Volume-4

The Agrineer

2013

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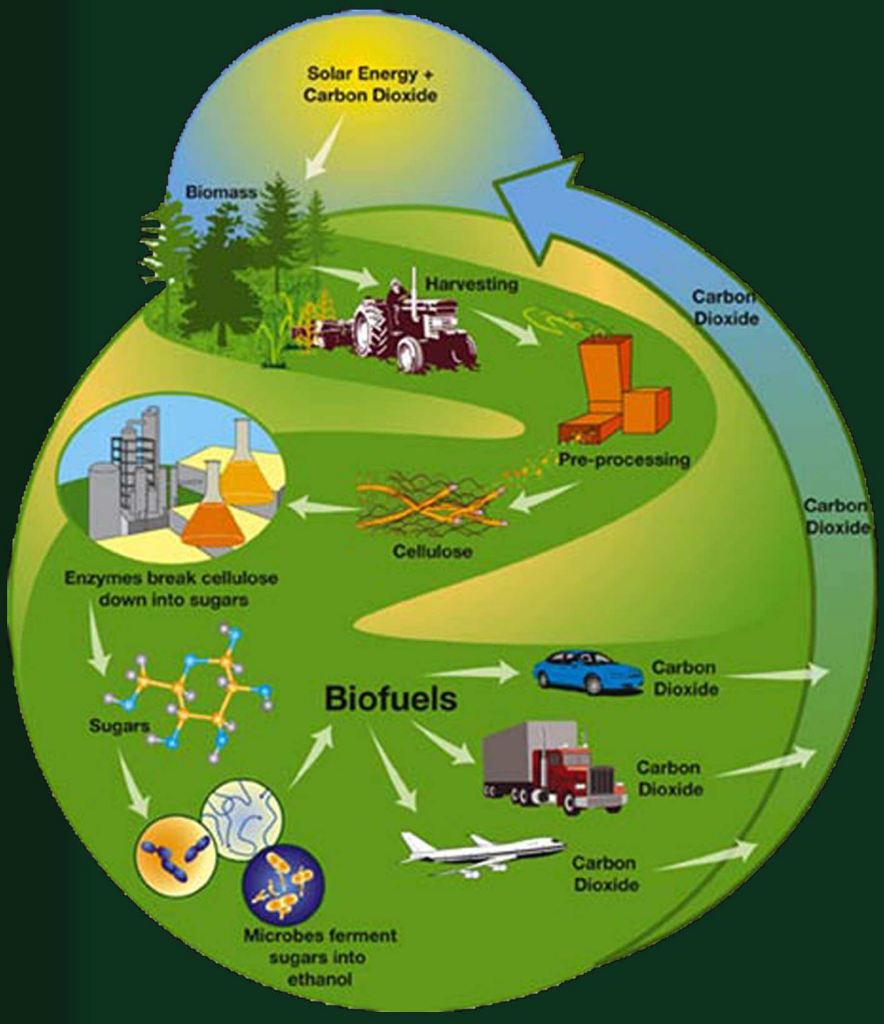

An Annual Publication of
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IOE, Purwanchal Campaus
Dharan, Sunsari (Nepal)

Tribhuvan University

Institute of Engineering

Nepal Agricultural Engineering Students Society
Purwanchal Campus, Dharan

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AND here we are!!!

With the great effort our dream come true to succeed in the publication of forth volume of our technical journal *"The Agrineer"*

During this publication, there were different obstacles encountered, although we exercised our best to bring this volume in time. Now, we are feeling proud and happy at the success.

We have inputed our full effort to make the issue perfect, flawless and to live up to the expectation of readers but it is bound to erroneous. Comments and suggestion for further improvement of this journal would be greatly appreciated.

The Agrineer team are obligated to thank to all those writers who have contributed their valuable time for the articles. Also we are thankful to office of dean, campus administration, department of agriculture engineering for their kind support and guidance.

We express our heartiest gratitude to our sponsors for the financial support without which the publication would have been limited to a dream.

At last we express our sincere gratitude to all the teacher, friends, individuals and well-wisher who directly and indirectly helped us during the publication of this journal.

The Agrineer team.

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Date: 2069-9-15

MESSAGE FROM DEAN

I am happy to write few words in this magazine *"The Agrineer"*, an organ of Nepal Agriculture Engineering Students' Society (NAESS) of IOE, Eastern Region Campus, Dharan.

I feel very happy that NAESS is publishing this publication containing different articles of teachers and students. I believe, this publication shall prove to be very effective in the dissemination of creative achievements of teachers and students in the area of agriculture Engineering.

Our Concern is the prosperous Nepal and this is possible only with increasing productivity through capable and competent work force. Institute of engineering (IOE) is, therefore striving to produce brains who can contribute to the economic growth of Nepal. I believe, our students through NAESS and this publication shall carryover this mission of IOE eventually contributing to the national development process.

The efforts of the AGRINEER- publication of NAESS is appreciating in this regards.

Prof.Dr.(Er.) Bharat R. Pahari
[B.E.(civil), M.Sc.engg(Building), Ph.D.(quality of Engg Edu), Post Doc.(Quality Mgmt.)]
DEAN

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MESSAGE FROM CAMPUS CHIEF

I am very happy to know that Nepal Agricultural Engineering Students' Society (NAESS) is going to publish their 4th issue of THE AGRINEER. I would like to congratulate all the students of Agricultural Engineering for their effort in bringing out this publication.

There are so many countries in the world where the percentage of population involved in agriculture lies within single digit and capable to fulfill the food demand of their entire population. In Nepal, although more than 80% of the population is involved in agriculture but cannot produce sufficient food for the country's demand. This is a serious problem to be answered by concerned agencies and policy makers. Agricultural Engineering can be a vital component in making our county self-dependent in food demand and even can export.

I congratulate 'The Agrineer' team for publication for their hard work and courage to publish 'The AGNEER' and I believe this will be a good support in disseminating the information related to agricultural engineering.

13/05/2013

(Er. Jawed Alam)
Campus Chief

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MESSAGE FROM CO-ORDINATOR

I am very glad to hear that Nepal Agricultural Engineering Students' Society (NAESS) is on the way to publish the fourth issue of *The Agrineer*. I would like to congratulate the NAESS members and the Agrineer team.

As agriculture is one of the most important sector of country's development in which agricultural Engineering is a very supporting part so the Agrineer, the collection of agriculture related research papers, is helpful for all agricultural related persons as i hope.

I appreciate the work of NAESS and hope continuity of such works in the future too.

Dipendra Nath Gupta
Program Coordinator
Department of agricultural Engineering

Regd No.29/046/047

नेपाल कृषि इन्जिनियर्स सोसाइटी

Nepalese Society of Agricultural Engineers

I am happy to know that ***"Nepal Agriculture Engineering Students Society"*** of Institute of Engineering, Purwanchal Campus, Dharan has thought of giving continuum to "***The Agrineer"***– an annual publication of the society for which the functionary of the society is in the process of bringing out the fourth issue. On the behalf of Nepalese Society Of Agricultural Engineers (NSAE), I would like to congratulate and wish the team for the success foreseen by the society and the institution.

As well known about the country's high dependency on agriculture, this type of document (publication) will help not only in transferring the new knowledge and development that are being made in a wider context for the betterment and upgrading the existing technologies and skills; ultimately contributing to the growth of farmer, society and the country in a whole but also helps to spread the indigenous local knowledge of the countrymen both within and outside Nepal. The academic researches carried out in Nepal are limited in black and white document:- generally used only for the degree achievement. Research findings have to be disseminated to the grass root level for the country to march fast on the development path. Hence research findings have to be circulated among the main stakeholders. Therefore I am sure that this publication will insure propagating the research findings of both the students and the faculty members' works.

Lastly, I would like to thank once again to the committee for giving me the opportunity to express my feelings and make this note. NSAE welcomes new ideas and information thereby being fully committed in extending all the possible support to the students in their carrier pursuit.

Thank you and Best wishes.

Prof.Khem Raj Sharma,PhD

President

TRIBHUVAN UNIVERSITY
Institute of Engineering
Nepal Agricultural Engineering Students Society
Purwanchal Campus
Dharan-8,Sunsari

MESSAGE FROM PRESIDENT

I am very happy to add the new issue of the technical journal, fourth volume of *The Agrineer*. The credit for this goes to the "The Agrineer Team".

Though it has been one and half decades of the start of Agricultural Engineering in Nepal, yet it seems to be under the shade. Neither farmers have understood clearly about Agricultural Engineering nor the planners have realized its importance and capabilities in the up-liftment of agricultural country like Nepal. This results to abroad fly of the products of IOE, the power of nation.

Realizing this waiting for no one we our self has established NAESS, the power in the form of organization that work for the welfare of agricultural engineering students, which is continuously publishing the technical journal not only to outtake research, skills and technologies limited in our study but also to clarify the wrong concept about this engineering and to alarm the country planners. AGRO TECH EXPO is also our another way to do so.

Finally, i would like to thanks everyone who has helped us in the publication of the fourth issue of *The Agrineer*.

Subash Adhikari
President

CONTENTS

S.N. PAGE NO.

Development of Power Tiller Driven minimum Tillage and Zero Tillage Maize Planter

G.K. Kafle[a,b*] S. Upadhaya[a] Y.K. Rai[a] J.S. Kim[a] A.K. Sukla[a]

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Abstract

Maize planting using traditional methods is time consuming, labor intensive, and expensive. In this study, a maize seed metering system was developed and its performance was tested under both laboratory and field conditions using power tiller. The minimum tillage and zero tillage furrow opener was developed for planting maize seed. The seed breakage was increased with increase in speed and found to be less than 3% at speed of 1.25 to 2.0 km/hr. The field capacity of the developed maize planter was calculated to be 0.171 ha/hr at the speed of 1.5 km/hr. The performance of maize planter was found to be better under minimum tillage conditions than under zero tillage conditions. The cost of planting was found to be more than 79% cheaper for the developed planter compared to other traditional method used in Nepal.

Keywords: Maize planter, Resource conservation technology, Minimum tillage, Zero tillage.

1. INTRODUCTION

The tillage operation in conventional agriculture is time consuming and costly process. For some crops, tillage and sowing operations require up to one-third of total cost. Conservation tillage is one of the important means to sustain and increase soil fertility and crop productivity [1].In conservation tillage cost of land preparation and sowing can be reduced to a great extent [1]. Minimum tillage and zero tillage are popularly accepted resource conservation technologies in different parts of the world. Minimum tillage and zero tillage can save substantial amount of time, irruption, and momentary cost in crop production [1-3].

In Nepal, the agricultural mechanization has very slow pace, and most of the farmers are continuing the traditional methods of farming which are labor incentive, costly, and time consuming. The average land holding per family across Nepal is found to be less than 0.8 hectare [4]. Due to low investment capacity and lack of infrastructure and market opportunities, majority of farmers in Nepal are adopting traditional technology in their production systems [4]. Therefore, cheap and small size machines are more suitable for promoting mechanization. Maize is the second major crop after rice in Nepal, and its demand is increasing day by day. There is urgent need for the mechanization of maize farming systems in Nepal.

The main objective of this study was to develop the power tiller driven minimum tillage and zero tillage maize planter. In the present study, the seed metering system of Chinese power tiller driven wheat seeder was replaced by developed metering system for maize seed and its performance was evaluated.

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2. METHODOLOGY

2.1. Description of the Power Tiller

The power tiller, two wheel tractor with attached rotavator, was used as power source for maize planting in this study. The power tiller was made in China (trade mark: huiyou), and its rated power was 15 hp. The engine, used in power tiller, contained one cylinder and operated by diesel. The forward speed can be maintained in the range of 1.54 to 16.83 km/hr, and reverse speed can be maintained in the range of 1.20 to 4.18 km/hr.

2.2. Construction and Design of Seed Metering System and Furrow Opener

The developed seed metering system and the seed cut off device is shown in the Figure 1. The ground wheel with tread (made using iron) was attached to the seed metering system as shown in Figure 1(a). The ground wheel was used as power source for seed metering. When the power tiller moves, the ground wheel rotates and according to rotation of ground wheel, the seed plate rotates. The seed plate contained number of holes (Fig. 1(b)), and holes are occupied by seeds. The power transmission system was designed to maintain the plant to plant spacing of 25 cm using equation (1) [5]. The row to row spacing was fixed to 70 cm for both minimum tillage and zero tillage tests.

$$\frac{\pi D}{b} = \frac{n \times N_2}{N_1} \quad (1)$$

Where,
D = Diameter of the Ground wheel
n = Number of cells in the rotor
N_2 = Rpm of the rotor (seed plate)
N_1=RPM of the ground wheel
b = Seed spacing

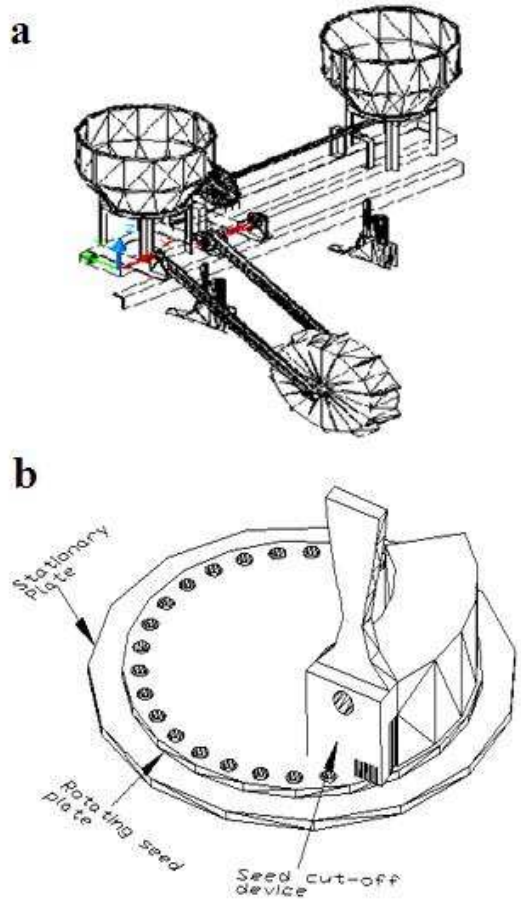

Figure 1: (a) Developed seed metering system, (b) horizontal cell feed type seed plate with seed cut off device

The developed minimum tillage and zero tillage furrow opener are shown in Figure 2. The slit width of furrow opener was fixed 2cm.

2.3. Laboratory and Field Testing

Laboratory and field testing for developed maize planter was performed following the standard test protocol [5]. The seed rate and seed breakage % was determined in the laboratory by jacking up the axle of the power tiller and rotating the wheel of the power tiller at different speeds (11, 17, 22, 28, 32 revolution per minute (RPM)). The plastic bags were fixed in each furrow openers to collect the seed. Uniformity of the seed spacing was measured by employing sand bed method. The germination test (seed viability) was performed for the seeds collected from metering mechanism.

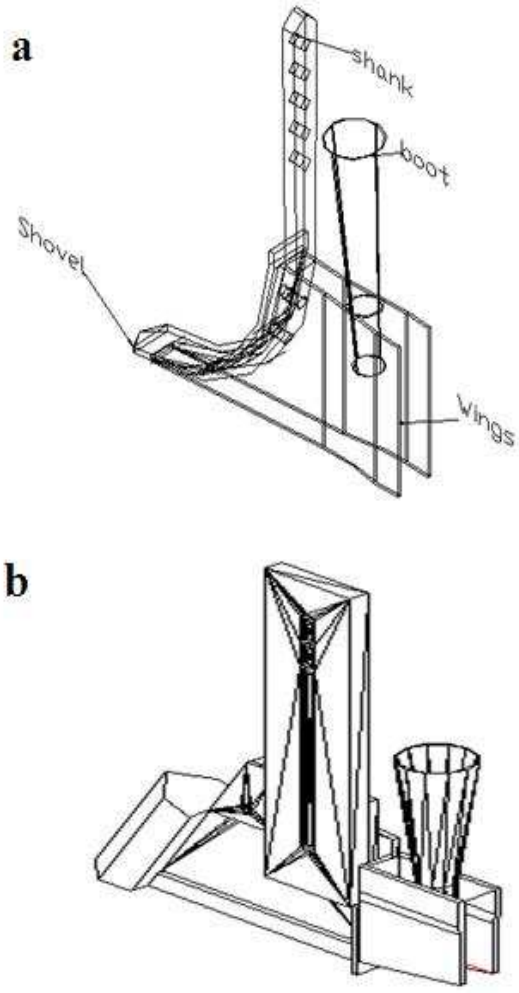

Figure 2: Furrow opener (a) minimum tillage, (b) zero tillage.

Figure 3 shows the picture of developed maize seed metering system attached to Chinese power tiller and the tests plots (minimum tillage and zero tillage). For the field test under minimum tillage conditions the rotavator attached to power tiller was operated; however, under minimum tillage conditions, the maize planting was done without operating rotavator (shovels of rotavator were opened). The speed of the power tiller was fixed 1.5 km/hr and the field capacity of the designed maize planter was calculated. Similarly, the depth of planting was fixed 5cm. Evenness of seed spacing in the field test was determined by taking the plant to plant distance after the maize plant was grown up as shown in Figure 3.

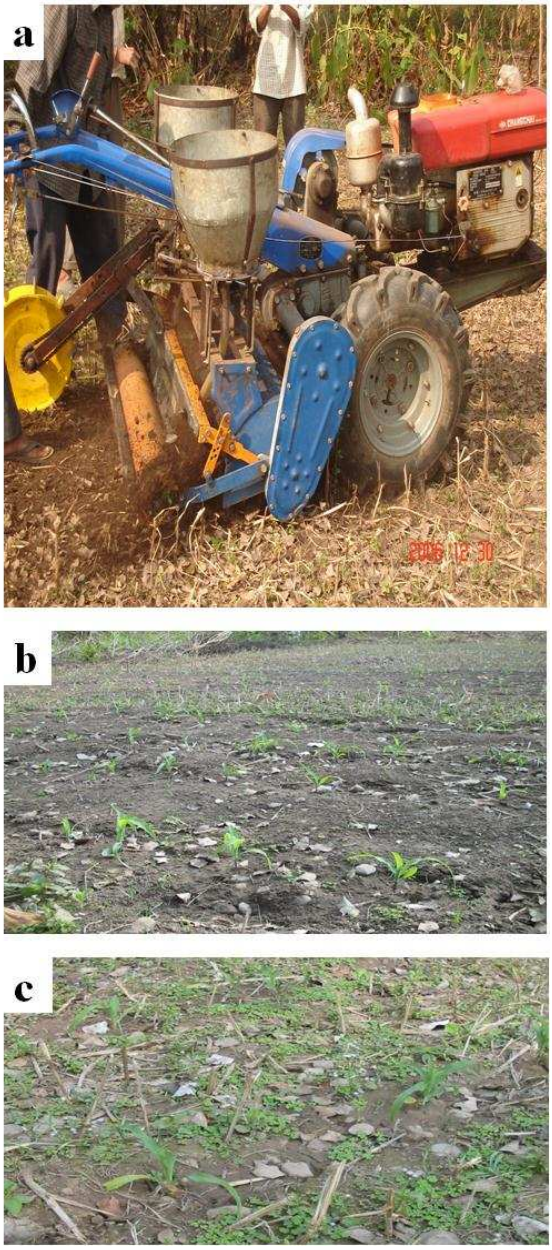

Figure 3: Picture of (a) power tiller with maize metering device, (b) minimum tillage test plot, (c) zero tillage test plot.

3. RESULTS AND DISCUSSION

3.1. Lab and Field Performance of Maize Planter

The seed metering system showed good performance under both laboratory and field conditions. The seed cut off device allowed only a single seed to fall to the hose of the furrow opener. The seed breakage linearly increased with the increase in the speed (Fig. 4). The seed breakage was found to be less than 3% at speed of 1.25 to 2.0 km/hr. The use of soft material like rubber (Fig. 1(b)) for separating seeds in seed cut-off device may be the reason for low breakage of seed in this study.

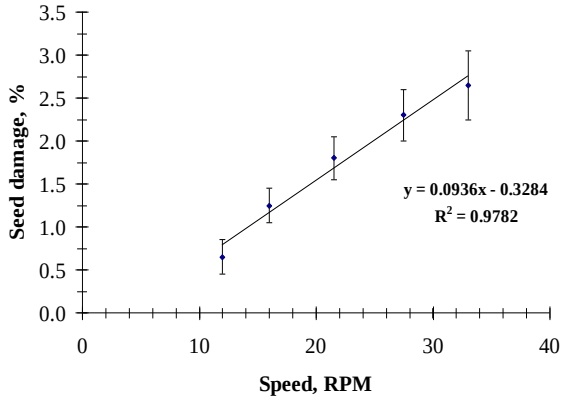

Figure 4: Effect of speed on seed damage (laboratory test).

