultivated). Bicyclic monoterpenes (alpha-Pinene, Camphene and beta-Pinene) was the second group for natural and cultivated sage plants respectively with 12.0% and 12.3%. Monocyclic monoterpenes (alfa-Terpinene, Limonene, gama-Terpinene) were found higher in natural samples (7.1%) than in cultivated one (5.7%). Myrcene (Aliphatic monoterpene) was around 1.3% and para-Cimene (aromatic monoterpene) was found with 0.3% for both sample types. Profile and leveles of main compounds found in natural and cultivated *Salvia Officinalis* samples from North Albania was the same with other reported studies from Mediterrean area (Daferera et al., 2000; Radulesku et al 2004; Kamatou et al, 2008).

**Table 1.** Percent of compounds dedected in analyzed *Salvia officinalis* essential oil samples from North Albania, June 2019

	Rt	Natyral	Cultivated
alfa-Pinene	4.32	4.19 ± 1.03	4.94 ± 1.27
Camphen	4.41	5.56 ± 0.94	5.11 ± 1.73
beta-Pinene	5.22	2.19 ± 0.73	2.33 ± 0.81
Myrcene	5.34	1.19 ± 0.42	1.17 ± 0.32
Limonene	6.41	0.27 ± 0.05	0.21 ± 0.04
alpha-Terpinene	6.47	6.32 ± 1.42	5.31 ± 1.63
Cineole	6.73	9.43 ± 3.21	9.65 ± 2.42
para-Cimene	7.33	0.32 ± 0.10	0.33 ± 0.07
gama-Terpinene	7.98	0.28 ± 0.07	0.15 ± 0.04
Cis-Sabinene hydrat	8.13	0.14 ± 0.04	0.23 ± 0.04
Linalool	8.44	0.17 ± 0.05	0.10 ± 0.03
alpha-Thujone	9.12	30.34 ± 3.25	35.62 ± 4.28
beta-Thujone	9.21	5.67 ± 1.27	4.29 ± 1.43
Camphor	10.52	19.12 ± 3.41	17.44 ± 3.62
Borneole	11.78	2.40 ± 0.93	2.43 ± 0.88
Terpinen-4-ol	12.21	0.47 ± 0.11	0.46 ± 0.06
alpha-Terpineole	14.43	0.25 ± 0.06	0.31 ± 0.05
Bornil acetat	16.95	1.47 ± 0.33	1.39 ± 0.35
beta-Cariophyllene	23.14	3.29 ± 0.64	3.40 ± 0.83

alpha-Humulene	24.65	4.42 ± 1.53	3.91 ± 0.94
Total	97.49		98.80
Total Monoterpene's	89.77		91.49
Monocyclic Monoterpene's	8.11		5.80
Bicyclic Monoterpene's	11.95		12.25
Aliphatic Monoterpene's	1.24		1.27
Oxygenated Monoterpene's	68.17		71.83
Aromatic Monoterpene's	0.30		0.34
Seskuiterpenes	7.72		7.31

Natural plants usually grow to higher altitudes where air temperatures are lower and soils are poorer. This may be the reason for the lower percentages of Thujones in them. Cultivated plants grow in fertile areas, under human care such as planting time, irrigation, ripening time, etc. This may be the reason for the higher percentages of Thujones in these plants. It should be noted that peoples prefer to use natural sage plants more often due to the better taste and effects they have. In many lands where sage is cultivated today, it has been used for crops, fruits and vegetables. So, cultivated plants may affected by previous use of pesticides, other chemicals and agricultural agromechanics.