The seed rate was calculated to be 18.7 kg/ha (1000 seeds = 0.283kg). The average seed to seed spacing was measured 27.5 cm and average evenness was calculated 0.74. The average seed germination was calculated to be 95%.Thus results showed that there is not much effect on seed viability after passing through developed seed metering system.

The field capacity was calculated to be 0.171 ha/hr at the speed of 1.5 km/hr. The speed of power tiller was maintained low due to small size of test plots and undulations in the test plots. The average plant to plant spacing in the minimum tillage test plot was measured to be 24 cm, and evenness in the seed spacing was in acceptable range. However, in the zero tillage test plots some non-uniformity in seed spacing was observed compared to minimum tillage. The average plant population was counted to be 9 plants /m^2 on the 12^{th} day of the first germination of the seed. The depth of the planting was closer to the designed depth (5cm) for minimum tillage; however, depth of planting was non uniform in the case of zero tillage planting. Further study need to be conducted to improve the performance of zero tillage system. We had observed skidding of ground wheel during operation under field conditions, which higher for zero tillage compared to minimum tillage. Thus, the reason for less uniformity in seed spacing during zero tillage operations may be due to higher skidding of the ground wheel.

3.2. Cost of Planting

Table 1 shows the estimated cost of planting maize using developed maize planter and other popular methods of planting in Nepal. The cost of planting of maize for developed planter was calculated to be NRs 910/ha (calculated on 2006), which was more than 79% cheaper than other traditional methods used in Nepal (Table 1).

Table 1. Cost of planting maize by different methods of planting in Nepal

Planting methods	Cost of Operation (NRs/hr)[a]	Planting cost (NRs/ha)[a]	Reference
Zero tillage and minimum tillage maize planter	151.52	910	This study
Tractor drawn cultivator seed broadcast and covering	-	4417	[6]
Tractor drawn cultivator land preparation + sowing + animal plough	-	4980	[6]
Animal land preparation and sowing	-	4610	[6]

NRs: Nepalese Rupees

-: Not determined

[a] Cost was calculated on 2006

4. CONCLUSIONS

The developed planter can be used for planting maize under both minimum and zero tillage conditions. The precision of maize planting was higher when used under minimum tillage conditions compared to zero tillage conditions. The use of minimum tillage and zero tillage planters could reduce the maize planting cost by more than 79%compared to traditional methods used in Nepal. Further study is needed for the commercialization of the developed zero tillage and minimum tillage maize planter.

ACKNOWLEDGEMENT

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Study of Tractor Accidents in Eastern Region of Nepal

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Abstract

Tractor though popular for agriculture purpose in many countries but in context of Nepal it is mostly used for transportation. Around 57,000 nos of tractor have been imported till 2010. With this increasing rate of tractor, its accidents are also increasing in alarming rate, due to various reasons such as brake failure, over turn, overload, driver carelessness etc. which results loss of human lives. This tractor accident occupies third highest rank in no regarding road accidents in our country with in which Eastern region occupies second highest tractor accident in Nepal. The Casualty accident rate has increased tremendously within last three years (Bs2067-2069). Death and injury rate has increased respectively by more than 50 percentage and around 15 percentage in comparison to previous year.
The accident data are taken from news- paper, e-news and Eastern regional traffic directory. This present study was done of tractor involvements in Eastern region. Tractors with trailers have significantly higher accident rates. Characteristics of the nature of operating environment were found to have larger effects on the accident rate. The Models of casualty and property-damage accident rates were developed using road type and area type.
However, in order to reduce the tractor accidents it is important to understand the working mechanism and potential of these vehicles. Also, installing certified roll over protective structure (ROPS), setting up tractor, operator seat belt, safe speed and safe operating practices is crucial to prevent tractor accident.

INTRODUCTION

Nepal is an agriculture country. About 17 % of our land is productive for Agricultural purpose. But, Nowadays due to lack of human power, mechanization is the best option for agriculture commodities. In which tractor has been popular for transportation of agriculture products and by-products. It is used for to operate combine harvester, tillage practices etc.

Tractor is a high powered vehicle that is designed to carry out variety of work. The type of work depends on its size, type of attachments it has and the type of tasks it is designed to accomplish. Technically a tractor can be the engine of a tractor trailer truck, but more commonly, tractors are known as personal mowers or those that are used for agricultural purposes.

Across the inter villages and highways of Nepal, tractor accidents are happening at an alarming rate. Many times we have heard the horror stories about an accident that involved a 4-wheeler, which completely wrecked another vehicle. Many of us have had the misfortune of witnessing one first hand. Nobody would wish to experience or see this fact. One can only hope that the parties involved in a tractor trailer accident will be okay.

Driving while under the influence of alcohol and other drugs is seen as a possible cause of tractor accidents. According to eastern regional statistics, the number of accidents is caused due to overturn, over load and driver carelessness. There are a higher percentage of accidents due to overturn and mishap, which faults the passenger vehicle. Driving while under the influence, will impair all motor skills, and might cause you to come face to face with a truck.

Tractor accident statistics of all over Nepal show that the roads of the Nepal witness over 250 accidents each year. This is according to data released by traffic directory. Unfortunately, a high number of these types of accidents end in fatalities, within it eastern region has second higher accident of whole 5 region.

What is even scarier about these statistics is that a high percentage of tractor trailer accidents are caused not by the driver of the truck. It is the driver of smaller vehicles that were involved in a crash, which is usually the cause in error of judgment. In such accidents, the driver in the smaller vehicle will most likely sustain a serious injury. On the flip side of that, many of these types of accidents will most likely end in fatalities.

Till the fiscal year 2009/2010 around 57,000 tractors of 35-45 horse power has been imported in our country. Every year more than 130 and 150 people are died and injured in tractor accident. A recent data from traffic directory, this fiscal year 2068-069 above 214 people have died and 604 injured. This show, the tractor accidents are increasing in alarming rate.

According to three years, Eastern Region tractor accident in road is higher. Its main causes are overturn and driver carelessness.

Table 1: Three fiscal years accident causes

	Causes		
Fiscal Year	Hitting	Turn Over	Drop
066/067	26.09%	65.94%	7.97%
067/068	47.69%	47.69%	4.62%
068/069	41.38%	55.56%	3.07%

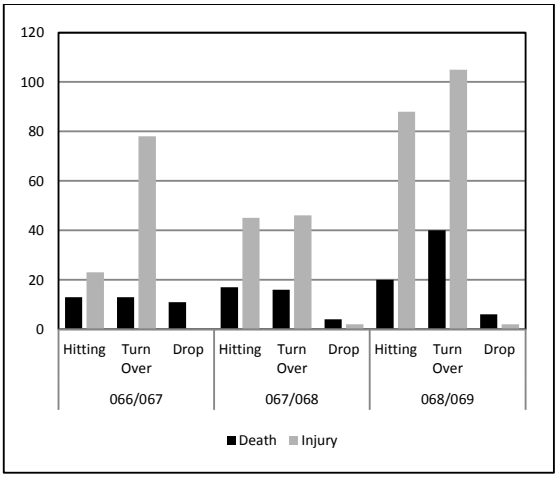


Figure 1: Eastern Region three years' statistic data with causes

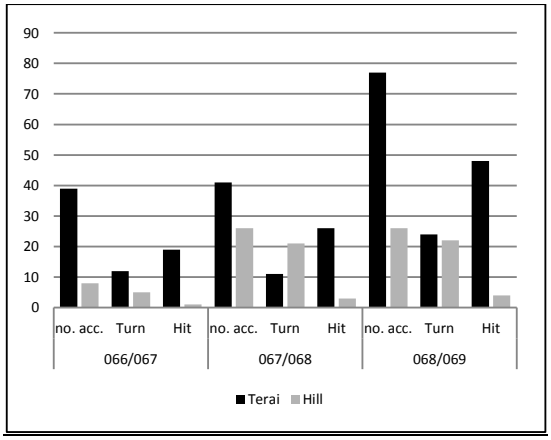


Figure 2: Eastern Region three years' statistic data in terai and hill

This above figures evidently tells statistical accidents within three years 067, 068 and 069 in Eastern region which shows the death due to tractor accident is increasing. Moreover, the tractor accident in terai is higher compare to hill. The main cause of accident in terai is hit or mishap i.e. driver carelessness and similarly in hill main cause of tractor accident is turnover, which is due to steep road with heavy load in trailer and its solution is rolls over protective structure.

As attention has focused on tractor safety, it has become apparent. That little is accurately known about the operating experience of overload, brake failure, skid off road, mishap, driver carelessness, etc.

There is a thumb rule for vehicle operation:

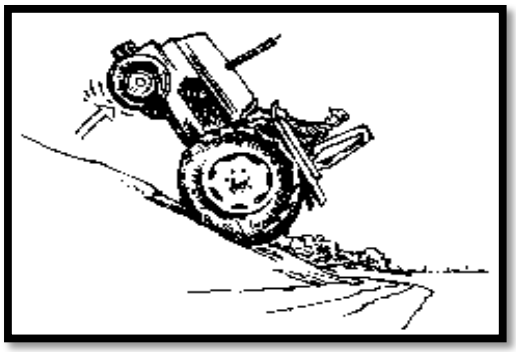
Stay back as far as the bank is high.

- Operate smoothly; avoiding jerky starts, sudden turns and hard braking. Smooth operation is safer and can prevent costly breakdowns.

Main reasons of Tractor accident:

1. Overturn
2. Overload
3. Skid off
4. Brake failure
5. Driver Carelessness

1. Over turn



Tractor overturns occur too fast for you to jump clear in most cases. An overturn can reach the "point of no return" in about 30 to 45 second and can flip completely in about 2 second. It takes 30 to 45 second to realize the driver is in danger, and then he must react. The reaction time is at least 30 to 45 second and that's when he is ready to act. Unless he is expecting the tractor to flip, the reaction time probably will be even longer (he will have a problem if he is expecting it to flip). The combined hazard recognition and reaction times will be 1 to 2 seconds

before he begin to move. It takes another second to clear the tractor after he reacts.

Prevent of overturns

Setting up the tractor

Install a certified ROPS and seat belt if tractor does not already have them. The ROPS won't prevent an overturn, but it will let driver to survive. A roll-over protective structure (ROPS) provides a crush-free zone of safety around the operator's station and the seat belt keeps him in the protected zone. Less deaths cause due to overturns where a ROPS and seat belt were in use. However, operators not wearing their seat belts have been thrown from tractors and crushed, some by the ROPS structures that were intended to save them. Wide front end tractors have more stability against side overturns than tricycle frame tractors. This benefit is greatest when the wheel spacing is at its widest practical setting.

Use of the widest practical wheel spacing increases stability against side overturns. Wider wheel spacing provides a wider stability zone. It is much easier to keep the center of gravity inside the wider stability zone.

While moving the tractor uphill the center of gravity of tractor is in trailer part if the tractor is loaded then there is a chance of overturn. So, proper ballasting maintains right balance for stability and control. The tractor's weight should be distributed evenly on each side, where we can add ballast load on front part of it. This helps us to reduce overturning of tractor. In which we can increase load with about 70% of the weight on the rear wheels and 30% on the front wheels. The control of the tractor will be lost if the front wheels lift from the ground when engaging the clutch or starting up slopes or if the front wheels slide when attempting turns.

Extra rear weights are needed when using front-end loaders to maintain traction on the rear wheels. Rear ballast can be wheel weights, fluid in the tires or a heavy implement on the 3-point hitch. Losing traction on the rear wheels can be disastrous since movement and braking is accomplished by the rear wheels.

Survive An Overturn

Almost all overturns can be prevented by safe operating practices. However, the real tragedy is that virtually every tractor overturn is survivable if the tractor is equipped with a roll-over protective structure (ROPS) and the operator is wearing the seat belt. The ROPS and seat belt is the best life and health insurance policy. It prevents serious injury or death. As an added benefit, the ROPS helps limit damage to the tractor in an upset. Manufacturers have reduced the cost of ROPS retrofit kits. We can find a certified ROPS for all recent tractors.

Even if driver refuses to wear the seat belt, he should try to stay in the seat during an overturn if the tractor has a ROPS. Hang on as tight as he can. As mentioned earlier, overturns are too fast for him to react, so he won't be able to jump clear of the tractor. If driver jumps, he may still be crushed by the tractor, possibly by the ROPS that is there to protect him.

2. Overload

Overloading increase tire failure because the tractor trailer runs hotter, has faster brake wear, less fuel economy, and unnecessary downtime caused by premature wear and tear on the transmission. An overloaded tractor trailer truck takes longer to stop and will most likely rear end another vehicle when it needs to make an emergency stop. Overloaded tractors moves slower uphill and faster downhill.

Usually, tractor trailers are used for transporting construction material and people in rural village instead of agricultural reason. The standard size of tractor trailer in our country is 392 X 185 X60 cm and its capacity is 4 ton. But here, we load around 7 ton of materials on tractor trailer which is more than 4 ton and it is the key reason to become the tractor unstable. Hence, cause an accident.

3. Skid off

The loss of traction between a tractor's tires and the road surface due to the forces acting on the tractor cause skid of its wheel. Skids occurring in accidents are usually the result of last minute action, by the driver, when faced with a crisis ahead rather than actually causing an accident. Skids can occur both in the dry and wet as well as icy conditions. However, in our country the main causes of skid off is due to absence of brake in trailer part of tractor. Thus, the driver cannot control during high speed and imbalance conditions occur.

The main causes of skidding are as follows:

- Harsh or sudden acceleration
- Excessive of sudden braking
- Coarse or jerky steering movements

4. Brake failure

Regular repairing and maintenance of tractor is main cause for brake failure and also operation of old tractors without any repair and maintenance cause brake failure.

5. Driver Carelessness

Overtaking and driving inappropriately close to another vehicle is the main two recklessness of driver to cause an accident.

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Water Quality Analysis of Sardu Watershed Area

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Abstract

The objective of the study was to assess the physical and chemical characteristics of the major water sources of Sardu watershed area, which are the sources of drinking water supply to the Dharan Municipality and Vishnupaduka VDC. The samples for the test were collected from Sardu intake, Sardu rivulet, Khardu intake, Kokahakhola and Pakuwa intake and analyzed in the laboratory. The lab analytical results were compared with WHO International Standard and Nepal Drinking Water Standard 2062 and the suitability of water for drinking purpose were determined. Secondary data were collected to understand the water characteristics variations over period of time. Field visits were made to assess the water quality deteriorating agents near the water sources. Interviews were conducted to know the level of awareness among the residents towards water quality. Most of the physical and chemical characteristics were found to be within the permissible range of standard values and thus fit for drinking without treatments. But, BOD, iron and lead were found to be beyond the permissible range and thus the water must be purified for these parameters. The levels of contaminants were found to be increasing with respect to those in 2002. This might be due to increase of human and animal influence, degradation of natural biofilters and increase of soil erosion on the upstream area of the water sources. People awareness towards water quality was found to be lacking. Most of them have insufficient knowledge about water treatment techniques. They have more interest in quantity rather than quality. Water quality of Sardu watershed area can be improved either by disinfection or by growing appropriate aquatic plants, as biofilters in/near the water sources. Plans and policies are must to reduce the human influence near the water sources. People should be made aware of safe drinking water with the assistance of national and international agencies.

Keywords: Quality, Characteristics, Awareness, Contaminants, Influence

1 INTRODUCTION

Water is probably the most important natural resource in the world, since without it, life cannot exist. About 60% by weight, of a person body is water. It is believed that under certain conditions a person may survive without food for about 5 weeks but can seldom live without water for more than a few days (Potter and Hotchkiss, 1996).Water is necessary for plant and animal life. A civilization cannot develop or prosper without ample water for domestic, agricultural and commercial activities. Unlike many other raw materials there is no substitute for water in many of its uses.

With the even increasing use of water for human beings, it has become more important to appraise water quality of a continuous basis. Water serves more in fulfilling of human needs than does any other natural resources. However, water may also be a medium for transporting microorganisms and toxic chemicals. Water both in quantity and quality is a serious problem in many areas.

This study covers the water quality analysis of major water sources existing in Sardu watershed area, which was carried out by assessing the physio-chemical water quality status of major water supply intakes in Sardu watershed area and by evaluating the fitness of water for drinking purpose.

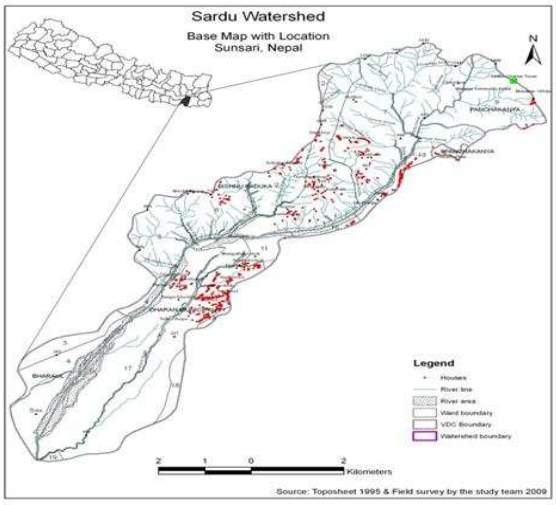
2 METHODOLOGY

2.1 Study Area

The study area lies in Sunsari district of Nepal and study area is situated within 87° 27'00" and 87° 32'00"E longitude and 26° 85'00" and 26° 87'00" N latitude. The watershed having about 857.363 ha.area with altitude ranging from 750 m to 1300m.
Sardu watershed area is the main source of water supply for Dharan municipality and Vishnupaduka VDC. NWSC, Dharan collects water from Sardu and Khardu-khola and distribute to the municipality .DFID distributes the water of Pakuwa-khola to the people of Mangalbare area. The people of Vishnupaduka VDC are dependent upon the water of Kokaha-khola lying in Sardu watershed area.

The streams originating from the watershed that drain into Sardu-Khola include Khani-Khola, Sulikot-Khola, Gadi-Khola, Chotimorang-Khola, Churibas-Khola, Lampate-Khola and Nametar-Khola originating from Adheri Dada, Saguri Dada and Pathibhara Dada. While Lampate-Khola, Sulikot-Khola, Khani-Khola and Churibas-Khola drain into Sardu-Khola, the stream draining into Kardu-Khola includes Chotimorang-Khola. The major sources in Vishnupaduka side of the watershed are Kokaha and Pakuwa-khola.

The rock formation in the watershed includes gray-micaceous sandstones, conglomerates and mudstone. The conglomerates range from quite hard to soft and frigile. The mudstone is soft and tends to slake and disintegrate upon exposure. These are essentially unmetamorphosed (DoMG, 2003).Soils in most of the part of the watershed is stony with boulders and sand in river bed and banks and loose coarse textured in other part of the watershed.



The climate of the watershed in general is sub-tropical, though some part of the watershed area, particularly those extending above elevation above 1000 m, has also warm temperate climate. The average annual rainfall of Dharan is 2125.2 mm which is higher than the mean annual rainfall of 1500 mm for the country.

2.2 Sampling Sites

The samples were taken from Sardu intake, Sardu rivulet, Khardu intake, Kokaha-Khola and Pakuwa intake. These sites were selected because NWSC, Dharan collects water from Sardu and Khardu intakes for distribution to Dharan Municipality. People of Phusre area use the water from Sardu rivulet. DFID distributes the water from Pakuwa intake to Mangalbare area and people of Vishnupaduka VDC use the water from KokahaKhola. The other small rivulets had insignificant discharge.

2.3 Sampling Frequency

The number of samples to be taken and the sampling interval depends upon the parameter to be monitored. The samples were taken on the basis of National Drinking Water Quality Standard Implementation Guideline 2062. However, due to lack of facilities and technical problems only three samples were taken from each source.

2.4 Sample Preservation and Handling

The water samples collected from the source were kept in ice box and then carried to the laboratory within four hours after sampling. The samples were protected from direct sun light and other possible contaminations.