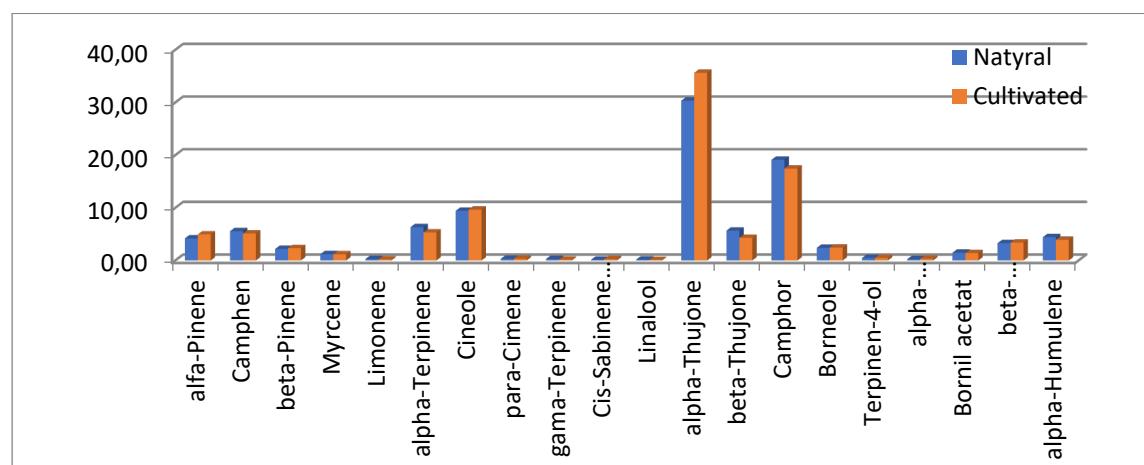


Figure 2. Profile of main constituents in natural and cultivated *Salvia officinalis* samples

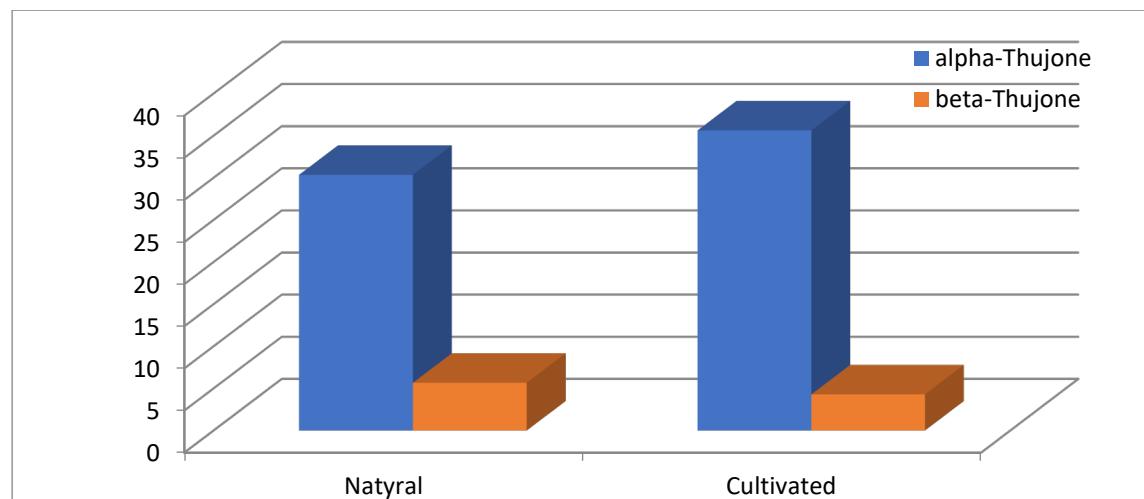
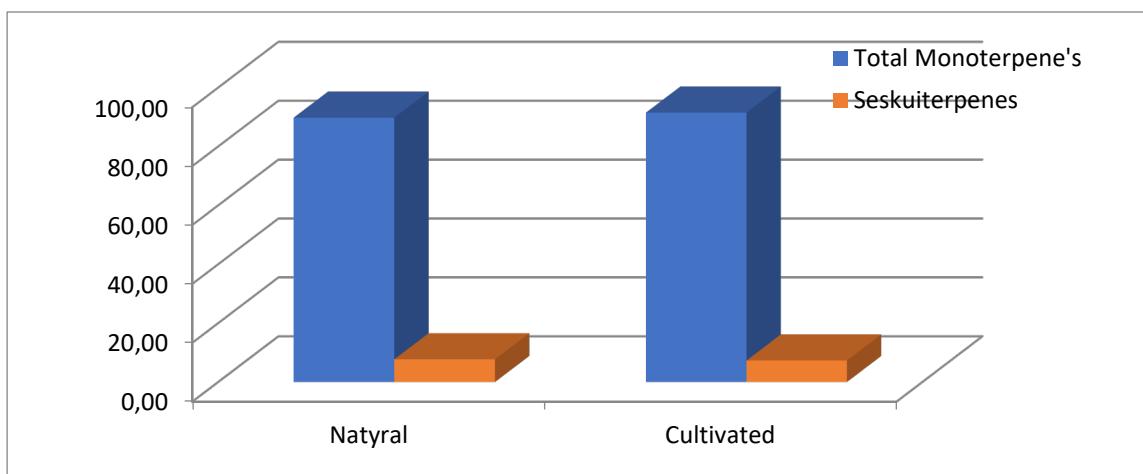
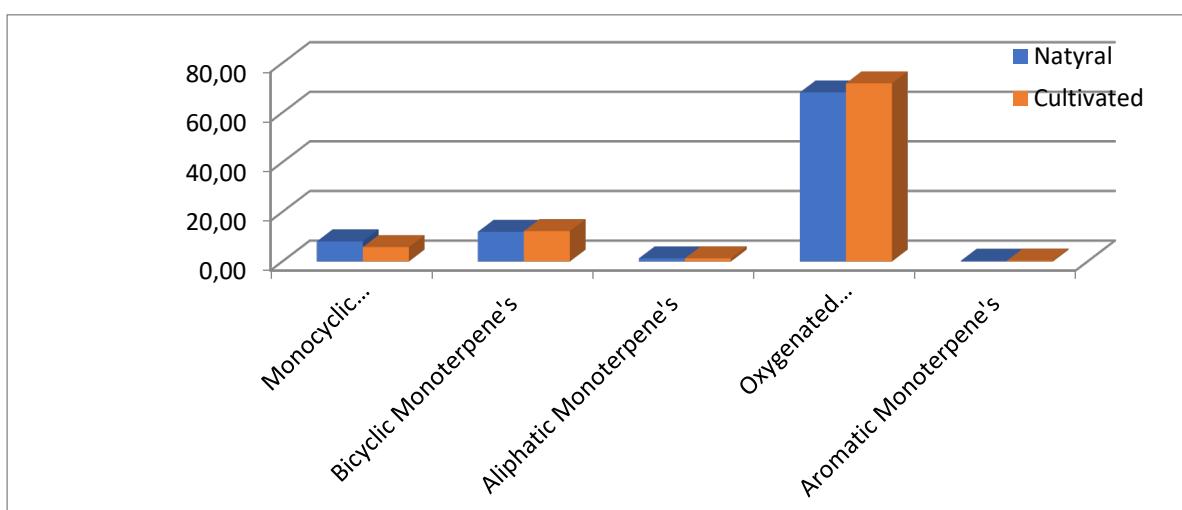


Figure 3. Percentage of Thujone's in natural and cultivated *Salvia officinalis* samples



**Figure 4.** Monoterpene's and sesquiterpenes in natural and cultivated *Salvia officinalis* samples



**Figure 5.** Distribution of monoterpenes in natural and cultivated *Salvia officinalis* samples

#### 4. CONCLUSIONS

Natural and cultivated essential oil of *Salvia officinalis* samples from Tropoja (North Albania) were analyzed using GC/FID technique. Gas chromatography technique is recommended by the literature. Averages of results for both sample types present the total for 20 main compounds that were found for analyzed *Salvia Officinalis* essential oil. It was observed the same profile for all analyzed samples (natural and cultivated).  $\alpha$ -Thujone,  $\beta$ -Thujone, Camphor, Cineol, Borneol, alfa-Terpinene, alfa-Pinene and beta-Pinene. *Salvia Officinalis* essential oils were found to have higher concentrations for the total of alpha and beta-Thujone that are the prime biologically active component. The cultivated samples were shown the higher concentrations of these compounds because of these plants are grown in agricultural areas that are more fertile and under the farmer care. Natural plants usually grow to higher altitudes where air temperatures are lower and soils are poorer. Differences could be connected with the geological factors, the latitude, humidity, the harvesting time, etc. The main group for both sample types were monoterpene's. The main groups between monoterpenes were oxygenated monoterpenes, bicyclic and monocyclic monoterpenes for both natural and cultivated sage plants. Aliphatic and aromatic monoterpenes were found in lower level. Profile and leveles of natural and cultivated *Salvia Officinalis* samples from North Albania was the same with other reported studies from Mediterrean area. The work would be complete if it continues for several years for shown better the differences between natural and cultivated *Salvia Officinalis* plants.

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**P 5. A REVIEW ON THE COMBUSTION SYSTEMS IN MEDICAL WASTE  
MANAGEMENT AND ITS ENVIRONMENTAL EFFECTS IN TURKEY**

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**ABSTRACT:** The number of hospitals in Turkey is increasing day by day. This increase has also led to an increase in waste load. Increasing waste load led to the initiation of waste management practices related to this issue in hospitals. The arrangements were made regarding medical waste management in Turkey for the first time in 1993. These regulations have been amended in accordance with the 2005 EU Environmental Directives. Both in Turkey and in the world, it can be said that the revised format of the medical waste management, depending on the technology. In this study, by considering the intended medical waste management in Turkey will focus on the potential harm to the environment. In addition, ashes remaining as a result of incineration should be evaluated in terms of environment. Therefore, the disposal of these ashes is also mentioned.