Table 2.1 Laboratory Analysis Method

S.N.	Parameters	Analysis method	Remarks
1	pH	APHA-4500H$^+$	As per standard of ISO 17025
2	Conductivity	APHA-2510	
3	Turbidity	APHA-2130B	
4	Colour	APHA-2120C	
5	Total dissolved solids	APHA-2540C	
6	Total hardness	APHA-2340	
7	Nitrate	APHA-4500	
8	Chloride	APHA-2500B	
9	Fluoride	APHA-2500	
10	BOD	APHA-5210	
11	Iron	APHA-3500	
12	Lead	APHA-3500	
13	Zinc	APHA-3500	
14	Copper	APHA-3500	
15	Arsenic	APHA-3114	

2.5 Laboratory Analysis Method

The water samples were collected according to guidelines of the laboratory and they were carried to the SEAM-N MMA Environmental Laboratory, Biratnagar for the analysis. The sampling was done by the study team and the collected water samples were analyzed by the authorized lab analyst in the SEAM-N-MMA Environmental Laboratory, Biratnagar. The methods adopted for the analysis of the water quality parameters are given in Table 4.2.

3 RESULTS AND DISCUSSION

3.1 Laboratory Analysis Report

The Lab tests were performed in the month of Jan-Feb 2010 and were carried out in the SEAM-N MMA Environmental Laboratory, Biratnagar. The characteristics of water as determined in the lab are discussed in the following paragraphs.

3.1.1 Turbidity

It was found that during the project period (Jan-Feb), the turbidity of Sardu intake and Sardu rivulet has decreased where as that of Khardu intake first increased and then decreased. It was also seen that turbidity of Pakuwa intake has increased and that of Kokaha-khola has decreased and then increased. This might have occurred because of variation in suspended matters, such as clay, silt, colloidal organic particles, planktons and other microorganisms, due to human activities near the water sources or some natural causes.

The average value of turbidity of the Sardu intake, Sardu rivulet, Khardu intake, Kokaha intake and Pakuwa intake were found to be 1.96, 1.78, 0.05, 0.27 and 0.26 NTU respectively which are below the permissible value (5 NTU) of Nepal Drinking Water Standard 2062 and WHO International Standard. So the water can be used for drinking purpose without any treatment for turbidity.

It was found that in December 2002 the turbidity of Sardu, Khardu and Kokaha khola were 6.34, 6.42 and 6.15 NTU respectively which are larger than the corresponding present values. The decrease in turbidity might have occurred due to increase in vegetation near the water sources which act as natural filters and due to awareness among people towards the protection of the water sources.

3.1.2 Colour

The water of Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake had the colour average value as 0.27, 0.21, 0.20, 0.10 and 0.12 respectively which are less than the permissible value of Nepal Drinking Water Standard 2062 and WHO International Standard. Thus, these water are unobjectionable with respect to colour.

3.1.3 Conductivity

It was found that the conductivity of the water in all of the above sources were in decreasing trend during Jan-Feb. This indicates the increase in salt concentration in the water sources. The average value of conductivity of Sardu intake, Sardu rivulet, Khardu intake, Kokaha-khola and Pakuwa intake were 67.85, 183.4, 100.3, 138.35 and 296µS/cm respectively. These values are less than the permissible value of Nepal Drinking Water Standard 2062. It can also be seen that the conductivity hence salt concentration is least in Sardu intake and maximum in Pakuwa intake which indicate that the water of Pakuwa needs more treatment than that of Sardu.

3.1.4 pH

The pH of Sardu intake, Sardu rivulet and Khardu intake were found to fluctuate first decreasing and then increasing within the project period but the pH of Kokaha-khola and Pakuwa intake were in decreasing trend. The average pH of these sources were 7.05, 7.51, 7.23, 7.39 and 7.8 respectively. All these values are within the maximum concentration limits (6.5-8.5) of Nepal Drinking Water Standard 2062 and also within permissible limits (7-8.5) of WHO International Standard. Thus the water of Sardu water shed area can be used for drinking purpose without any treatment for pH. However the water are slightly alkaline in nature.

In December 2002, the pH of Sardu, Khardu and Kokaha khola were 8.16, 8.25 and 8.35 respectively (Sah, 2002). Thus it can be seen that the pH of the river water in the Sardu watershed area has decreased within 8 years.

3.1.5 Total Dissolved Solid

The total dissolved solids of the Sardu intake, Sardu rivulet, Khardu intake, Kokahakhola, and Pakuwa intake were found to be 26, 53.9, 48.8, 94.4 and 141mg/l respectively. According to Nepal Drinking Water Standard 2062 the maximum concentration limits for TDS is 1500mg/l and according to WHO International the permissible value is 500mg/l. Thus the water of Sardu watershed area is suitable for drinking and requires no treatment.

In December 2002, the TDS of Sardu, Khardu and Kokaha khola were 330.60, 350.60 and 342.10mg/l respectively (Sah, 2002). Thus, it can be seen that TDS has decreased and it indicates that the mineral contaminants are decreasing.

3.1.6 Total Hardness

It was found to be decreasing for Sardu and Khardu intake and increasing for the other three. The average values were found to be 25.4, 60.21, 31.17, 29.1 and 88.38mg/l respectively for Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake. The maximum concentration limit according to Nepal Drinking Water Standard 2062 is 500mg/l. Thus total hardness is within tolerance limit of

drinking water. These water can be easily softened by boiling or by adding lime to it.
In December 2002, the total hardness of Sardu, Khardu and Kokaha khola were 93.66, 85.61 and 106mg/l respectively. Thus the total hardness of the Sardu watershed area was found to be decreasing.

3.1.7 Nitrate

The nitrate levels were found to be decreasing in Sardu intake and Sardu rivulet where as it remained almost constant in the other three sources. Its average value for Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake were found to be 0.27, 0.12, 0.15, 0.15 and 0.22mg/l respectively. All of them are much below than the Standard value for drinking water. The nitrate level was found to be low because of no agricultural practices near the water intakes.
In Deceber 2002, the nitrate levels were nil. Thus nitrate level are found to be increasing which might be due to biological activity or the chemicals used in agricultural land in Bhedetar area mixing into the water sources.

3.1.8 Chloride

It was found to be constant for Sardu intake, Kokaha khola and Pakuwa intake whereas insignificantly increasing for Sardu rivulet and Khardu intake. The average value for Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake were 2, 1.5, 1.5, 2 and 3mg/l respectively. All of them are less than the standard value; hence, suitable for drinking.
The chloride content, in December 2002, was found to be 0.97, 1.1 and 1.86mg/l respectively for Sardu, Khardu and Kokaha khola. Thus no significant changes have been noticed for the past 8 years.

3.1.9 Fluoride

Its content for Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intakewere found to be 0.14, 0.05, 0.17, 0.21 and 0.34mg/l respectively. These values are under the standard values (0.5-1.5mg/l) for drinking as suggested by WHO International and Nepal Drinking Water Standard 2062. It can be seen that the fluoride content of Pakuwa intake is near to standard values, so it would be better to use with precaution

3.1.10 BOD

BOD values of samples from Sardu intake and Kokaha khola were found to be decreasing while those of other three were increasing. Its average values for Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake were found to be 7.51, 7.15, 8.76, 7.96 and 8.14mg/l respectively. This indicates that Khardu intake has more oxidisable organic matter in comparison to others. According to USPHS the BOD value within the tolerance limit for potable water is not more than 3mg/l (Kudesia, 1998). Thus the water from all of the above sources should be treated for BOD before consumption.

3.1.11 Iron

The iron contents of Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake were found to be 0.68, 0.45, 1.09, 0.31 and <0.05mg/l respectively. According to WHO International and Nepal Drinking Water Standard 2062, the permissible iron content is 0.3mg/l. Thus the water of only Pakuwa intake is safe for drinking and that for others require treatment before drinking. In December 2002, the iron contents of Sardu, Khardu and Kokaha khola were found to be 0.30, 0.28 and 0.17mg/l respectively (Sah, 2002). Thus it can be seen that the iron content of Sardu and Khardu has increased while that of Kokaha has decreased in the period of 8 years.

3.1.12 Lead

The lead content of Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake was found to be <0.02mg/l which is higher than standard value (0.01mg/l) of Nepal Drinking Water Standard 2062. Thus all of this water are unsafe for drinking and hence require some treatment before consumption.

3.1.13 Zinc

The zinc content for all the samples were found to be <0.02mg/l but that of Pakuwa intake was 0.12mg/l. The permissible value according to Nepal Drinking Water Standard 2062 is 3mg/l. Thus the water is safe for drinking in the context of zinc.

3.1.14 Copper

The copper content of Sardu intake, Sardu rivulet, Khardu intake, Kokaha khola and Pakuwa intake were found to be 0.10, 0.13, <0.001, 0.14 and 0.09mg/l respectively. The standard value as suggested by WHO International and Nepal Drinking Water Standard 2062 is 1mg/l. Thus the water is safe for drinking in the context of copper.

3.1.15 Arsenic

The arsenic content of all the samples were found to be <0.005mg/l. The standard value according to Nepal Drinking Water Standard 2062 and WHO International is 0.05mg/l. Thus the water is safe for drinking.

4 CONCLUSIONS

The following conclusions can be drawn from this study:

The water of Sardu Watershed Area is safe for drinking with respect to physiochemical characteristics except for BOD, iron and lead.

BOD has been noticed much higher than the permissible value and has significantly increased in the period of a decade.

The parameters such as pH, turbidity, total dissolved solids and total hardness are found to have decreased in Sardu, Khardu and Kokaha khola whereas the parameters like nitrate, BOD and iron have increased in the period of about a decade. The chloride content was found almost constant.

5 RECCOMMENDATIONS

From this study following recommendations can be made:

Since, the water was found unsafe due to high content of BOD, iron and lead, water must be treated for these parameters before drinking.

The water quality can be improved by growing appropriate bio-sand-filters in the rivers, stream etc.

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Effect of Sowing Dates and Varities on Yield and Yield Attributes of Direct Seeded Rice In Chitwan Condition

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Abstract

Rice (Oryza sativa L.) is the most common staple food of a large number of people on earth. It is the most important crop of Nepalese agriculture and economy. Rice transplanting and sowing time sometimes gets delayed due to lack of assured irrigation or surplus of rainfall in the major areas of terai and inner-terai of Nepal. Viewing these facts, an experiment was carried out to evaluate the effectiveness of sowing dates and varieties on growth and yield of direct seeded rice in Chitwan. A field experiment was conducted at farmer's field of Phulbari, Chitwan from May to November 2010. The experiment was laid out in split plot design with sowing dates on the main plot and variety on the sub plot. Number of effective tillers per square meter in June 13 sowing was significantly higher (318) as compared to June 28, May 29 and July 13 date of sowing and they were statistically similar. There were significant differences in effective tillers per square meter among the varieties too. Hardinath-1 had the highest number of tillers per square meter (346.1). However filled grains per panicle were highest in June 13 sowing (92.36) followed by May 29 (91.24) and lower number of filled grains was observed in July 13 sowing. Significantly more sterility was observed in July 13 sowing (19.90 %) whereas other sowing dates produced statistically similar sterility percentage. The thousand grain weight was influenced by both the factors used in the experiment i.e. sowing dates and varieties. Significantly higher test weight was observed in June 28 sowing (21.25 gm) and it was statistically similar with May 29 sowing and June 13 sowing (21.17 and 21.04 g) and at the same time significantly lower test weight was observed in July 13 sowing (19.33g). Among the different sowing dates, June 13 sowing produced significantly higher grain yield (3.84 t ha^{-1}) as compared to other sowing dates and significantly lower yield was observed on July 13 (1.92 t ha^{-1}) sown crop. The straw yield was the highest (6.85 t ha^{-1}) in June 13 sowing which was significantly superior to the straw yield from June 28, May 29 and July 13 sowing. Similarly, significantly highest straw yield was observed in Hardinath-1 (6.07 t ha^{-1}) and lower straw yield was recorded in Sabitri (5.23 t ha^{-1}). Higher harvest index was obtained with June 13 sowing (0.36) followed by June 28 sowing, May 29 and July 13 sowing (0.35, 0.34 and 0.33 respectively). Among the sowing dates, June 13 sown crop produced higher grain and straw yield along with higher gross return, higher net profit, and more favorable benefit-cost ratio.

INTRODUCTION

Rice (Oryza sativa L.) is consumed by about 3 billion people and is the most common staple food of a large number of people on earth; in fact it feeds more people than any other crop. Ninety percent of the world's rice is produced and consumed in Asia, where irrigated and rainfed rice ecosystems form the mainstay of food security in many countries (Wassmann et al., 2009). It is the most important crop of Nepalese agriculture and economy as it is grown in about 1.48 million ha with total production of 4.02 million tons. The average productivity of rice is 2.71 ton/ha (MoAC, 2011). Share of rice to the agriculture gross domestic product (AGDP) is 20% and total food production is 56% and it contributes more than 50% to the total calories requirement of Nepalese people (NARC, 2007). The increasing scarcity of water resources in irrigated rice systems and the competition from industrial, domestic and non- rice agricultural sectors suggest the need to use and conserve rainfall and irrigation water more efficiently. Direct seeding is an alternative rice establishment method that is relatively less labor-intensive and less water consuming. The direct-seeded rice area in Asia is about 29 million ha, which is approximately 21% of the total rice area in the region. DSR culture is compatible with the irregular rainfall pattern, guaranteeing crop growth, which avoids the need to leave land idle due to failure of transplanting (Kabaki, 1998). It can results in earlier maturity of rice, which helps to improve wheat productivity through timelier establishment (Malik et al., 1998). Rice transplanting and sowing time sometimes gets delayed due to lack of assured irrigation or surplus of rainfall in the major areas ofterai and inner-terai of Nepal. The adoption of a direct seeded method for rice culture would significantly decrease the cost of rice production in south East Asia (Flinn and Mandac, 1986). Sowing on time ensures that vegetative growth occurs during a period of satisfactory temperatures and high levels of solar radiation and guarantees that grain filling occurs when milder autumn temperatures are more likely, hence good grain quality is achieved (Farrell et al., 2003). However at the same time no varieties have been specifically developed for this purpose. The existing varieties used for rice culture do not appear to be well adapted for growth and yield. Viewing these facts, an experiment was carried out to evaluate the effectiveness of sowing dates and varieties on growth and yield of direct seeded rice in Chitwan.

MATERIALS AND METHODS

A field experiment was conducted at farmer's field of Phulbari, Chitwan from May to November 2010.

Geographically it is located at 27° 37' N latitude and 84° 25' E longitude with an elevation of 228 meter above mean sea level. The type of the soil was sandy loam and acidic in nature with low organic matter content and total available nitrogen whereas available phosphorus was high but at the same time available potassium was medium. The total rainfall received by crops during growing season was 2308.60 mm. Similarly average maximum temperature ranged from 26.01^{0}C at 3rd week of November to 36.50 ^{0}C at 2nd week of June and minimum temperature ranged from 17.57 ^{0}C at 3rd week of November and 27.5 ^{0}C at 1st week of June and August.

The experiment was laid out in split plot design with sowing dates on the main plot and variety on the sub plot. Experimental plots consisted three replications and 12 treatments combinations. The main plot factor consisted of four sowing dates at fifteen days interval starting from 29 May. Sub plot factor consisted of three different crop varieties viz. Hardinath -1, Sabitri and Ram. The net size of each plot was 11.04 m^2(4.6m x 2.4m). Total field area was 398 m^2 (15.5m x 59m). There was a bund of 0.5 m width between two experimental plots and each replication was separated by bund of 1 m width. Row to row distance was made at 20 cm apart and seed was sown continuously in the row.

Seeds were sown at the rate of 80 kg/ha in each date of sowing in the line. Gap filling was done after 15 days of sowing in the sparsely germinated rows to maintain the desired plant population. One third of the recommended dose of nitrogen (100 kg/ha) and full dose of phosphorus (30 kg/ha), potash (30 kg/ha) and zinc sulphate (20 kg/ha) were applied at sowing, and the remaining nitrogen was top-dressed in two equal splits, half at active tillering and half at panicle initiation stage. For effective weed control Pendimethalin 1 kg a.i. ha^{-1} was used in moist condition at evening hours in all the treatments just after sowing of rice. One hand weeding operations were done at 25 days after sowing (DAS) to reduce the competition between weeds and crop for nutrients and spaces. Single spraying of insecticide Thiodan (Endosulfan 35% EC) 2 ml. lit^{-1} of water was applied before milking stage of crop to control sucking insect particularly rice gundhi bug. Life saving irrigations was applied in research plot at the time of need during vegetative stage and light irrigation was applied before panicle emergence and flowering stage in each plot.

MSTAT-C was used for running statistical analysis. Duncan's Multiple Range Test (DMRT), a mean separation technique, was applied to identify the most efficient treatment. Calculation was done at 5% level of significance.

RESULTS AND DISCUSSION

Effect of sowing dates and varieties on yield attributing traits in DSR

Effective tillers per square meter

Sowing dates significantly influenced the number of effective tillers per square meter. Number of effective tillers per square meter in June 13 sowing was significantly higher (318) as compared to June 28, May 29 and July 13 date of sowing and they were statistically similar. Significantly higher effective tiller per square meter in June 13 might be due to favorable environmental conditions which enabled the plant to improve its growth and development as compared to other sowing dates. This result is in alignment with the findings of Pandey et al. (2001). There were significant differences in effective tillers per square meter among the varieties too. Hardinath-1 had the highest number of tillers per square meter (346.1). This might be due to significantly higher tiller mortality percentage of Sabitri (34.64%) than other varieties 20.91 and 26.13% respectively for Hardinath -1 and Ram (Table 1). The difference in tiller production among cultivars may be attributed to varietal characters (Chandrashekhar et al., 2001).

Significant interaction effect of sowing dates and varieties was observed on effective tillers per square meter. The interaction of Hardinath -1 with all the sowing dates produced more effective tillers whereas the interaction of Sabitri with different sowing dates produced lower number of effective tillers. The interactions of June 13 sowing and Hardinath-1 produced more tillers (360.3) and significantly lower number of tillers were produced by the combination of July 13 and Sabitri.

Filled grains per panicle

However filled grains per panicle were highest in June 13 sowing (92.36) followed by May 29 (91.24) and lower number of filled grains was observed in July 13 sowing. The lower number of filled grains per panicle beyond the June 13 sowing might be due to synchronization of grain filling stage with low temperature, which increased the grain sterility and hence less filled grain percentage. This result is aligned with the findings of (Janardhan et al., 1980).

Table 1. Effect of sowing dates and varieties on number of effective tillers, panicle length, filled grains per panicle, sterility % and test weight in direct seeded rice (DSR) at Phulbari, Chitwan, Nepal, 2010

Treatments	Yield attributes				
	No of effective tillers	Panicle length (cm)	Filled grain per panicle	Sterility %	Test weight (g)
Sowing dates					
May 29	291.9[b]	20.84[b]	91.24	15.80[b]	21.17[a]
June 13	318.0[a]	22.76[a]	92.36	14.53[b]	21.04[a]
June 28	298.9[b]	22.95[a]	89.07	15.84[b]	21.25[a]
July 13	285.2[b]	19.52[c]	88.55	19.90[a]	19.34[b]
LSD (P = 0.05)	13.76	1.01	NS	2.05	0.87
SEM ±	3.97	0.29	3.67	0.59	0.25
Varieties					
Hardinath-1	346.1[a]	23.00[a]	92.36	14.64[b]	19.99[b]
Sabitri	246.1[c]	18.86[b]	88.14	18.20[a]	21.02[a]
Ram	303.3[b]	21.93[a]	90.41	16.71[ab]	21.09[a]
LSD (P = 0.05)	12.9	1.93	NS	0.96	0.83
SEM ±	4.3	0.46	1.51	2.37	0.27
CV %	4.99	7.57	5.99	16.62	4.64
Grand Mean	298.5	21.26	90.31	16.51	20.69

Treatments mean followed by common letter (s) within column are not significantly different among each other based on DMRT at 5% level of significance

Among the varieties relatively higher number of filled grains per panicle was recorded in Hardinath-1 (92.36) followed by Ram and Sabitri (90.41 and 88.14 respectively). The more filled grains in Hardinath-1 could be due to early maturation before low temperature conditions prevailed and higher sterility percentage in the Sabitri and Ram.

Sterility percentage

Percentage of empty grains is determined by air temperature during the critical growing stage, namely at the time of meiosis (9-12 days before flowering) and flowering (Shihua et al. 1991). Significantly more sterility was observed in July 13 sowing (19.90 %) whereas other sowing dates produced statistically similar sterility percentage (Table 1). Lower sterility in early sowing was due to optimum photoperiod availed by these treatments for growth, development and starch filling in the grains.

Among the varieties Sabitri had significantly higher sterility percentage (18.20 %) than Ram and Hardinath-1 (16.71 and 14.64 % respectively). Higher sterility percentage in Sabitri was due to its long growth duration, high nutrient and moisture requirement whereas low sterility in Hardinath -1 might be its ability to grow in marginal land with limited water and nutrient supply. Interaction effect of sowing dates and varieties had no significant effect on sterility percentage.

Thousand grain weight (test weight)

The thousand grain weight was influenced by both the factors used in the experiment i.e. sowing dates and varieties. Significantly higher test weight was observed in June 28 sowing (21.25 gm) and it was statistically similar with May 29 sowing and June 13 sowing (21.17 and 21.04 g) and at the same time significantly lower test weight was observed in July 13 sowing (19.33g). Higher test weight in June 13 and June 28 sowing was attributed to optimum photoperiod availed by these treatments for growth, development and starch filling in the grains and sufficient soil moisture availed by well distributed rainfall.

Among the varieties, Sabitri had significantly higher test weight (21.08 gm) than the Ram (21.09 gm) and Hardinath-1 (19.98 gm). Greater thousand grain weight of Sabitri was probably due to the facts that it seeds are long and bulkier. There was no significant interaction between sowing dates and varieties on thousand grain weight.

Effect of sowing dates and varieties on yield in direct seeded rice

Grain yield

Grain yield is a function of various yield components primarily number of kennels per panicle, productive tillers and 1000 grain weight etc. Among the different sowing dates, June 13 sowing produced significantly higher grain yield (3.84 t ha^{-1}) as compared to other sowing dates and significantly lower yield was observed on July 13 (1.92 t ha^{-1}) sown crop. This showed that the grain yield gradually decreases as the sowing was done before 13th June or delayed after 13th June. The higher yield in case of 13th June sowing was

attributed to increased cumulative mean value of temperature and sunshine hour due to early sowing, more number of productive tillers, more number of grains per panicle, and higher test weight. These results are in line with that of Iqbal et al. (2008) who reported that the highest yield (4-5 tha^{-1}) was obtained when the rice crop was sown earlier in the season.

Likewise in the varieties, Hardinath-1 produced significantly higher grain yield (3.39 t ha^{-1}) as compared to Ram (3.07 t ha^{-1}) and Sabitri(2.76 t ha^{-1}). The higher grain yield of Hardinath-1 was because of higher LAI, slower leaf senescence which contributed to better light interception and higher assimilates production, higher dry matter production especially at the later growth stage of crop and higher harvest index. The greater remobilization of stem reserve towards the grain resulted in higher gain yield in Hardinath-1. No significant interaction between sowing dates and varieties on grain yield was observed. However, Hardinath-1 with different sowing dates produced comparatively higher grain yield and Sabitri with different sowing dates reported to produce lower yield (Figure 1).

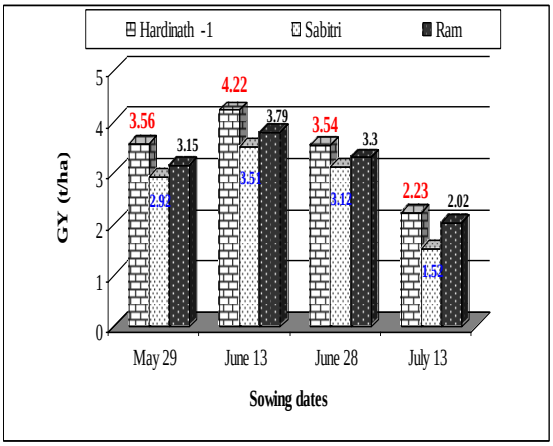

Figure 1. Interaction effect of sowing dates and varieties on grain yield (t/ha) in direct seeded rice, at Phulbari, Chitwan, Nepal 2010

Straw yield

Straw yield (tha^{-1}) was significantly influenced by the sowing dates and varieties (Table 2). The straw yield was the highest (6.85 t ha^{-1}) in June 13 sowing which was significantly superior to the straw yield from June 28, May 29 and July 13 sowing. Similarly, significantly highest straw yield was observed in Hardinath-1 (6.07 t ha^{-1}) and lower straw yield was recorded in Sabitri (5.23 t ha^{-1}).

The significant interaction between sowing dates and varieties on straw yield was observed. In general Hardinath-1 produced higher straw in all the sowing dates, followed by Ram and Sabitri. The interaction of Hardinath-1 with June 13 sowing produced the highest straw yield (7.43 t ha^{-1}) and it was significantly higher than all other interaction of sowing dates and varieties. Sabitri produced the lowest straw yield (2.60 t ha^{-1}) with July 13 sowing.

Harvest index (HI)

Harvest index indicates the efficiency of assimilate partition to the parts of economic yield of the rice plants (i.e. panicle). Higher harvest index indicates better assimilate transport to the panicle.

Significantly higher harvest index was obtained with June 13 sowing (0.36) followed by June 28 sowing, May 29 and July 13 sowing (0.35, 0.34 and 0.33 respectively). Better assimilate partitioning from the source (leaf and non-laminar organ i.e., leaf sheath, stem, flag leaf) to the panicle (sink) occurred in the two varieties namely Hardinath-1 and Ram compared with Sabitri. There were no significant interactions between sowing dates and the varieties on HI.

Table 2. Effect of sowing dates and varieties on grain yield, straw yield and harvestin direct seeded rice (DSR) at Phulbari, Chitwan, Nepal, 2010 index

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index
Date of sowing			
May 29	3.21^{b}	6.08^{b}	0.34^{c}
June 13	3.84^{a}	6.85^{a}	0.36^{a}
June 28	3.32^{b}	6.17^{b}	0.35^{b}
July 13	1.92^{c}	3.46^{c}	0.33^{d}
LSD (P = 0.05)	0.28	0.56	0.001
SEM ±	0.08	0.16	0.0003
Varieties			
Hardinath - 1	3.39^{a}	6.07^{a}	0.35^{a}
Sabitri	2.76^{c}	5.23^{c}	0.33^{c}
Ram	3.07^{b}	5.63^{b}	0.34^{b}
LSD (P = 0.05)	0.11	0.13	0.0008
SEM ±	0.03	0.04	0.0002
CV %	4.42	2.85	3.75
Grand Mean	3.076	5.64	0.34

Treatments mean followed by common letter (s) within column are not significantly different among each other based on DMRT at 5% level of significance.

Treatments	Economic Parameters			
	Total cost NRs/ha (' 000)	Gross return NRs/ha (' 000)	Net return NRs/ha (' 000)	B:C ratio
Sowing dates				
May 29	60.33[a]	82.15[b]	22.09[c]	1.36[b]
June 13	57.33[b]	96.78[a]	39.98[a]	1. 69[a]
June 28	52.53[c]	84.45[b]	31.85[b]	1.60[a]
July 13	52.53[c]	48.76[c]	-8.19[d]	0.92[c]
LSD (P = 0.05)	0. 76	7.05	3.67	0.13
SEM ±	0.21	2.04	1.06	0.03
Varieties				
Hardinath -1	55.67	87.53[a]	31.87[a]	1.56[a]
Sabitri	55.67	66.85[c]	11.23[c]	1.19[c]
Ram	55.67	79.72[b]	21.20[b]	1.42[b]
LSD (P = 0.05)	NS	2.52	6.24	0.04
SEM ±	0.09	0.84	2.08	0.01
CV %	0	3.74	33.68	3.69
Grand Mean	55.67	78.03	21.43	1.39

Effect of sowing dates and varieties on economic parameters in direct seeded rice

There was significantly higher gross return, net return and benefit cost ratio with June 13 sowing. Table 3 depicts clearly the economic analysis of direct seeded rice. Among the varieties, Hardinath-1 recorded significantly higher gross return, net return and benefit cost ratio. Regarding the interaction of sowing dates and varieties on economic parameter , no significant interaction was observed ,however the interaction of June 13 sowing and Hardinath-1 revealed comparatively higher gross return, net return and benefit cost ratio and at the same time combination of July 13 and variety Sabitri deserved lower value of economic parameters.

Table 3. Effect of sowing dates and varieties on cost of production, gross return, net return and B: C ratio in direct seeded rice at Phulbari, Chitwan, Nepal, 2010

CONCLUSIONS

Among the sowing dates, June 13 sown crop produced higher grain and straw yield along with higher gross return, higher net profit, and more favorable benefit-cost ratio. The variety Hardinath-1 produced significantly higher grain yield, net return and higher B: C ratio as compared to the variety Ram and Sabitri. Regarding the interaction, combination of Hardinath-1 with different sowing dates recorded to produce higher grain yield, straw yield. So, it would be better to use the variety Hardinath-1 and follow June 13 as optimum sowing date for rice cultivation along with the other elements for crop management under the direct seeded rice (DSR) in Chitwan.

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Developing Wastewater Irrigation

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Abstract

The theme of the desk study is to analyze the development of wastewater irrigation, and the possible risks and opportunities of wastewater use in irrigation with special reference to environmental issues. Wastewater irrigation in urban and peri-urban areas, contributing to improved livelihoods and productivity in wastewater use, and insight for environmental sustainability and health promotion will be discussed. In this study, the need for wastewater use in agriculture, in relation to water resources availability, urbanization, and population growth is presented with an assumption that population keeps increasing and more food needs to be produced in the future with more water applied to this purpose. It examines the links between wastewater use in agriculture and constraints and potentials arising from developing wastewater irrigation. In this study, wastewater consisting of domestic sewage that does not contain industrial effluents at levels that could pose threats to public health and the environment will be discussed.

Population Growth and Water Scarcity - General Considerations

In developing countries, fast-growing urban populations are demanding more fresh water and food, while giving rise to generating greater quantities of domestic wastewater (UN, 2006).According to UN (2006), three quarters of the world's total irrigated area is located in developing countries and in 20 years 60% of the world population will be living in cities. This UN study projects more water will be needed for municipal use, and, consequently, additional municipal waste (domestic) water will be produced - all in the same place and within a limited area. In reality, population growth increases both demand for fresh water and the amount of wastes that are discharged into the environment, thus leading to more pollution of clean water resources. Moreover, agricultural irrigation will need to claim large quantities of water to produce the food required to feed the world, as agriculture (The *term 'agriculture' also inclu*des livestock husbandry, fisheries and forestry) is the main source of the world's food.In the cases described above, water is becoming scarce due to population growth and urbanization, and agriculture is the main sector suffering from reduced water availability. Increasing scarcity of freshwater resources and growing environmental awareness give rise to the use of domestic wastewater as an alternative source of water.

Box 1- Wastewater - A Best Option!

Agriculture is the largest consumer of water, requiring hundreds times more than is used for personal needs. This situation drives the demand for wastewater from domestic sewage systems and industry. As mentioned by IWMI (2006), agriculture currently consumes 70% of the world's developed fresh water supplies. Taking this into account, IWMI (2006) estimates that by improving the productivity of water used for agriculture by 40%, it is possible to reduce the amount of additional freshwater needed to feed the world's growing population to zero. This leads to the conclusion that there are significant opportunities to improve the water productivity of all agricultural production systems and thereby reducing the pressure on finite freshwater resources. Wastewater use in agriculture may be one of the best options towards this end.

Developing Wastewater Irrigation - Key Issues

The key issues pertaining to environmental concerns come together with application and impact of wastewater on the livelihoods and health of people. So, it is reasonable to deal with these issues - environmental, health, and livelihood - side by side.

From the environmental aspect, there are potentially positive and negative impacts on different levels (of wastewater use) that should be considered when developing wastewater irrigation (Hoek, 2002).In many situations, wastewater irrigation has arisen without planning –often the water is untreated leading

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to negative environmental impacts.In developing countries, wastewater agriculture is largely the result of unplanned pollution of irrigation sources with wastewater (Raschid-Sally et al., 2004a:P.84**).**Wastewater irrigation has the potential to offer important advantages yet can be dangerous to people's health and the environment**.**Since the reality is that the wastewater use in irrigation in those countries is a fact of life, what is important here is to look at mitigating these negative impacts on the beneficiaries of wastewater use and align its use with sustainable livelihoods. In other situations, the use of wastewater in agriculture is strictly controlled leading to positive environmental impacts (WHO, 2006).This is clearly the case in developed countries where wastewater is used because of environmental concerns.

Developing wastewater irrigation is a set of complicated and interrelated issues that includes (1.) upstream - downstream interactions, (2.) groundwater and surface water quality, and (3.) health and environmental concerns. This statement is confirmed by Huiberset al. (2005) who explains that wastewater use in agriculture is a very complex issue comprising a wide range of different elements such as food production, hydrology, health and socio-economic issues and overall environmental risks. However, it should be mentioned that recycled water can have the advantage of being a constant, reliable year round water source and has high potential for use in agriculture.

Negative Health and Environmental Effects – Be Aware!

Generally, the use of domestic waste water for irrigation poses less risk to the environment than use of industrial waste water, especially with industries that use or produce highly toxic chemicals. One has to be aware that efforts should be made to reduce or eliminate practices that involve the mixing of domestic and potentially-toxic industrial wastewater, particularly where wastewater is used for agriculture.According to Toze (2006), there have been a number of risk factors identified for using wastewater irrigation in agriculture. He bases his argument on the fact that some risk factors are short term and vary in severity depending on the likelihood of human, animal, or environmental contact (e.g., microbial pathogens); while others have longer-term impacts which increase with continued use of recycled water (e.g., saline effects on soil).

Major risk factors, such as (1.) informal use of wastewater in urban agriculture,(2.) relatively-low sanitation and hygiene standards,(3.) limited untreated wastewater,(4.) a lack of planned approaches to wastewater use, and (5.) lack of enforcement of appropriate guidelines or standards to the safe use of wastewater, can pose health and environmental risks as follows.

Environmental Risks:

Pollution of soils with heavy metals and contaminants from human pathogens, nutrients, and dissolved solids lead to environmental risks. In fact, these risks may include negative impacts to the environmental quality of soils, groundwater, and surface water and to ecological conditions, if wastewater is disposed of indiscriminately.WHO (2006) identified pathogens that can contaminate crops and soils if wastewater is applied to extremely-porous soils where groundwater is close to the surface. The most important negative effect on the environment caused by agricultural wastewater use is the increase in soil salinity, which, if not controlled, can decrease productivity in the long term.

Public Health Risks:

Water associated vector-borne diseases, in particular malaria and infectious diseases from the presence of human pathogens and certain chemicals in wastewater, has been reported by World Bank (2008). Moreover, important health risks include the transmission of intestinal infections to agricultural workers in wastewater-irrigated fields and to consumers of wastewater- irrigated produce due to intestinal parasites and the transmission of fecal bacterial diseases such as diarrhea, dysentery, typhoid, and cholera.

It is likely that possible effects depend on each specific situation (e.g., local culture and practice) and how the wastewater is used. There are clearly serious drawbacks for human health that result from using wastewater without adequate safeguards.These cases call for everyone involved to be extremely cautious with every situation when developing wastewater irrigation practices.

Improving Water Productivity and Livelihoods - More Production from Every Drop!

Irrigation with waste water is potentially very profitable for farmers, as the nitrogen and phosphorus content of sewage might reduce or eliminate the requirements for commercial fertilizers

Box2 - Measures of Health and Environmental Risks

The health of urban poor is particularly linked to inadequate management of wastewater. Use of wastewater in agriculture could be an important consideration when its disposal is properly planned (Fatta, 2005:P.228).Treatment of wastewater to varying degrees can significantly reduce the concentrations of contaminants and thus decrease the risk of disease and its transmission.Besides treatment, some measures (1.) like selection of appropriate crops, (2.) selection of suitable irrigation techniques, and (3.) human exposure control will often be desirable to prevent pathogens on crops from affecting the consumer (Carr, 2005:P.107).As pointed out above, wastewater use in agriculture has benefits in the form of livelihoods improvement and income generation, and can be utilized with minimal risk with treatment to public health and the environment.

(Fattaetal.,2004: P.234).This statement suggests that the availability of this additional water and available nutrients near urban and peri-urban centers will increase the choice of crops which farmers can grow. In this case, wastewater irrigation can contribute to the achievement of millennium development goals by reducing poverty and hunger. As more food crops are produced, farmers' incomes will rise and food security will increase.

An additional advantage, as mentioned by Redwood et al. (2008), is the proximity of food production to its markets resulting in lower transportation costs. Also, wastewater has better potential to irrigate fodder that supplies an urban and peri-urban livestock-based production. As mentioned by Scott (2004), fodder cultivation is particularly well matched to wastewater and is generally tolerant of the high salinity levels characteristics of urban wastewater. This provides an opportunity to produce milk as close to market as possible. It also represents an important urban and peri-urban agricultural product which enhances livelihoods. As wastewater is being used increasingly for irrigation in urban and peri-urban agriculture, and even in distant rural areas downstream of the very large cities, it drives significant economic activity, particularly those of poor farmers (Rutkowskiet al., 2007:P.84).All in all, it can be affirmed that wastewater use in agriculture has a good potential for providing multiple benefits.

How Wastewater Use in Agriculture Leads to Environmental Protection

Wastewater for irrigation poses a number of environmental risks at various levels (WI, 2005: P.2).However, it offers an opportunity for increasing environmental security by reducing the amount of untreated wastewater discharged into the aquatic environment (Ex- River, Sea).This practice not only conserves valuable freshwater flows from rivers and streams upon which fish and wildlife depend, butit also takes advantage of the nutrients contained in wastewater to grow crops. Additionally, using recycled water reduces pressure on fresh water supplies by reducing the amount of water that needs to be extracted from environmental water sources. It would otherwise lead to the degradation of water quality.

Moreover, irrigation schemes based on the use of wastewater can be the means of recycling important soil nutrients such as phosphorous and nitrogen back to farm lands(Khan, 2006:P.200). This plan reduces the impact of these nutrients on aquatic environments contributing to environmental sustainability by using those nutrients for increased crop production. Additionally, using the nutrients available in wastewater reduces the environmental impacts associated with the mining (phosphorous) and production of artificial fertilizers (WHO, 2006).

Furthermore,it is clearly a case of environmental protection when, as mentioned byFoster (2003), aquifer recharge with treated wastewater becomes possible in areas where aquifers are depleted from overuse. An indirect consequence of irrigated agriculture with fresh water or wastewater is aquifer recharge. The recharge of aquifers has the advantage of increasing the local availability of water (WHO, 2006).

Box3 - Health and Environmental Issues: Solutions with an Integrated Approach

The complex issues of wastewater use in agriculture (described in P.2) along with the negative environment and health implications need to be addressed.With careful planning and management, the use of wastewater in agriculture can be beneficial to the environment (WHO, 2006).Kretschmeret al. (2002) argues that wastewater use in agriculture requires an integrated planning approach, considering economic as well as environmental and health issues. He bases his argument on a view that the IWRM approach looks at the whole urban water cycle and across the urban-rural continuum at environmental consequences downstream, as well as socio-economic benefits of resource recovery (IWMI,2006:P.1).This calls for an integrated solution (rather than fragmented)to be combined with locally-appropriate and sustainable risk-reduction measures. It should also be recognized that solutions require the active involvement of stakeholders. In brief, solutions should be economically, financially, socially, and culturally acceptable. A planned use of wastewater that seeks to maximize the benefits and minimize the risks will require an integrated approach.

Conclusion

Based on the discussion above, it can be acknowledged that developing wastewater irrigation has multiple benefits in using a resource that would otherwise be discarded posing major health and environmental challenges. One of the greatest advantages is providing farmers with a reliable, safe, and economically-feasible source of irrigation water. In reality, development of wastewater irrigation is a ground-breaking development of water resources in urban areas.

In summary, the primary goal of wastewater irrigation is to maximize the benefits to the poor who depend on the resource while minimizing its risks. Protection of human health and the environment are the most important considerations in the use of wastewater. However, it must be properly managed. This leads to the conclusion that, although the development of wastewater irrigation provides enormous opportunities for sustaining livelihoods of poor people, health and environmental issues associated with this practice cannot be neglected.Developing and applying safety measures based on appropriate research and its resulting options in the local context will help minimize health and environmental hazards of wastewater use.

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Comparative Study on Noise Pollution along Koteshwor-Suryabinayak Extension Road

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Abstract

Noise pollution may be unnatural sound, which is dumped into the atmosphere without regarding to the adverse effect it may be having. This research aims at measuring the noise level and recommending the steps to be followed in minimizing the sound pressure level. In poor availability of the specific guidelines and policies regarding noise pollution prevention and control in the country, this research has aimed of monitoring noise due to Koteshwor and Suryabinayak road extension. General traffic activities, public activities, pressure horns, generator, vehicles brake, etc were the major sources of noise. The observed average equivalent twenty four hour average sound pressure levels at different distance were greater than prescribed WHO guideline value of 70dB(A) for industrial, commercial shopping and traffic areas, indoor and outdoor. So, hearing impairment was possible at the both site.