**Keywords:** Medical Wastes, Waste Disposal, Waste Incineration Systems.

## P 6. DISPOSAL OF SEWAGE SLUDGE WASTES IN FLUIDIZED BED FURNACES: A REVIEW

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**ABSTRACT:** In this study, the disposal of the sewage sludge by fluidized bed combustor and the pollutant emissions in the combustion plants were evaluated. The content of the sludge, its disposal by combustion and properties of fluidized bed plants are discussed from an environmental matter of view. Combustion is a method of disposal that quite reduces the volume and mass of the sludges. Sludges are generally combusted together with domestic wastes, while they are used as combustible alone in indirect combustion or together with another combustible as raw materials. Nowadays, there are alternative technologies available for the disposal of sludge by combustion, and choosing the most suitable one requires an investigation. Also, the technology chosen must be environmentally friendly and economically feasible. Among these technologies, mono-combustion is the most rooted method and fluidized bed furnaces are more preferred. Because in fluidized bed furnaces both wet and semi-dried sludge can be combusted. The major apprehension the combustion of sludge is the release of gas and solid pollutants into the atmosphere. During high temperature combustion, the problems of ash removal and filtration of heavy metals can be solved or reduced, while the problem of heavy metals can supply strict emission limits using the latest combustion technologies. In addition, combustion of sludges in fluidized bed furnaces and producing electrical energy in this way can both solve the problem of sludge and contribute to the solution of problems such as the use of local resources in energy.

**Keywords:** Sewage sludges, Combustion technologies, Fluidized bed combustion, Emissions.

## P 7. ROLE OF SPIRULINA PLATENSIS IN THE DETOXIFICATION OF FREE RADICALS AND GLUCOTOXICITY

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**ABSTRACT:** *Spirulina platensis* is free-flowing blue-green microalga. The organism as a whole as well as its extracts has been known to be highly nutritious and possess health-benefiting properties from combating against malnutrition to diabetes. The present research aims to explore such therapeutic properties of *S. platensis* extract using *in vitro* methods. Initially the biochemical and phytochemical properties of the aqueous extract of the organism were studied. DPPH assay was used to evaluate the free radical scavenging activity of the extract which exhibited the antioxidant potential of the organism. *S. platensis* extract could also inhibit the activity of  $\alpha$ -amylase enzyme by 37.09%, thus, indicating its ability to control postprandial glucose levels. Diabetes leads to hyperglycemia which promotes the formation of Advanced Glycation End products (AGEs). Effectiveness of the *S. platensis* extract in prevention of glycation was determined using BSA as the protein and glucose as sugar. Reduction in protein aggregation was detected spectrophotometrically and by Congo Red assay. *S. platensis* extract caused reduction in formation of fructosamine by 9.84%, carbonyl content by 55.77% as determined by NBT assay and DNPH method respectively. The extract could effectively reduce browning of sugars by 22.67% which occurs due to Maillard reaction in the initial stages of glycation. Agarose gel electrophoresis method revealed the efficacy of *S. platensis* extract to prevent the stands breaks in plasmid pBR322 which occur as a result of glycoxidative DNA damage. Thus, this research proves that the consumption of *S. platensis* can provide health benefits such as antioxidant, antidiabetic, antiglycating and anti-tyrosinase effect along with nutrition.

**Keywords:** Antidiabetic, antiglycating, antioxidant, glycoxidative DNA damage, *Spirulina platensis*.

## P 8. HEAVY METALS TOLERANCE BY S. PLATENSIS

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**ABSTRACT:** Excessive discharge of wastewater into natural water bodies cause water pollution, due to disturbed self-revival systems. Heavy metals in the sewage have affected the ecosystem to the extent that it is a detriment of humans, as it is difficult to eliminate them and instead, they accumulate in the organisms. Use of dry biomass of *Spirulina platensis* has proven to precipitate and biosorb heavy metals. This study aimed to check the tolerance of wet biomass of *S. platensis* to various heavy metals usually associated with wastewater. Preliminary experiments were conducted to standardise and optimise the growth conditions of *S. platensis*, in turn establishing a growth curve. Special emphasis was made on checking the tolerance of the microalgae to mercury [Hg(II)], for other organisms seldom grow in the presence of mercury.

**Keywords:** Bioaccumulation, *Spirulina platensis*, Heavy Metal Toxicity, Mercury, Wastewater

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