1 INTRODUCTION

Noise pollution is a significant environmental problem in many rapidly urbanizing areas. This problem is properly not recognized despite the fact that it is steadily growing in developing countries (Barbozaet al.1995). Like in other developing countries Nepal is also facing the consequences of noise pollution due to urbanization and increasing number of vehicles. Only few researches has been carried out and even such surveys conducted in the past have revealed that noise levels in urban areas of Nepal are generally much higher than recommended international standards. It is well established now that noise is a potential hazard to health, communication and enjoyment of social life. It is becoming an unjustified interference and imposition upon human comfort, health and quality of modern life (Ahmad, k., 1998).

Noise pollution is an interfering air-pollutant which possesses both auditory and host of non-auditory effects on the exposed population. It is well established now that noise is a potential hazard to health, communication and enjoyment of social life. It is becoming an unjustified interference and imposition upon human comfort, health and quality of modern life (Ahmad, k., 1998). In Nepal, only few researches being carried out in noise pollution. In order to devise the proper implementation of plan to mitigate the problem of noise pollution the scientific researches should be done. This research aims at measuring the noise level and recommending the steps to be followed in minimizing the sound pressure level. In poor availability of the specific guidelines and policies regarding noise polluting prevention and control in the country, this research has aimed of monitoring noise due to Koteshwor and Suryabinayak road extension.

2 MATERIALS AND METHODS

2.1 Study Area

The study was carried out in two different sites Koteshwor which lies in 27^0 40'N latitude, 85^0 25'longitude and 4323ft elevation and Suryabinayak 27^0 39' N latitude, $85^0$25' longitude and 4352ft elevation. Four different points were chosen at each site.

At Koteshwor:

A. Near Bhaktapur bus park
B. In front of police bit
C. Near traffic office
D. Center of KoteshworChwok

At Suryabinayak:

E. Way to Suryabinayak, near to divider
F. Way to Suryabinayak, far from divider
G. Way to Gopali near to divider
H. Way to Gopali far from divider

2.2 Measurement of SPL:

Noise level were recorded at different day time zones for instance, early morning, late morning, day time, evening and night time for each sampling sites. Each time the equipment is switched on, the sound level meter runs for few minutes. There is one set of data for each time zone for each sampling site representing sound levels recorded at different time zone of the day, which depicts activity related sound level of the area. The data given by measurement are evaluated as average sound pressure level (L_{eq}), average day night sound pressure level (L_{dn}) and percentile level for each sampling site at various time zones are presented in tabular form. JIS Z 8731/1983 was followed during the operation and calculation of sound pressure level. The applied digital sound pressure recorder has the following specification:

Instrument name	Digital sound level meter
manufacturer	Lutron, Taiwan
Measuring Range	35 to 130 dB(A)
Service Temperature Range	0 to 40 degree Celsius
Model No.	SL 4010
Serial No.	B 33990
Calibrated at	94 dB(A)

3 RESULTS AND DISCUSSIONS

3.1 Sound pressure Level:

At Koteshwor, the observed Ld& Ln varied from 81 dB (A) ~88 dB (A) and 78 dB (A) ~83 dB (A) respectively. The minimum sound pressure 54 dB (A) was observed at early morning and mid night hours. The maximum sound pressure level in the monitoring site reached up to 99 dB (A) which was due to honking of pressure horn. Similarly the equivalent SPL varied from 63 dB (A) ~81 dB (A) in the day time while it was 60 dB (A) ~73 dB (A) in the night time. The average day night sound pressure level was about 83 dB (A).

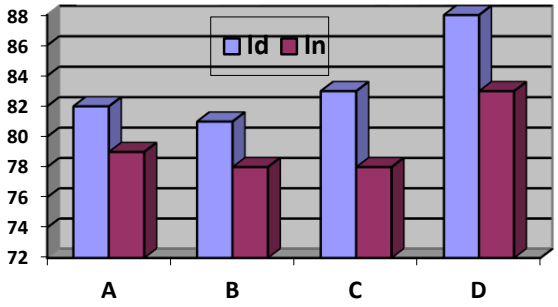

Figure 3. 1: Site Wise Composition of Ln and Ld at Koteshwor extension road

At Suryabinayak, the observed L_d& L_n varied from 72dB (A) to 85dB (A) and 68dB (A) to 74dB (A) respectively. The minimum sound pressure of 52dB (A) was observed at night time. The maximum sound pressure level in the monitoring site reached up to 92dB (A) for honking of pressure horn. Similarly, the equivalent sound pressure level varied from 64dB (A) to 75dB (A) in the day time while it was 42dB (A) to 78dB (A) in the night time. The average day night sound pressure level was about 75dB (A).

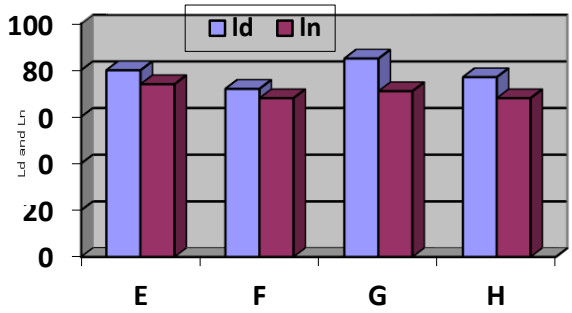

Figure 3.2: Site Wise Composition of Ln and Ld at Suryabinayak extension road.

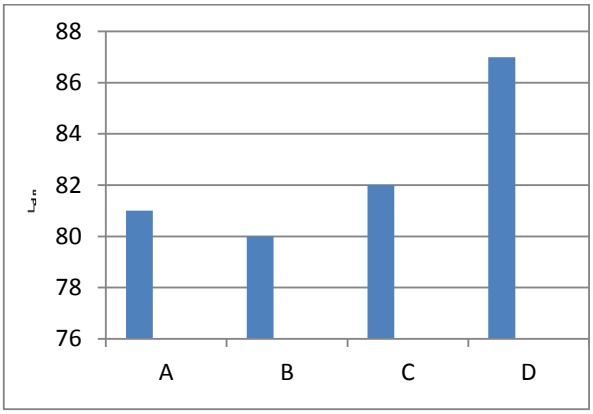

Figure 3. 3: Site wise comparision between Ldn at Koteshwor

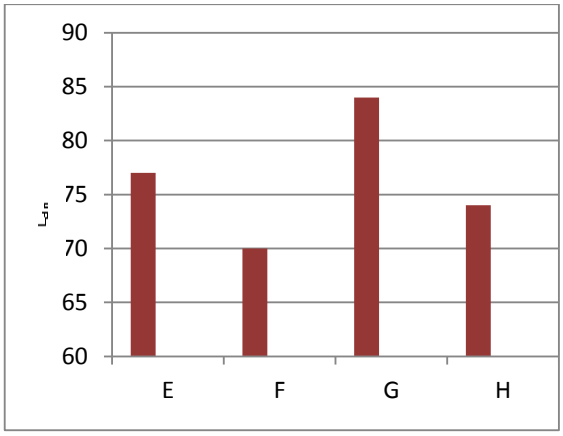

Figure 3.4: Site wise comparision between Ldn at Suryabinayak

The sound pressure data entailed that day-night average sound pressure level (Ldn) at the points of Koteshwor, A- near Bhaktapur buspark, B-in front of police bit, C-near traffic office and D-center of Koteshworchowk were 81 dB(A), 80 dB(A), 82 dB(A) and 87 dB(A) respectively which is comparatively higher than the day night average sound pressure level(Ldn) at the points of Suryabinayak, E-way to Suryabinayak near divider, F-way to Suryabinayak far from divider, G-way to Gapali near divider and H-way to Gapali far from divider were 77 dB(A), 70 dB(A), 84 dB(A) and 74 dB(A) respectively.

Leq value is higher in surybinayak (64 dB(A)~78 dB(A)) than koteshwor (60 dB(A)~74 dB(A)) during early morning while the leq values is lesser in suryabinayak (42 dB(A)~60 dB(A)) than koteshwor (60 dB(A)~74 dB(A)) during mid-night (figure 4.4 and 4.5). The obtained data for these various noise descriptors for monitoring time zone revealed that the ambient sound pressure level was strongly influenced by high traffic conditions. In addition air traffic was seen occasionally which also added sound level at the Koteshwor site.

3.2 Noise pollution Level:

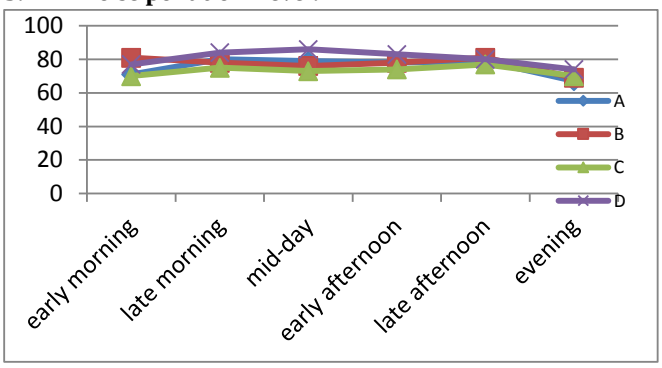

Figure 3.5: site wise NPL variation at Koteshwor

NPL value for surybinayak (72 dB(A)~86 dB(A)) were higher than in koteshwor (70 dB(A)~81 dB(A)) during early morning while the NPL values is lesser in suryabinayak (56 dB(A)~61 dB(A)) than koteshwor (63 dB(A)~79 dB(A)) during mid night (figure 4.6 and 4.7).

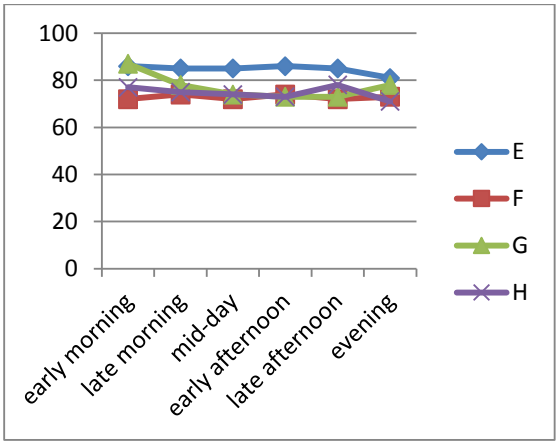

Figure 3.6: site wise Npl variation at Suryabinayak

3.3 Standards, Guidelines and Health Consequences:

The observed average equivalent twenty four hour sound pressure levels at both sites were greater than prescribed WHO guideline value of 70dB(A) for industrial, commercial shopping and traffic areas, indoor and outdoor. The observed maximum sound pressure level was lesser than the prescribed WHO guideline value of 110dB (A) in every spot. The observed night time average values in every distance spot were greater than 42dB (A) [Netherland Standard]. So the health effects are increased average motility when sleeping, indoor annoyance self reported sleep disturbance and environmental insomnia. The residents of both Koteshwor and Suryabinayak are likely to suffer from these biological effects.

At observed night average SPL, the situation is considered increasingly dangerous for public health. Adverse health effects occur frequently a high percentage of the population is highly annoyed and there is some limited evidence that the cardiovascular system is coming under stress (WHO night time Guideline Value: $L_{n,}$ outside > 55 dB, NNGL for Europe, 2007).

4 CONCLUSION:

The following conclusions are drawn from the study :

General traffic activities, public activities, pressure horns, generator, vehicles brake, etc were the major sources of noise.

The observed average equivalent twenty four hour average sound pressure levels at different distance were greater than prescribed WHO guideline value of 70dB(A) for industrial, commercial shopping and traffic areas, indoor and outdoor. Therefore, hearing impairment is possible at the both site.

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Food Deficit: Challenge for the Modern World

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062-BAE-01

Abstract

World's population exceeds seven billion, but the land for agriculture is decreasing day by day due to infrastructure and other uses. Some countries are doing huge investment on wars while some countries facing severe food shortage. Millions of peoples are dying due to hunger every week. The most challenging issue for the modern world is to provide a food for increasing population from decreasing agricultural lands. This article intends to analyze the causes and consequences of food deficit and tries to provide some solutions to fight with it.

INTRODUCTION

The food deficit is a widespread scarcity of food caused by several factors including crop failure, population unbalance or government policies. Nearly every continent in the world has experienced a period of food deficit throughout the history. Some countries, particularly in sub-Sahara Africa, continue to have extreme cases of food deficit.

Food shortage occurs when food supplies within a bounded region do not provide the energy and nutrients needed by that region's population. Food shortage is most easily conceptualized as a production problem - not enough food is grown to meet regional needs - but constraints on importation as well as storage can also cause or contribute to food shortage. Food shortage is also created where food is exported from areas where production is adequate or even abundant.

Food sufficiency or deficit always depends upon the population to be feed. Availability of food is determined by domestic production, import capacity, existence of food stocks and food aid. Access to food depends on levels of poverty, purchasing power of households, prices and the existence of transport and market infrastructure and food distribution systems.

Despite a general decline in fertility rates, world population is still growing rapidly. United Nations predictions of global population increase to the year 2025 require an expansion of food production of about 40-45% (Stockle, 2002). According to an FAO report released on 9 October 2006, forty countries are facing food emergencies and require external assistance (FAO, 2006).

Nepal occupies the 16th position among 31 countries that are reeling from a food deficit with 40 districts facing a food shortage. Food insecurity is growing in Nepal as well as in the world despite improvements in technology in food production and processing. In addition rising prices is aggravating the food crisis. On the other hand, natural calamities such as winter droughts and floods have had a severe impact on food security in the country (The Kathmandu Post, 2010-04-01). In Nepal Humla, Mugu and Bajhang are the districts having extremely food deficit where less than 4 month food sufficiency occurs. Similarly 7 districts have severely food deficit (less than 6 months food sufficiency), 18 districts have moderate food deficit (less than 10 months food sufficiency), 14 districts have mild food deficiency, 9 districts have food sufficiency and 21 districts have food surplus (WFP,1998). According to Nepal Agricultural Research Council, in 2005 Nepal had 213,027 MT foods was sufficient, but in Mountain and Hilly region of Nepal had 64,683 MT and 287,923 MT foods was deficit respectively (Manandhar, 2005).But according to Water and Energy Commission Secretariat, Nepal was self sufficient in food grain production until 1990. Due to drought condition in 2005/06, production fell short by 21,553 MT and by 179,910 MT in 2006/07 due to drought and natural calamities (WECS, 2011).

CAUSES OF FOOD DEFICIT

The different stakeholders related to food deficit issues blame each other for its causes. On the world food day (October 16) of 2010 foreign minister of Canada said that developed countries are responsible for the food deficit. He identifies following three reasons that the developed countries are responsible for food deficit:

1) Developed countries are gradually decreasing the investment in agriculture and increasing in the industrial sector.
2) Developed countries have technology so that they convert edible product into non edible product (eg.

Biodiesel from maize), whereas millions of people are dying of hunger.

3) Developed countries are more responsible for the global warming and it affects most in developing countries (floods, landslides drought etc.) which adversely affects on the food production (Nepal is 4th most vulnerable country in South Asia due to climate change) (Thapa, 2010).

Food deficit in Nepal is mainly the result of insufficient inputs in the production process, conversion of food grain into animal feed, erratic rainfall, delayed monsoon and poor land husbandry. The crop yield data show big yield gaps (the gap between attainable yield and the national average yield). The gap is three tons per hectare for wheat, three tons per hectare for maize and two tons per hectare for rice. Thus, over a million hectares of cultivable land yield below average (Sapkota, 2011). Agro scientists in Nepal often complain that there is not enough money for research and awareness programs aimed at farmers, which would be of enormous help in reducing these gaps. Unavailability of quality seeds, fertilizers and plant-protection chemicals for the crops are other important factors. Moreover, the government does not have enough space to store all of the food grain produced in the country; instead traders across the border store Nepali harvest, thus leading to seasonal shortages. According to the statistics of the Ministry of Agriculture and Cooperatives, wheat production was down 17 percent due to drought. Similarly, drought brought down paddy production by 11 percent and corn by 4 percent. The fall in production is likely to affect prices. A study done by the Department of Industry revealed that the price of coarse rice was up 41 percent in February compared to the same month in 2009. Similarly, the price of lentil increased 25 percent, flour 25 percent and black gram 44 percent compared to previous year. Sugar rose by 60 percent (The Kathmandu Post, 2010).

Even when production shortfall is the primary cause of insufficient supply, the ecological and political reasons for production problems vary widely. They range from natural disasters such as drought, flood, or fungus, to political disasters such as civil conflict, to misguided economic policies such as price controls- all of which discourage production of essential foods.

Increased demand for meat is a particular concern, since livestock conversions, usually calculated in terms of food energy grain-to-livestock ratio is high. In a feedlot, it takes two kilos (kilograms) of grain to produce one kilo of chicken or fish, four kilos to produce one kilo of pork, and seven to produce one kilo of beef. Some suggest the ratios may be even higher: 3:1, 6:1, and 16:1. In the 1990s, it was calculated that some 4.3 billion large domesticated animals and 17 billion poultry eat 40 per cent of the world's grain supply (Messer &Dr. Rose 2009). In general causes of food deficit can be listed as follows:

1. Social Causes	2. Political Causes
i. Inequality ii. Dependency iii. Exploitation iv. Discrimination v. Disparities vi. Lack of participation	i. Lack of appropriate policies ii. Lack of commitment iii. Lack of good governance (transparency, accountability, responsibility) iv. Poor decentralization
3. Economic Causes	**4. Environmental Causes**
i. Poverty ii. Unemployment iii. Lack of capital formation iv. Lack of appropriate agricultural inputs (seeds, fertilizers, pesticides, irrigation etc.) v. Lack of infrastructure (road, communication, transportation etc.) vi. High population growth rate	i. Global warming and climate change ii. Pollution iii. Natural calamities (flood, fire, landslide, drought) iv. deforestation

CONSEQUENCES OF FOOD DEFICIT

The phenomenon of food deficit is usually accompanied or followed by regional malnutrition, starvation, epidemic and increased mortality. From the perspective of state security, food insecurity would also have implications on the political stability of states, both as a cause and effect. Food security can be jeopardized by the lack of political or social stability. Likewise, food insecurity can lead to political and social instability and, in turn, a regime's survival.

Apart from its implications on domestic stability, food insecurity could destabilize regional security. The policy to curb food export in order to secure national food supply in one country could have a negative impact on other countries. Food security has gained more political weight and become the focal point for discussion and cooperation as a non-traditional security issue.

Areas of famine are almost exclusively found in areas of armed conflict and food wars - the use of hunger as a weapon in active conflict and the consequential food insecurity (Khorid, 2000).Social consequences of food deficit are under nutrition, slow growth rate, begging, conflict, migration etc. Political consequences are instability and refuges, while rise in prices, low production and unemployment are common economic consequences and deforestation, climate change, soil erosion are some common environmental consequences.

HOW TO DECREASE FOOD DEFICIT?

1) Developed countries should increase their investment in agriculture and they should stop converting edible food into non edible product.
2) The irrigated land was, on average, more than twice productive as rain-fed land (Stockle, 2002). Irrigation agriculture will be an essential component of any strategy to increase the global food supply. Much effort will be needed to increase the efficiency of existing irrigation systems.
3) In the case of food grains, some estimates suggest that in developing countries as much as $1/4^{th}$ to $1/3^{rd}$ of the total crop may be lost as a result of inefficiencies in the postharvest system (Ojha & Michael, 2010). It is essential that a major centralized effort be made to provide research and development capability in the field of postharvest technology and to expand or develop joint programmes with national organization.
4) Agricultural protection should be granted to developing countries that have food shortage and large availability of good land.
5) Land, seeds, fertilizers and chemicals should be available in sufficient quantities to sustain the required production.
6) International trade rules need a new framework in order to ensure enough food to the poor.
7) There is no quick fix for the underlying cause of the food crisis, but urgent interventions are needed to address immediate food shortages for the countless people facing hunger and malnutrition. The High-Level Conference on World Food Security, held in Rome in June 2008, identified a number of concrete steps to mitigate hunger (Cecchi, 2009). The most urgent is to increase emergency food aid and to assist poor people in obtaining the maximum yield from the next season's crops. Etc.
8) If the farmers are supported with proper inputs in time and storage facilities are improved, we can attain the goal of food sufficiency in a not too distant future. Also, if the farmers could store rainwater during monsoon for its use in the dry season, millions of tons of additional yield can be achieved. None of these measures require genetic manipulation of seeds, which is Monsanto's forte.
9) An integrated livelihood improvement approach will be required to ensure food security at the local level. In addition increasing access to markets, capacity building of farmers and developing entrepreneurship for high-value cash crops and commodities will be needed to cope with such emerging problems.
10) In developed countries, higher consumption of animal foods and fat is being discouraged to make more food available to meet global food needs, and to encourage sustainable agricultural practices.
11) A food shortage is likely to impact most heavily on women and girls, who are often the last fed in poor households. So the knowledge about gender equity and social inclusion is also related with food deficit (UNDP, 2008). Etc.

CONCLUSION

There are no hard and fast rules and no fixed methods to reduce food deficit. Process and methods used to reduce food deficit mainly depends on the causes of it. This problem is not only for developing countries. Some steps should be moved within the country and developed countries also assist to developing countries. For the developing countries reducing the postharvest losses, maximum utilization of available resources, gradually moving towards the modern farming system may be major solutions. Whole world should be concern about the food deficit. Lastly every people should be aware about "if we save food from wasting, it can save another lives."

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An Innovative step in the Field of Energy Generation: Blue Energy

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A rapid increase in world population and improvement of living standards has caused the global energy consumption to soar. Since demand is increasing day by day, but the cheap electric and chemical energy sources are limited; the environmental impacts of energy and resource scarcity could be the great challenges for the human civilization in the future [1]. Fulfillment of this enormous energy demand through fossil fuel consumption and traditional resource management seems unrealistic [2]. This excessive use of fossil fuels and the unsustainable life-style in developed countries lead to an increase in the price of fossil fuels and ultimately contribute to the problem of global warming. Consequently, the production of clean energy and development of new technologies for harvesting electricity are becoming increasingly necessary. This necessity has ultimately lead to investments in developing renewable energy sources such as solar, biomass, wind, hydrogen, wave, tidal, hydro-power, etc [3].

The entropy generated during the mixing of sea and fresh water can be used to produce electricity [4] which is completely renewable and sustainable [5]. This source of energy is known as salinity gradient power or also called Blue Energy [6, 7]. It has a global potential up to 2.5 kJ of extractable energy per liter of fresh water assuming that sea water is available in excess [8, 9]. Therefore, around 20 % of the global electricity demands (2 TW) can be fulfilled from all freshwater streams by using this source [10, 11]. Particularly, if this principle becomes reality, there would be an enormous potential for energy conversion from estuaries around the world. Furthermore, the huge amount of high concentrated streams (brine) produced as waste in industries can turn into a valuable source of energy in the near future [12].

The most studied of the existing technologies based on this principle are Pressure Retarded Osmosis (PRO) and Reverse Electro-Dialysis (RED), which are still in the development phase and investigations are under way to upscale them. PRO uses the osmotic pressure difference developed between salt and fresh water to run a turbine [13, 14]. RED uses ion exchange membranes to collect the ionic charge developed when passing different concentrated water through the cell to generate electricity through electron flow in cell [12, 15-17]. These techniques are currently been developed for a larger scale in order of kW. A small prototype plant based on PRO with capacity of 10 kW [18] has been constructed in Norway and a 5 kW plant, with planning to be up-scaled to 50 kW, has been envisioned in The Netherlands applying the RED technology [7].

Comparatively more emphasis is given in RED technology as it has a potential of producing huge amount of energy. In RED, a concentrated salt solution and a less concentrated salt solution are brought into contact through an alternating series of anion exchange membranes (AEM) and cation exchange membranes (CEM). Anions migrate through the AEM towards the anode and cations move through the CEM towards the cathode. The difference in chemical potential between both solutions is the driving force for this process. The chemical potential difference generates a voltage over each membrane and the overall potential of the system is the sum of the potential differences over the all membranes. At the electrodes a red-ox couple is used to convert the chemical energy into electrical energy. [8]

They need auxiliary equipment for operation which increase the complexity and costs of the system and ultimately reduce its overall efficiency. High membrane costs and short life due to bio-fouling in case of RED and development of significantly small pressure difference in PRO are the major obstacles for the substantial progress of these technologies. Thus a need for new methods is still present and capacitive energy extraction technologies have been recently proposed applying a simple process of flowing the salt water and fresh water alternately through a device containing activated carbon [6, 19, 20].

In capacitive energy technology, ion exchange membranes are used for selective transfer of ions and to shield counter –ions which give rise to the membrane equilibrium potential also known as Donnan potential [23-25]. This potential is used as

driving force for adsorption and desorption of ionic charges in porous carbon electrodes without the use of secondary energy converters or batteries. When the carbon electrodes are immersed in concentrated salt solution, one gets charged with anions and other gets charged with cations [6, 22, 26]. A potential difference is generated across the electrodes due to buildup of the Donnan potential, resulting in the flow of electrons over the external circuit. When the electrodes are shifted to less concentrated solution (river water), the ions diffuse away from the electrodes into the river water, discharging them. As a result opposite current is generated. This process of charge and discharge of the electrodes allow the extraction of electricity via the external resistor (15).

Blue energy has had some attention in the oil crisis of the seventies, but interest has waned since that time. Currently, the Netherlands is the only country where the possibilities of blue energy using reverse electro-dialysis are being researched. Wetsus - a water research institute founded in 2004 - developed interest in the blue energy principle which is starting a number of research projects on blue energy. When there is more familiarity with the technology, a mega project has been established with the aim of 1000 MW electricity production in the Netherlands (26).When the technology becomes available in modules, and the price of membranes drop significantly, blue energy plants can also be built at smaller freshwater outlets and it will then also become a profitable export product to countries such as Egypt, India, Srilanka and Bangladesh (which have a large river delta).

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Conservation Tillage

Shreemat Shrestha,

What is tillage?

Tillage is a basic operation for the crop cultivation. Tillage is the manipulation of soil to obtain favorable conditions for the germination of seed, plant establishment and growth. Tillage operation includes ploughing, harrowing, mechanical destruction of weeds and soil crusts etc. and it prepares agricultural land with good tilth appropriate for seeding/ transplantation. Tillage is performed by using different tillage implements, viz. animal drawn plough, Power tiller drawn plough/cultivator, tractor drawn plough, manually operated implants. (Fig. 1) For example, a mustard seed requires a seedbed consisting of fine particles, since the seed itself is very small.

Fig.1: Tillage operations by using animal drawn plough, Tractor drawn implements and manually operated implants.

Functions of tillage:

- To prepare a seedbed of good tilth.
- To destroy weed and prevent it's growth
- To incorporate organic mater, manure and fertilizer in soil
- To improve aeration in the soil
- To improve infiltration and water retaining capacity of soil and reduce water loss.
- Precision leveling/ grading and shaping for irrigation and other operations.

Drawbacks of excessive tillage:

Traditionally preparation of very fine seedbed by multiple operation of tillage implements were considered to be prerequisite for enhanced crop production. It is observed that soil erosion is accelerated due to excessive tillage, which is presented in fig. 2. After realizing the negative effects of continuous excessive tillage, it is realized that the present practice of excessive tillage in crop production is not economical as well as not sustainable. Annual average nutrient loss from sub-Saharan African soils is estimated at 24kg/hectare and rising. In South Asia, the cost of different forms of land degradation - such as loss of soil structure leading to erosion, compaction and formation of surface crusts, is estimated at US$10 billion a year. (FAO, 2000)

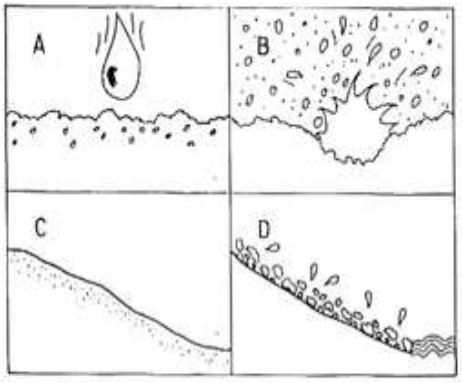

Figure 2

Phases of the erosion process:
The impact of rain drops on the bare soil surface (A), causes the detachment of small soil particles (B), that clogg the pores and form a surface sealing (C). The water that runs off carries soil particles, which are deposited down slope when the runoff velocity is reduced (D).

(Derpsch, et al., 1991)

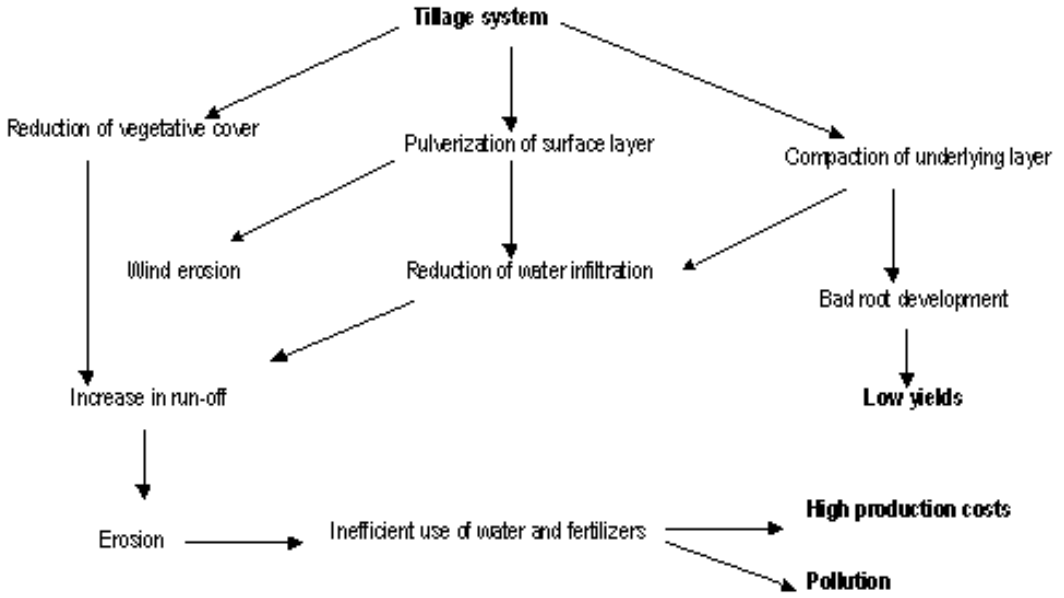

Fig. 3: Flow chart of drawbacks of tillage

The flow chart of draw back of tillage is explained in the fig. 3. The major consequences of excessive tillage operations are reduction in crop yield, increase erosion, high cost of cultivation and increased air and water pollution. The major drawbacks of tillage operations are listed below.

- Timely planting is not possible due to long turn around time due to number of tillage operations (viz. primary, secondary etc.)
- Increase in production cost due to number of passes
- Loss of soil moisture due to exposure of moist soil underneath
- Loss of soil in rainy season mainly in bari land
- Destruction of soil structure
- Limits water infiltration through surface sealing
- High demand on power, time and equipment
- Causes tillage erosion

Research conducted in Brazil (Roth, 1985) also shows, that the percentage of soil covered with plant residues is the most important factor that influences water infiltration into the soil. While virtually all water from a simulated rainfall of 60 mm/hour infiltrated when the soil was 100% covered with plant residues, in the case of bare soil 75 to 80% of rainwater left the plots as runoff (Figure 4).. Similar results have been obtained by researchers in many parts of the world.

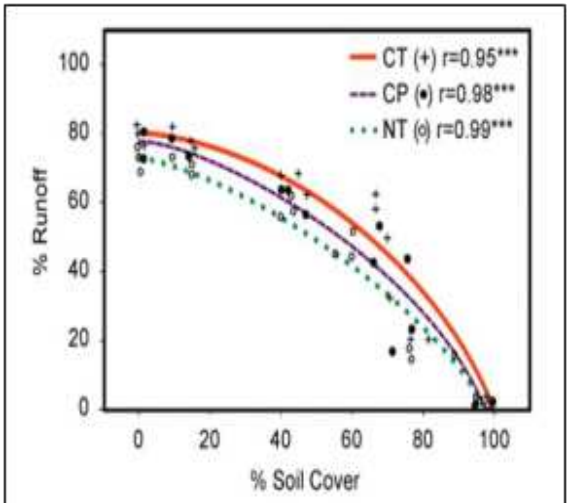

Figure 4: Total runoff after 60 minutes of simulated rainfall as affected by % soil cover and tillage system (CT: conventional tillage, CP chisel plough, NT: no-tillage).

Conservation tillage:

Traditionally multiple tillage operations were considered essential to create a favorable seedbed, to achieve good soil-seed contact, and to ensure rapid, uniform crop emergence. But due to excessive tillage for fine seed bed has resulted more soil erosion, increased cost of cultivation, more environmental threats etc. After World War II, Melsted (1954) addressed the effects of tillage on tilth and suggested that by substituting capital for labor, the science of farming could replace the art of farming. He suggested that by using fertilizer N and reduced tillage, erosion could be controlled, organic matter increased, and optimum soil tilth developed. Hence to address the negative effects of excessive tillage, new dimension of tillage i.e. conservation tillage is developed and adopted around the world. Permanent no-till is now used on 45% of cropland in Brazil, 50% in Argentina, and 60% in Paraguay, with Paraguay now leading the world in percentage of no-tillage adoption. Access to adequate herbicides and seeding machines, as well as sufficient knowledge of no-tillage methods, were necessary in each instance for widespread adoption of the system. (Derpsch, 2004)

Fig. 5: Conservation tillage

In conservation tillage, crops are grown with minimal disturbance of soil. When the amount of tillage is reduced, the stubble or plant residues are not completely incorporated, and most or all remain on top of the soil rather than being plowed or incorporated into the soil. In this tillage system more than 30 percent of soil surface is covered by crop residue. The new crop is planted into this stubble or small strips of tilled soil. Weeds are controlled with cover crops or herbicides rather than by tillage. Increased use of crop residue and organic matter in the soil in conservation tillage system improves the soil tilth and soil fertility after few years of its adoption.

Function of Conservation Tillage:

- Minimum disturbance of the soil for crop cultivation is the major function of conservation tillage resulting significant reduction in soil erosion.
- Covering the soil surface by crop residue (at least 30 percent) is an integral component of conservation tillage to conserve soil moisture as well as add organic matter in the soil and suppress weed.
- In contrast to conventional tillage system the major focus of conservation tillage system is creation of favorable condition of soil environment for better crop establishment and growth through biological processes rather than physical and chemical process.

Limitations:

- In the soils with poor drainage capacity the conservation tillage may not provide favorable result for few years.
- Weed control is critical in conservation tillage.
- For the few years the crop yield may be less than conventional tillage system in some cases.
- In general mindset of farmers, extension agent, and even scientists are based on agricultural production on conventional tillage system. Hence there is need of mindset change of farmers & technicians through training and demonstrations on conservation tillage system.
- Unavailability of appropriate bullock drawn zero till/ minimum till drill for small/ narrow hill terraces.

Advantages:

- The operation cost of planting is significantly reduced due to single pass of bullock/ tractor compared to multiple pass of primary and secondary tillage before sowing. Timely planting is possible in minimum tillage system in contrast to delayed planting due to long turn around time in conventional tillage system.
- Due to minimum disturbance of soil and use of cover crop and crop residue on soil surface, the air and water erosion is significantly reduced in conservation tillage system.
- In the rainfed situation residual soil moisture is critical. Due to minimum disturbance of soil, soil moisture is conserved and efficiently used by the crop for its germination and establishment.
- In conservation tillage system the quality of soil is enhanced due to cover crop, crop residue mulching and addition of organic matter in soil.
- A continuous no-till system increases soil particle aggregation (small soil clumps) making it easier for plants to establish roots. Improved soil tilth also can minimize compaction. Compaction is also reduced by reducing trips across the field.
- Intensive soil tillage accelerates organic matter mineralization and converts plant residues in carbon dioxide, which is liberated into the atmosphere contributing to the green house effect and to global warming. Conservation tillage reduces the releases of CO_2 into the atmosphere because of minimum disturbance of soil and surface cover by agricultural residue. Moreover reduced number of hours on use of tractors/ machines in conservation tillage in contrast to conventional tillage also significantly reduces the emission.

Disadvantages:

Conservation tillage system involves a long term process to enhance the quality of soil to enhance the agricultural productivity in sustainable manner. Hence, it is not possible to attain immediate quantum jump of agricultural production by adoption of conservation tillage.

Types of Conservation Tillage:

Zero tillage, minimum tillage and contour tillage are major conservation tillage system practiced.

Zero Tillage:

In zero tillage system, soil is opened (narrow slit or small pit) only for placing seed and fertilizer and then covered. This tillage system includes dibbling by using dibble stick, sowing by using zab seeder and using zero till drill. The dibble stick and zab seeder is used to sow bold grained seeds such as maize, soya bean etc. The zero till drill can sow small as well as bold grain seeds depending upon its metering device.

A **dibble stick** (Fig. 6) is a stick to make holes in the soil. Its conical point requires less force to penetrate the soil than a blunt stick. A farmer makes a hole with a dibble stick and drops few maize kernels in to the hole by other hand, . As the farmer steps forward to plant next hill he covers the seed and firms the soil with his foot.

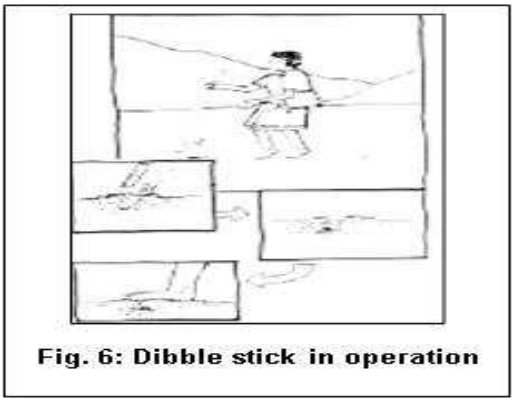

Fig. 6: Dibble stick in operation

A **Zab Seeder** (Fig. 7) is manually power machine of weight about 3-6 kg weight with 1 kg of maize seed and fertilizer. At the bottom of seed and fertilizer box there is seed plate and fertilizer metering device. A typical zab planter makes 2 rectangular adjacent holes about 2X3 cm and 5 cm deep and drops metered maize seed and fertilizer in those 2 holes. Like in dibble stick the farmer covers the seed and fertilizer and firms the soil with his foot while in operation.

Fig. 7: A jab seeder in operation

A **Zero till drill (Fig.8)** consists of narrow furrow opener which makes a narrow slit in the soil. It also consists of seed and fertilizer box which is metered by the metering device and dropped to that narrow slit. A chain or a press wheel is attached to cover and firm the soil. Depending upon the power source the zero till drill is further classified as animal drawn zero till drill, power tiller drawn zero till drill and 4 wheel tractor drawn zero till drill. In power tiller operated zero till drill the narrow slit is made by the straight blades of the rototiller. Zero till planter/ seed drill have either all or some of the following components:

- Hoppers for seed and, if applicable, for fertilizer with the respective metering mechanisms and delivery tubes.
- Row cleaner, if necessary, to remove excess mulch from the plant row.
- Cutting disc to cut through residue cover.
- Furrow opener for fertilizer.
- Furrow opener for seeds.
- Seed press wheel.
- Furrow closing wheel (often in combination with depth control).
- Furrow press wheel.

Zero tillage is successfully adopted by a farmer Jaya Kisor Yadav in Parsa in wheat cultivation since last 12 years (Fig. 9)

Fig. 8: Zero till drill in Operation

Fig. 9: Zero tilled Wheat in Parsa

Minimum Tillage:

In minimum tillage system consists of following different tillage systems in which there is significantly less tillage operation than the conventional tillage system.

Minimum tillage by depth: In conventional tillage system there is several pass of tillage tilling the soil of depth more than 10 cm. In minimum tillage by depth system minimum till drill (Fig.10) is used which till the

Fig. 10: Min. Till Drill in Operation

soil depth of about 2-4 cm, meters the seeds and drops the seed and covers and press by roller simultaneously in a single pass.

Minimum tillage by tillage area: In conventional tillage system whole land is ploughed where as in minimum tillage by area system only a part of the land along the contour is ploughed and prepared a seed bed rather than ploughing entire plot.

Strip tillage: In strip tillage only a narrow strip is tilled and seed is sown along the strip. In between the strips the land is not tilled at all. There are also strip till drill (Fig.11) to perform strip tillage.

Fig. 11 : Strip Till Drill in Operation

Contour Tillage:

The tillage is performed across the slope and along the contour (FIG.12) and the plants are also planted along the contour. The contour tillage will enhance the infiltration and reduce the runoff and soil loss. Moreover contour tillage will reduce variation in tillage depth and speed and consequently reduce tillage erosion (Lobb et. al , 2000)

Fig. 12: Contour cultivation

Surface seeding:

Surface seeding is adopted for wheat crop after rice harvest in the field if there is very high soil moisture (if there is clearly visible foot prints while walking on the field). In this case the wheat seed is mixed with cow dung and kept for 24 hrs then it is broadcasted in the field with out any tillage at late hours at the time of sun set. The seed is mixed with cow dung to facilitate easy germination and to prevent from birds eating wheat seed. (Fig. 13)

Fig. 13: Surface Seeding

Controlled Traffic Farming (CTF)

In controlled traffic farming, all the field traffic is restricted to permanent traffic lanes (of tractor), which are normally untilled and unplanted, to optimise traction and traffic ability. The untrafficked soil of the crop beds can be managed for optimum crop performance, uncompromised by traffic or unnecessary tillage. Further more, controlled traffic can make field operation timely and precisely, which is in accordance with precision farming trends in the near future. Controlled traffic with zero tillage provides better protection for both surface and subsurface soil, resulting in reduction of runoff and improvement of crop production. With CTF, the need for tillage is often minimal and it is synonymous with and enhances the performance of conservation and zero tillage systems. The concept of controlled traffic may offer a feasible system to ameliorate soil structure and increase soil available water and water use efficiency. Controlled traffic farming separates crop areas and traffic lanes permanently, providing optimal conditions for crop growth (no traffic) and traction (compacted). Even though 20% of the field was occupied by wheel tracks without planting, no yield decrease was observed in controlled traffic treatment when compared with conventional tillage. Power requirements and fuel consumption were lower in controlled traffic.

Conservation Tillage period:

Conservation tillage and sowing is performed just after harvesting the previous crop, this will not only results timely planting but also conserves residual soil moisture. In conservation tillage system, the field is not kept fallow. If major crop is not possible cover crop is sown in fallow period. Leguminous and grass are the major cover crops.

Precaution:

- Check there should be at least 30 percent of field area covered by the crop residue.
- Do not adopt zero till at poor drainage condition.
- Adopt appropriate weed management practice in conservation tillage system
- Harvest the cover crop at least 15 days before planting main crop in water deficit areas.
- Never burn the crop residue in the field

Scope:

- Zero tillage can be well adopted in medium to coarse textured soil with periodic drought prone area.

- Minimum tillage and contour tillage can be well adopted in silty clay and loam soil as well as in sloppy area.
- Surface seeding in the area were there is excess soil moisture for wheat cultivation especially in low lands with drainage problems.

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Evapotranspiration and Its Estimation Methods

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EVAPOTRANSPIRATION

Evapotranspiration (ET) is the amount of water removed to atmosphere via evaporation and transpiration. Evaporation accounts for the loss of water from the soil surface, water surface and intercepted area, such as leaf surface. Transpiration is the diffusion of water from the plant, especially from the stomata to the atmosphere to equilibrate the water vapor. A plant basically absorbs water for their activities, such as photosynthesis, and removes part of the absorbed water to the atmosphere by transpiration. The contact of the soil surface and the root zone make the transfer of water from soil to root zone.

In the past, ET was simply considered as the exchange of surface energy which is highly dependent on the vegetation cover (Farahani et al., 2007). During the late 1990s, Allen et al. (1998) defined actual evapotranspiration (ET) as "the evapotranspiration from disease-free, well-fertilized crops, grown in large fields, under optimum soil water conditions, and achieving full production under the given climatic conditions."

Potential evapotranspiration (PET) is defined as the loss of water from the short crops (grass) which fully shades the ground, exerts little or negligible resistance of flow of water, and is always well supplied with water (i.e. water is not limiting). In general, PET cannot exceed free water evaporation under the same weather conditions (Allen et al., 1998).

ET measured with a reference crop is termed as reference ET (ET_{ref}). Generally, alfalfa and clipped grass surfaces are used as the reference crops. The ET_{ref} is the evapotranspiration from a field with uniform cover of at least 100 m span of same or similar dense growing plants having specific height and surface resistance grown in well watered condition (Allen et al., 2005). Both PET and ET_{ref} are highly dependent on climatic parameters such as air temperature, wind speed, solar radiation, and relative humidity.

Basically, ET depends on the aerodynamic roughness and albedo, which varies from crop to crop. It is different at different locations due to difference in transformation of sensible and latent heat flux. On the other hand, the evaporation is also affected by ground water table, capillary rise, soil moisture content, soil heat capacity and soil type. The ET is the major factor governing the crop water use since transpiration accounts 99% of water uptake by plants. Major factor influencing ET are crop type, soil moisture, ground water table, and weather and climates of the area. Though ET accounts for largest portion of water balance, it is either neglected or sometime estimated as the residual of soil water balance. This paper briefly describes three methods of measuring actual evapotranspiration and different methods to measure reference evapotranspiration.

Methods of Estimating Evapotranspiration

Though ET is very difficult to measure, several methods have been developed for its measurement. Generally, there are two different methods, namely direct and indirect methods. The direct method measures the ET directly. The direct method includes either water balance or the energy balance approaches. Lysimeter, eddy covariance, soil water balance and Bowen ratio methods are some of the direct methods. Lysimeter and eddy covariance (EC) system are widely used direct methods to measure the actual ET (Farahani et al., 2007). The indirect method refers to estimating the ET from the ET_{ref} and crop coefficient (K_c) value. There are different ways to estimate the $ET_{ref,}$ namely combination, temperature, radiation, and pan evaporation based methods.

1. Lysimeter

Lysimeters are a widely used and accurate method to measure ET using the water balance equation. Lysimeters are also used as a standard method to calibrate other ET models (Jensen and Haise, 1963; Allen et al., 1998). According to Jensen et al. (1990) a lysimeter is a "tank filled with soil in which crops are grown under natural conditions to measure the amount of water lost by evaporation and transpiration." The crops grown in the lysimeter and surrounding field should be of same variety (Fig. 1). Soil conditions inside the lysimeter should match with that of outer environment. All the components of water balance like rainfall, irrigation and drainage along with change in water storage is monitored in lysimeter to estimate the ET rate over a certain time interval (Jia et al.,

2006). The accuracy of the lysimeter, and ET values depends on the type of lysimeters. Mechanical lysimeter has the accuracy of about 0.05-0.02 mm (Howell et al., 1985). Generally, the shape, size and depth of the lysimeter design depend on its purpose and soil profile characteristics. The lysimeter can be of different types like weighing and non-weighing. Though lysimeter is a widely used and standard method, measuring ET by lysimeter is not a feasible method in humid regions and in area with shallow water table (Jia et al., 2006). Sometimes, the design of lysimeters is critical for ET estimates. Heating of the lysimeter rim by solar radiation may lead to micro-advection of sensible heat into the lysimeter plant canopy (Farahani et al., 2007), generally when the lysimeter rim is made of steel. Lysimeters also have long measurement periods and relatively small fetch area compared with eddy covariance systems (Rana and Keterji, 2000).

Figure 1.Lysimeter in the field

2. Soil water balance

Evapotranspiration can be estimated from soil water budget equation:

$$ET = P + I – R – \Delta S - D$$

Where, P is precipitation; D is deep percolation; R is runoff; I is irrigation; and ΔS is the change in water storage. In given equation, the only remaining variable ET can be determined once all other variables are measured or estimated. Soil moisture content can be measured by different instruments such as time domain reflectometry (TDR), Hydraprobe, tensiometer, and neutron probe (NP). Deep percolation is difficult to measure when the measured depth is less than the wetting front. The capillary rise, fluctuating water table, and subsurface drainage are obstacles of this method (Nachabe et al., 2005). Though this method is only suitable for small area, it is a widely accepted method and can be used for irrigation scheduling (Nachabe et al., 2005).

3. Eddy covariance

The eddy covariance (EC) system is an advanced method and is considered to be more accurate than other methods for determining actual evapotranspiration (Farahani et al., 2007). Modern, precise and high speed instruments are used in the system. Sensors for measuring vertical wind speed (~ 10 Hz), temperature and humidity enable the EC system to compute ET electronically (Campbell and Norman, 1998). The EC system measures the ET of a large area, covering an upwind distance of about 100 times the sensor height above the canopy surface (Sumner, 2001), whereas lysimeter is useful only for a point measurement.

This method offers more advantages over other methods. The EC system overcomes the site disturbance, no need to measure any components of the water balance, and measures the ET above the plant canopy (Twine et al., 2000; Sumner, 2001). Moreover, the ET measured by the EC is independent of the soil surface.

This system is also considered to be highly reliable to estimate energy fluxes (Baldocchi, 2003). It had been used to measure the temporal and spatial inconsistency of carbon dioxide, water vapor and energy fluxes in different vegetations by Moreo et al. (2007) and Baldocchi et al. (2001).

Figure 2. Eddy covariance system in maize field

The EC system is used to measure the ET directly. This system draws a statistical covariance between vertical fluxes of vapor within the upward and the downward legs of turbulent eddies (Sumner, 2001). The measurement is made at a high speed for temperature and wind speed. The amount and direction of water vapor in the atmosphere is dependent on wind movement. Vertical wind speed is

measured and compared with vapor density. The CSAT3 3D sonic anemometer measures the turbulent fluctuation of wind in horizontal and vertical direction (Fig. 2). This system measures ET as the function of energy balance, it measures latent heat flux (LE), which is equivalent to ET. This system uses expensive instruments and requires lot of calculations.

4. Reference evapotranspiration

The ET can be estimated indirectly from an ET_{ref} value and a crop coefficient. Different weather parameters, like temperature, rainfall, and solar radiation are used to estimate ET_{ref} using combination, temperature, radiation and pan evaporation methods (Allen et al., 1998; Doorenbos and Pruitt, 1977). Among all the methods, the ASCE-EWRI 2005 is the standardized and widely accepted method for reference ET calculation (Allen and Pereira, 2009; Farahani et al., 2007).

The combination methods include 1948 Penman, 1963 Penman, 1972 Kimberly- Penman, 1982 Kimberly Penman, 1977 FAO 24, and 1974 Hprcc Penman. All these methods use the weather parameters, such as temperature, radiation, wind and humidity for calculating the ET_{ref} taking grass or alfalfa as the reference crops (Allen et al., 2005; Irmak et al., 2008). The 1963 Jensen-Haise, FAO 24 Blaney-Criddle, 1985 Hargreaves and Samani belong to the temperature method (Allen at al., 2005; Irmak et al., 2008). These methods use temperature and solar radiation as the main input parameter. The temperature method underestimates the ET_{ref} during windy and sunny days (Irmak et al., 2008; Trajkovic and Kolakovic, 2009). Radiation method, like 1972 Priestley-Taylor and FAO 24 Radiation, are used widely for ET_{ref} calculations. Though reasonable estimates of ET_{ref} can be done from these methods, its accuracy is in doubt during windy, dry and hot days (Farahani et al., 2007; Irmak et al., 2008).

The ET_{ref} can also be measured by the Pan Evaporation method. It uses a metal pan of about 1 m diameter, placed in a desired environmental condition. Water is kept in the pan and loss of water is measured by the scale or read from the scale in pan (Allen et al., 1998). This method only measures the evaporation of surface, but not transpiration. So, the measured evaporation is multiplied using a pan coefficient to get the ET_{ref}. The amount of ET_{ref} depends on the pan diameter and pan type (Allen et al., 1998). Pan evaporation method might sometime mislead the result due to the heat stored with in the pan and the reflection of solar radiation from the pan.

Actual evaporation could then be measured from reference evapotranspiration using crop coefficient. Crop coefficient is different for different crops and also vary along different development stage of crop. It is generally high during peak vegetative development stage, because crop requires higher water during flowering and grain filling period. It is given by $K_c = \frac{ET}{ET_{ref}}$ where, K_c is crop coefficient, ET is actual evapotranspiration and ET_{ref} is reference evapotranspiration (Allen et al., 1998).

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Impact of Water Harvesting Tanks on High Value Vegetable Crops at Household Level- A Case Study of Ambukhaireni VDC of Tanahun District

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1. BACKGROUND

In most parts of hilly regions in Nepal, one of the most important constraints in the production of dry season high value and marketable horticultural crops is lack of dry season irrigation. The total annual precipitation in Nepal is more than 1500 mm, 80 percent of this is confined during the monsoon period- June to September. Consequently, winter and spring seasons are relatively dry that constitutes 20% rainfall of the whole year in the period of 9 months. State financed irrigation projects irrigate mostly plain arable land in the country. These projects have generally tended to benefit relatively large farmers. Hence, the hills of Nepal suffer from alternating cycles of excess and scarcity of water with less water available over time as monsoon ends. Even if small, seasonal/perennial springs and rainwater are available, to tap them is a challenge. The importance of small-scale simple technology to harness water resource is obvious.

The proposed concept of the water storage tank system is to work with small, seasonal/perennial, surface or subsurface, upland water resources like springs or streams supplemented by rainwater, for dry season irrigation of high value vegetable crops in hilly regions of Nepal. The core idea is simple: a small water tank system, which should function within resource capacity of small hill farmers for filling hourly, daily or weekly dry season water supply gap of the upland sources. The collected water in the tank is used efficiently with water conserving irrigation methods like drip or sprinkler irrigation.

Water scarcity is especially during the long dry season becoming an acute problem for the farmers. The problem is not one of absolute shortage of water, but one of the distributions of the rainfall over the year. There are well known modern technologies for storage and lifting, but these are costly and beyond reach for most mountain households. What are needed are low cost, environmentally sound and locally sustainable options. The most obvious and already often used methods to storage water are low-cost tank and ponds. Ponds and low cost water harvesting tanks are in many ways suitable for storing water. They can be built with locally available materials and are not damaging to the environment. Rainwater harvesting is the capture, diversion and storage of rainwater for a number of different purposes including landscape irrigation, drinking and domestic use, aquifer recharge and storm water abatement.

There is high feasibility of dry season vegetable varieties in the hilly regions of Nepal. The attractive income generating potentiality of dry season high value vegetable crops is the focus of this research study. Water storage tanks referred in this study are the tanks to reserve water to use for the cultivation of high value crops during scarcity period. These are low-cost tanks because they involve simple technology and their construction involves optimum utilization of locally abundant input resources. Small scale and simple technology has a characteristic that it does not induce adverse environmental effect as the large scale does. Moreover, as this technology helps in dry season irrigation, it helps to increase vegetation coverage of crops and protects soil erosion from the otherwise barren uplands.

Low-cost water storage tanks help to enhance the capacity of small hill farmers to tap upland water resources in dry season to irrigate small plots of the high value vegetable crops and thus to increase the production. This would augment the income of small farmers that would help raise the economic status of them and eventually it would exert a positive thrust for the goal of poverty alleviation. This study seeks to prepare socioeconomic profiles and generates baseline information on the potential cooperating households of the research site. In addition the study report also presents information on the current situation of high value vegetable crops in the site.

2. OBJECTIVES OF THE STUDY

The main objectives of the study are

- To determine the effects of the water-harvesting irrigation systems.
- To determine the factor hindering the promotion of water harvesting irrigation system.

3. IMPACT OF WATER HARVESTING IRRIGATION ON HOUSEHOLD LEVEL

In the study area after the implementation of water harvesting tank program; numbers of changes have been occurred. Before examining the impacts prior situation of water resource use has been studied. The following impacts were found during study:

- Impact on Crop and Cultivation Pattern
- Impact on Crops Production
- Motivation and Change on Crop Production
- Improvement in Nutrition and Family Health
- Change in Perception of the Neighboring Communities
- Change in the Use of Agricultural Inputs and the Consumption
- Time Saved by Using Water Harvesting Tanks
- Benefit Perceived by Farmers
- Increase in Child Education level
- Impact on Women's Empowerment
- Change in Decision Making on Tank Related Issues.
- Impact on Water Management for Vegetable Production

4. RECOMMENDATIONS

Based on field observations and conclusion drawn here some suggestive recommendations that are made to utilize the water harvesting irrigation system more efficiently. The recommendations are expected to be useful to the tank users and program implementers, which are presented as follows:

- Advanced trainings to the mason, for water harvesting tank construction should be provided.
- To overcome the agriculture problems training on agriculture should be provided to all tank users by the concerned organizations. There should be follow-up supports by the agriculture technician of Agriculture Service Center.
- There should be provision of cover at all types of tanks to prevent the water of the tanks from foreign materials and any other accident caused by the children.
- The tank size should be 5000 to 6000 liters. The poor farmers cannot afford the cost of large tanks and the volume of small sized tanks is not sufficient to irrigate their vegetable crops.
- Upland spring water is used to fill the tanks. It will create problem to the source of drinking water supply. So there should be provision of gutter at roof of the houses to collect rain water in the tank.
- Subsidy in water harvesting systems should be provided to low income and under privileged groups of farmers by the concerned organizations to empower them and uplift their lagged socio-economic conditions.
- Farmers are not getting real price of their product but on the other hand, brokers are taking maximum profit from their products. There should be one co-operative among the vegetable growing farmers of this area. The farmers themselves should manage the marketing of vegetables to get real price of their products.
- Water harvesting irrigation systems are sustainable irrigation systems to irrigate horticulture and vegetable crops. Government of Nepal and non government sectors should give priority to promote and disseminate this technology to other area of Hills and Terai regions where water crisis is existent and other irrigation systems are expensive or not feasible.
- Horticulture, seasonal and off- seasonal vegetables farming is one of the major sources income of rural and marginalized farmers in Nepal primarily to uplift the socioeconomic condition. Water harvesting irrigation system can play vital role to success horticulture, seasonal and off-seasonal high value crops farming in Nepal.
- Before implementation of water harvesting irrigation program at any area resources of water should be trapped because availability of water is the most important factor to sustain the water harvesting irrigation program.
- Locally available materials, skilled and unskilled person should be used to construct the water harvesting tanks. The tank should be designed for low cost.
- Tank users group should be formed, formally registered, and provided back stopping.
- Linkage with other related line agencies ADO, ADB, VDC and DDC should be established through groups for promotion of water harvesting irrigation systems.

Note:
Abstract of thesis report of M. Sc. Degree in Natural Resource Management submitted to Pokhara University in 2007

Urban Farming and its Architecture

Arch. Kuber Shrestha

INTRODUCTION

Urban farming (UF) is defined as *"the practice of* growing, processing, and distributing fresh food by *people living in urban areas."* It involves plant cultivation from sources that may include ground crops, vine crops, and fruit and nut-bearing trees; it may also include raising animals (such as poultry) and bee keeping. Urban farming's unique feature is its direct integration with urban economic and ecological systems. It builds upon existing urban infrastructure, incorporating food crops into densely developed and populated environments. UF can take many shapes and forms, ranging in scale from row crops grown on city lots, to roof top farms, to backyard gardens. Urban production helps people understand where their food comes from and how it's processed, and it can also create many environmental, economic and social benefits. Environmental benefits associated with urban agriculture include potentially lower use of petroleum-based products, such as fertilizer, pesticides, and transportation fuels, resulting in lower amounts of air, water, and soil pollution when compared to conventional farming practices. UF sites tend to be much smaller than those in industrial agriculture, thus rarely requiring the use of heavy machinery that relies on fossil fuels for harvesting and processing crops. Furthermore, because UF is produced in close proximity to where it is sold and consumed, less fossil fuel may be required for transportation.

IMPORTANCE

Population of world increasing day by day, the population growth recorded about 2.5 billion populations in 1950, about 6.08 billion in 2000, now about 6.99 billion are living today and at the same growth rate there will be 9.3 billion on this earth in 2050. Studies by the United Nations indicated that more and more people are going to inhabit the urban areas than the rural ones (UN, 2010). The level of world urbanization will increase from 50% in 2009 to 69% in 2050. By 2050, urban dwellers will account for 86% of the population in the more developed regions and for66% of that in the less developed regions. This creates significant pressure to maintaining the ecological equilibrium and harmonizing the relationship between nature and the human being (Deelstra and Girardet, 1999). Rate of poverties highly increase and crisis of foods make people difficult to live in urban regions, which makes rise social and economic conflict and polluter environments, meanwhile world is facing the great problem of global warming and climate changing condition, which makes difficult to harvest seasonal crops and fruits in proper time in proper locations in traditional and industrial farming. If global warming steps up as same rate, the climate goes worst situation in future and fact is that bad weather makes farming difficult, risky and uncertain. Millions of tons of valuable crops are lost to hurricanes, floods, long-term droughts, and monsoons every year, so that to find the solution feeding to urban population in future, need to develop modify forms of agriculture systems like urban community farming, rooftop farming, sky farming, and vertical farming, facade farming to supply more foods in urban regions.

BENEFITS

Urban and peri urban farming promote the numerous benefits to urban people

- UF provide hygienic and healthy foods frequently and easy available in local market.
- In control mechanization, UF can develop in pure organic farming without using any pesticide and inorganic fertilizers.
- Wastewater (Basically treatment for not spread of diseases) and organic solid waste can be transformed into resources for growing agriculture products: the former can be used for irrigation, the latter as fertilizer.
- Use of wastewater for irrigation in urban farming can improve water management of fresh water for drinking and household consumption.
- Local production of food also allows savings in transportation costs, storage, and in product loss, what results in food cost reduction.
- No need to use heavy vehicles for farming and reduce in fossil fuel so pollution can be controlled.
- No need to stay idle and free without jobs for housekeeping person, they make income staying at home.
- Low income urban dwellers spend between 40% and 60% of their income on food each year, so this can be reduced.
- UF improves the quality of the urban environment through greening and thus, a reduction in pollution.

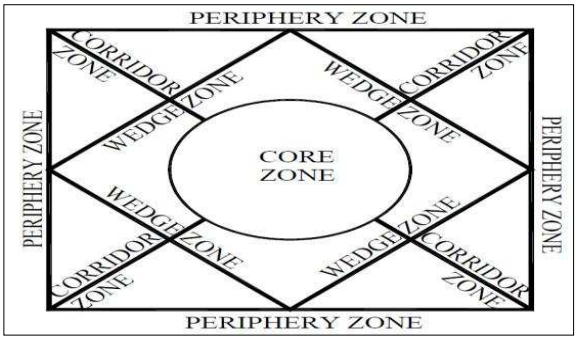
- Municipality can provided vacant urban areas used for agriculture production in urban poor area to upgrade their life.
- Urban community farming helps to people be together and being together solve any problem, which is responsibility towards the community for each ones.
- Vertical urban farming highly appreciable for urban area, where in small plot of land can product 5 to 6 times more than same plot of land in traditional farming.
- There is no need of soil to grow the plant in vertical farming.
- Different types of farming, animals' husbandry, recycling of rain water, energy harvesting can manage in single building.
- Urban building's roof tops can be converted in to garden, where choice of seasonal fruits and vegetables can grow up as per demand of owners.

DIFFICULTIES

- Limitation of agriculture area in urban cities
- According to invest, initial cost is expensive and difficulties to secure
- The use of waste water for irrigation without careful treatment and monitoring can resultin the spread of diseases among the population
- Sometime it arise controversial arguments between agriculture and urbanization.
- Farming area should protect from urban pollution like motor vehicle emission
- Require structural sound multi stories buildings for vertical farming.
- Need deep knowledge for hydroponics and aeroponics farming's.
- Centre of large indoor urban farming artificial light should provide in day time due tolack of sun light.

USE OF URBAN ZONES FOR FARMING

There are different categories of land used and zoning in urban area. Agriculture point of view urban region can classed as four zone models.



1. **Core zone**: These are high built up area of urban cities and limitation of agriculture land. Urban agriculture usually takes place on rooftops, balconies, temporarily vacant lots, in converted buildings, and sometimes in public parks. There are also examples of small-scale plastic greenhouse farming systems, including hydroponics. Urban agriculture may be forced out of core-city areas, considering the increasing focus of using vacant lots in urban revitalization programs.

2. **Corridor zone**: The corridor zones are similar to, though less dense than, the core. In the context of urban agriculture, they basically have the same characteristics of use. Farming in corridor zones usually takes place along main roads and railway lines because there are often large lots that have not yet been built out in those areas (Smit et al. 1996). Ornamental horticulture, grazing, market gardening, greenhouse vegetables and flowers, poultry, and other types of small livestock can all be found in corridor zones. These types of agricultural locations usually have low-intensity crops, recycle little waste, and produce low returns on labor. Low returns result because farmers in these areas often have little security concerning how long they can continue farming, which prevents long term planning or investment (Beatley 2000).

3. **Wedge zone**: Wedge zones are generally classified as having an extensive amount of land not suitable for development, such as steep slopes and wetlands (Smit et al. 1996). In larger cities, it is this type of land that is typically used for urban agriculture. Milk production, egg production, orchards, and fish ponds also take place in this zone. Keeping wedge land in high intensity agriculture may have a high opportunity cost because built use yields higher land rents than agriculture, but successfully achieves environmental conservation (CFSC 2003).

4. **Periphery zone:** The periphery zone is the rural-urban fringe characterized by small and medium-size farms oriented to the metropolitan market that are more diverse than those in rural areas (CFSC 2003). The agricultural industry in this type of land adapts to the new demands of urban markets. The acreage of agriculture on the periphery depends on the transportation efficiency and landscape features (Smit et al. 1996). This zone usually is earmarked intensive vegetable production because of lower transportation costs compared to more rural areas.

IMPLEMENTATION

Green building and green cities is the slogan of today's world, that's why cities in the world are trying to enhance sustainability by improving urban greenery and promoting green zones and urban farming. It support to improve ecofriendly urbanism and living in harmony between nature and human being. Implementation of urban farming in many, more densely and populated cities are lunched so many projects to make food secure and support for clean environment in urban regions.

Hong Kong

There are many high densely urban cities in world; Hong Kong is one of them, where the density has over 54000 to 100000 people/Km² (Dr. Sam C. M. Hui, 2011). High density urbanism promotes urban heat island and undesirable local microclimate. To control the urban heat island (UHI) and make ecological balance Hong Kong government has stated green zoning in urban areas and roof top farming and gardens in dwellings, open spaces and more greenery policies.

Singapore

Singapore is also big and beauty city of Asia, where the buildings built up areas are high and densely and land use for agriculture is limited. About 95% of all vegetables and fruits consumed in Singapore are imported and a lot more money should spend in food trades. Now, Singapore is raising city of modern urbanism by integrating nature and manmade sculptural for human habitations. Agriculture on rooftop, vertical farming, hydroponics and aeroponics systems of farming integrated within buildings can potentially produce 25% of the vegetables consumed in Singapore. It supports not only economic in food trades but also ecological balance.

Canada

In recent years urban agriculture has gained considerable momentum in North America. For instance, in Canada there are interesting projects and initiatives on rooftop gardens aiming to develop effective methods for urban agriculture. Moreover, some municipal and provincial governments in Canada have adopted green roof and urban farming into their urban planning goals and policies. They provided incentives (such as development density bonus and fee rebates) and information to encourage acceptance and market development.

U.S.A.

Urban agriculture is not a new concept within the U.S.A. Produce gardens appeared during World War I, and reemerged during World War II, marketed by the federal government as Liberty Gardens or Victory Gardens. These "patriotic" gardens served as a way for the federal government to urge U.S. citizens to take an active role in producing their own food and were considered a "civic duty and morale booster", as well as a way to support the war efforts (Matt Frank 2011 Nov). Urban cities in U.S.A. have great potential for food production and practicing in urban landscapes and in buildings. In skyscraper cities like New York lunched some notable urban farming projects on roof top like Brooklyn Grange Farm in Queens, New York City: 4,000m² (one acre) and Eagle Street Rooftop Farm in Brooklyn, New York City: a 600 m² commercial organic farming on a warehouse rooftop (Dr. Sam C. M. Hui, 2011).

UK

In UK already lunched the policies of low carbon city and authorities have considered and implemented measures to promote the development of green zone by providing urban farming, rooftop farming, about 14% of London's residents now already grow some food in their gardens. It is estimated that London people could produce up to 18% of the population's nutritional needs the strategies of supermarkets in north London started farming and growing food on rooftops to sell in market below. Number of UK residents started bee keeping farming on their rooftop gardens helps to develop the bee keeping farming to help reverse the decline in the population of solitary bees.

Japan

Importances of local food for Japanese people are very high and respectful, so the traditional culture in Japan emphasizes on domestic food production and consumption. Therefore, methods to cultivate local urban farming are of utmost importance. Tokyo has an ordinance that requires all buildings to devote 20% of their rooftops to greenery. Some farming areas are also provided on the rooftops and inside the buildings so that people can enjoy life to the vegetable-touch. The urban farming in Japan is often stylish and simple, so it is easy to participate, corresponding to the proposed package of city life. Nowadays, in Japan, it is also fashionable and cool to be a part-time farmer.

Nepal

Agriculture is backbone of economy of our country. About 85 percent of populations are involved in this sector. Most of the 90 percent people are farmers in rural area. About decade before, cause of the political conflicted situation in Nepal; people are immigrating

in urban area and population grew up significantly, which cause tendencies of oozing different crisis. The rate of built up areas are growing up rapidly in urban zones and booming on worst trends of agriculture land planning haphazardly for builds in urban and peri urban zones. As continuous this situation, in future the government will be unmanageable for proper planning and better habitations of urban life in food securities, clean water, and urban environment. But farming systems are changing and government enhancing to farmers the new technologies in agriculture to product more foods. People are involving in market oriented farming products in urban and peri urban areas. Although suitable for all-seasonal crops, the land is cultivated mainly under intensive horticulture. Located near the major market centers, it is the main source of perishable vegetables for the people in the city, and the farmers also have easy access to inputs. Commonly products are rice, wheat, maize and vegetables Lady's finger, Onion bulb, Onion leaf, Giant taro, Beet, Cauliflower, Brocauli, Cabbage, Squash, Capsicum chilly, Bethe sag, White jute sag ,Coriander leaf, Snake cucumber, Carrot, Hycinth bean, Bottle gourd, Grasspea, Ridge ghiroula,Tomato, Bitter gourd, Drum stick, Radish, Tamarind, Snake gourd, Pointed gourd, Cow pea,Cultivated mushrooms and the fruits were Pineapple, Custardapple, Papaya, Watermelon, Coconut, Litchi, Mango, Banana, Indian gooseberry, Blackplum, Singhara nut, Grapes and Indian plum, and livestock or animal husbandry are cows buffaloes, goats sheep, pigs, chickens. Modern system of farming in urban area like vertical and rooftop farming are little far from our societies because of lack of technologies and deep knowledge, but in future such kinds of farming will have more opportunities to flourish urban framing in Nepal. There are numbers of urban cities of Asian countries like Thailand, Taiwan, China, Saudi Arabia,India and European countries like German, France, Sweden, Switzerland, Italy, Spain, Russia, Netherland, Belgium, Finland, Denmark, so many other countries are boosting their urban cities to develop urban farming to enhance better urban life of inhabitants. It is believed that urban farming is a new efficient concept for sustainable and livable city. Although there are constraints and some limitations in growing food in the cities, the benefits of urban agriculture are tremendously more than the city food supply.

ROLES OF ARCHITECTURE

When Agriculture integrates with Architecture, then there will be a lot of opportunities exist for urban farming to flourish. It plays vital role in planning stage of urban agriculture in urban area and urban buildings. Limitations of agriculture space in urban cities create more difficulties and challenges of feasibly existence due to social, economic and technical problems, but colloquially, "where there is a will, there is a way" urban cities are blooming in green cities. Time and developing technologies declared that there are more possibilities of Agriculture farming whenever and wherever, and that results are cultivating crops without soil, like Hydroponics, Aeroponics, Aquaponic, Basic wick, Non-circulating raft system or Deep water, Top feed/drip, NFT (nutrient film technique), Ebb and flow and more. These modern systems of farming are highly appreciable for urban farming and buildings, so trends of new architects are boons for the revolutionary change of urban concrete building into green smart buildings. These are low carbon buildings, sustainable, ecofriendly and highly comfortable for habitations. The glance of architects for future smart urban buildings look like highly structural safe, multi purposes use, dynamic planning, more secure, self-sustainable in energy, water and hygienic indoor air quality multi-stories buildings, where synchronize between agricultural farming and people habitations. Inhabitants of those buildings involve in different types of farming to flourish. The vertical farming buildings emerge lot of opportunities for urban people socially and economically. People find their foods fresh and hygienic in building where they live.

Bright Farm System and Kiss + cathcart Architects Kiss are currently developing the first prototype Greenmarket system (hydroponic food production facility) to be built at Masdar City, in Abu Dhabi. This prototype system will act as a research and demonstration center for subsequent Green Market systems. The Green Market utilizes Bright Farm Systems pioneering rooftop and facade mounted, sustainable greenhouse designs, to integrate hydroponic food production into civic buildings. The layers of vegetation encased in the walls of the building provide shade for the building interior.

Clepsydra Urban Farm by Bruno Viganò & Florencia Costa. The 1500 sq.ft. footprint urban lot prototype (10-story) produces the equivalent to 6 acres of farmland for certain crops or 40 tons of tomatoes a year. The prefab structural frame is built with mechanically assembled steel rods needing no welding, enable fast mounting, disassembling and maintenance operations. The enclosure is made of a transparent, resistant structural plastic membrane (ETFE). Clepsydra can be composed into multiple kits creating sustainable neighborhoods and cities.

EDITT Tower ("Ecological Design In the Tropics") is being built in Singapore with the financial support of the National University. The 26 story tower will have over half its surface area covered by organic local vegetation. Solar panels will generate up to 40% of the building's energy demands, and human waste will also be converted into an energy source via anon-site bio-gas facility. The Architecture firm TR Hamzah&Yeang is constructing the building using recycled and recyclable materials.

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Acrylamide in Foods & Its Effects on Human Health

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Eating potato chips may seem harmless. However, recent studies have shown that subjecting foods to high temperatures during cooking processes such as frying could give rise to the formation of acrylamide, a chemical that causes cancer in rats and may cause cancer in humans. Several factors including product composition and processing conditions may affect the rate of formation of this chemical in starch rich foods. Low reducing sugar and the amino acid asparagine content is desired when cooking, since the formation of acrylamide is attributed to the Maillard reaction that occurs between these food components. Scientists are investigating ways of reducing the formation of acrylamide in foods without giving up flavour and quality. However, not many alternatives have been investigated.

Researchers in Europe and the United States have found acrylamide in certain foods that were heated to a temperature above 120 degrees Celsius (248 degrees Fahrenheit), but not in foods prepared below this temperature. Potato chips and French fries were found to contain higher levels of acrylamide compared with other foods. The World Health Organization and the Food and Agriculture Organization of the United Nations stated that the levels of acrylamide in foods pose a "major concern" and that more research is needed to determine the risk of dietary acrylamide exposure.

Acrylamide is a naturally occurring by-product of the cooking process that forms naturally in a wide variety of foods when they are heated or cooked, including coffee, chocolate, almonds, French-fries, crackers, potato chips, cereal, bread and even some fruits and vegetables. When heated to high temperatures in the presence of certain sugars, asparagine can form acrylamide. High-temperature cooking methods, such as frying, baking, or broiling, have been found to produce acrylamide , while boiling and microwaving appear less likely to do so. Longer cooking times can also increase acrylamide production when the cooking temperature is above 120 degrees Celsius.

While acrylamide has been present in the human diet ever since we began cooking with fire, it was not known to be in food until 2002 when a group of Swedish scientists presented research that detected it in some baked and fried foods. Prior to the Swedish study, food was not analysed for acrylamide because it was not an added ingredient, nor was it known to be a component of food.

No Acrylamide forms naturally when carbohydrate-rich foods are fried, baked, grilled, toasted or roasted at high temperatures. Acrylamide forms when foods are cooked at home and in restaurants as well as when they are made commercially. The primary way that acrylamide forms in foods is through the reaction of reducing sugars (such as glucose) with free asparagine, an amino acid found in many foods, during the browning process. Reducing sugars, asparagine, and other amino acids are all naturally present in many plant-based foods.

At doses much higher than what is in foods, acrylamide has been found to cause cancer in laboratory animals. Currently, the U.S. Food and Drug Administration, the World Health Organization and most other health regulatory bodies have not determined that the presence of acrylamide in food presents a health risk to humans and do not recommend that consumers change their diets for the purpose of avoiding acrylamide. Studies are ongoing on this subject.

Acrylamide has been around since mankind began cooking with fire and is present in approximately 40% of the American diet. As such, there is no single product that has been identified as the main contributor.

More importantly, the World Health Organization concluded that removing any one or two foods from the diet would not have a significant impact on overall exposure to acrylamide. That's why regulatory guidance to consumers regarding acrylamide has focused on recommending that people eat a balanced diet, choosing a variety of foods that are low in transfat and saturated fat, and rich in high-fiber grains, fruits, and vegetables.

Furthermore, the amount of acrylamide in a particular food varies based on the natural components of raw materials and cooking conditions. Therefore, removing one food from the diet is unlikely to change overall consumption.

A wide range of carbohydrate-rich products subjected to heating and consequently the

"browning Maillard reaction" - when flavours, colours, and textures are formed - generally contain acrylamide. Among the foods that develop acrylamide during the cooking process are coffee, chocolate, almonds, french fries, potato chips, cereal, crackers, bread, and even some fruits and vegetables.

Although the formation of acrylamide in cooked foods is still being studied, a number of leading government food safety authorities around the world advise that consumers eat a healthy and balanced diet, rather than eliminate certain foods. For example, the U.S. Food and Drug Administration (FDA) recommends that the public eat a balanced diet, choosing a variety of foods that are low in trans fat and saturated fat, and rich in high-fiber grains, fruits, and vegetables. Similarly, the World Health Organization (WHO) reinforces general advice on healthy eating, including moderating consumption of fried and fatty foods. The WHO concludes that there is not enough evidence about the amounts of acrylamide in different types of food to recommend avoiding any particular food product.

FDA and other health and scientific organizations are continuing to study acrylamide in food – how it is formed during cooking, its effect on health, and how its formation during cooking can be reduced. This research may form the basis for more specific dietary advice and/or federal regulation of specific food products in the future. FDA has explicitly stated, however, that warnings about acrylamide in food are not in the public interest at this time.

The industry's acrylamide mitigation efforts are truly global in scope. The industry has developed a special process using the enzyme, asparaginase, to mitigate acrylamide's natural formation in dough-based foods. This process has been implemented worldwide in every country that has approved the process.

Beginning shortly after the announcement in Sweden, there have been extensive studies devoted to the reduction of acrylamide in foods where possible without changing consumer acceptability of the resulting food product or increasing food safety concerns. Much of this work has been done in the food industries, but also has involved academic and government scientists/technologists. Members of the European food industry freely shared the results of their studies through a collaboration coordinated by the Confederation of the Food and Drink Industry of the EU (CIAA) (now known as Food Drink Europe). Education/mitigation of acrylamide in foods can be approached through (a) removing reactants (fructose, glucose, asparagine) before the heating process, (b) disrupting the reaction (addition of amino acids, food grade acids, changing reaction conditions) and (c) removing acrylamide after its formation during heat processing.

The latter approach has not proved to be viable. Efforts, ranging from laboratory through industrial scale, have focused on (a) changing ingredients (decreasing glucose, fructose, asparagine), (b) altering processing conditions (lower heating temperatures, decreased heating time, blanching, use of the enzyme asparaginase), (c) changes in equipment, and (d) agronomic practices (for example storage practices, breeding of cultivars with lower glucose, fructose and/or asparagines content, selection of current cultivars with lower glucose, fructose and/or asparagine contents).
Some approaches that have been used to reduce acrylamide formation in the laboratory or pilot plant have not yet been successfully scaled to industrial production yet. A relatively recent development has been the use of the enzyme asparaginase, which converts asparagine to aspartic acid. The latter cannot form acrylamide. Asparaginase is commercially produced from Aspergillusniger (DSM'sPreventase) or Aspergillusoryzae (Novozyme'sAcrylaway).

Both have been approved in several countries for use in reducing acrylamide in selected food products. They are particularly effective in dough products (e.g., cereal products or fabricated chips), but can be applied in soaking (blanching) (e.g., potato strips) where they can reduce asparagine concentrations on the surface. Reduction of acrylamide contents in selected products made from doughs has ranged upto over 90%.

The use of asparaginase is now included in the CIAA Acrylamide "Toolbox". After several years of cooperative research and testing, the results were compiled into the CIAA Acrylamide 'Toolbox," first released in 2005 not a prescriptive manual but giving brief descriptions of intervention steps that have been tried, evaluated, and have been successful in reducing acrylamide formation in specific classes of products. It warns where intervention steps have the potential for producing decreased product quality or acceptance. The Toolbox is meant for individual manufacturers including small and medium size industries. It can also provide useful leads for catering, retail, restaurants, and domestic cooking to aid in the reduction of acrylamide. It allows potential users to access assess and evaluate which reduction measures are appropriate for their product(s).

Currently, there does not appear to be a practical and effective method for completely eliminating

acrylamide from many kinds of products. There is not a single solution that can be applied to all foods. Nevertheless, through research and innovation, the industry is discovering ways to reduce levels of acrylamide in many foods and continues to develop innovative ways to reduce levels even further.

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