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An investigation on land use dynamics and ecological implications in Nepal

S. Gairhe[1], N.D. Upadhyay[1], S. Sapkota[1] and M.R. Tiwari[2]
[1] Nepal Agricultural Research Council (NARC), Singh Durbar Plaza
[2]Animal Nutrition Division, NARC, Khumaltar, Lalitpur
samaya43@gmail.com

ABSTRACT

Study on an investigation to land use dynamics and ecological implications in Nepal was undertaken using 23 years data from 1990 to 2012. We employed percentage change, averages, growth rate and annual rate of change. The study focused to find out the temporal variation and ecological implication of land use dynamics in Nepal. The result revealed that the share of permanent crop and other land have increased, but forest area and inland water have decreased over the years. The share of forest was below minimum suggested level of at least one-third of the geographical area. Therefore, efforts should be made to bring more area under forest, which could be intensified by aforestation on unused and undeveloped potentially productive land. The sharp decline in area (51950 ha annually) under ecological sector and (8380 ha annually) under arable land sector and its consequent shift towards as non-agricultural sectors is witnessed. In recent years such shift is more intense towards the non-agricultural sector (60320 ha annually) at the cost of ecological and arable land sector. This serious ecological implication needs carefully view by the planners. Such shifts if immediately attended can achieve by using land judiciously to cope up with the increasing demand of urbanization and industrialization.

Key words: Arable land, ecological sector, land use, non-agricultural sector

INTRODUCTION

Land is a basic input for agriculture and it occupies an important position among all the resources required for a modern economy (Ramasamy *et al.*, 2005). Like any other resource, it also has two dimensions *viz.*, quality and quantity; both of these are crucial components and are under serious threat due to their intensive and extensive use for agricultural and non-agricultural purposes. The way people use land resources is decisive for their social and economic well-being as well as for the sustainability of land resources. The rapid pace of economic development along with population growth, urbanization and industrialization exerted tremendous pressure on the limited natural resource base in the country. This poses a serious challenge to researchers and policy makers to strike a balance in the use of natural resources, keeping in mind the need for conservation of sustainable development and livelihood security.

Land is a finite natural national resource, efficient management of which is vital for economic growth and development of the country. Land utilization or land use is virtually an act played

by the inhabitants of an area to meet their basic requirements. The land utilization is usually demand driven and is an adjustment or allocation of the finite land resource under agricultural and non-agricultural sectors. Land use policy 2015 has classified entire lands of the country into following Land Use Zones (LUZs). Those zones could be sub-classified into Land Use sub-Zones as per necessity:

1. Agricultural Zone
2. Residential Zone
3. Commercial Zone
4. Industrial Zone
5. Mines and Minerals Zone
6. Cultural and Archaeological Zone
7. River and Lake-Reservoir Zones
8. Forest Zones
9. Public Use and Open Space Zone
10. Building Materials (Stone, Sands, Concrete) Excavation Zone
11. Other Zones as specified as per necessity.

However, we are discussing with the available data of land use system in Nepal from 1990 to 2012. The major land uses were; agricultural land, arable land, permanent crops, permanent meadows and pastures, forest land, other land and inland water.

Agricultural land refers to the crop land, arable land, area under permanent crops, area under permanent meadows and pastures and ponds. Arable land includes land under temporary crops, land under temporary meadows, land left temporarily fallow and any other arable land. Land under permanent crops refers to land cultivated with long-term crops, which do not have to be replanted for several years after each harvest. Permanent meadows and pastures refer to land which has been used for five years or more for growing forage crops. Forest refers to wood lots or timber tracts, natural or planted, constituting part of the holding which have or will have value as wood, timber, other forest products or for protection. Other land covers two categories: Unused and undeveloped potentially productive land: refers to land which is not being cultivated and which would require some development before it could be brought into crop production. Land in holding not elsewhere specified: includes land occupied by buildings, roads, ornamental gardens and other open spaces on the holding. Inland water refers to the river, brooklet, territorial stream, canal, pond, lake-reservoir or wetland, among others.

The study was focused to find out the temporal variation of land use categories and shifts in land use from ecological and arable sectors to others sectors in Nepal.

MATERIALS AND METHODS

Nepal has a total 5 developmental region, 14 zone and 75 districts. The time series data was obtained for a period of 23 years (1990 to 2012) from FAO website, which was further divided for analysis purpose into 2 sub-periods. Period-I which is 1990-2000 and

Period-II from 2000 to 2012 and further analyzed for overall period. Percentage change, averages, compound growth rate and annual rate of change were the analytical tools used.

Compound growth rate analysis

Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making interpretations and to evolve policy decisions. The growth in the area under different land use categories was estimated using the exponential growth function of the form:

$$Y_t = ab^t e^{ut} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

Y_t : Dependent variable for which growth rate was estimated
a : Intercept
b : Regression coefficient = (1+g)
t : Years which takes values, 1, 2, …,n
u_t : Disturbance term for the year t

The equation was transformed into log linear form for estimation purpose and was estimated using Ordinary Least Square (OLS) technique. The compound growth rate (g) in percentage was then computed from the relationship,

g = {Antilog of (b)-1}*100.

The significance of the regression coefficient was tested using the student's test

Annual rate of change

The dynamics of land use shifts was examined with help of simple identity of linearly additive land-use changes (Pandey and Tiwari, 1987; Sharma and Pandey, 1992; Wani *et al.,* 2009). The first accounting identity linearly summed up the area under all land-use classes which was equal to the total reported area, given by equation (1):

R=Fr +P +M +A +I+ O …… (1)

Where,

R = Total reporting area;
F_r = Area under forest;
P = Area under permanent crops;
M = Area under permanent meadows and pastures;
A = Area under arable lands;
I = Area under inland water;
O = Area under other lands;

Also, $\Delta R = \Delta F_r + \Delta P + \Delta M + \Delta A + \Delta I + \Delta O$ ……... (2)

The total land endowment can be conveniently grouped into three broad sectors, *viz.* (i) ecological sector (E) comprising F_r, P, M and I, (ii) Arable land (A) and (iii) Other land (O) . Then, the net changes within each sector can be budgeted as:

$$\Delta E = = \Delta F_r + \Delta P + \Delta M + \Delta I \quad \text{(3)}$$

$$\Delta R = \Delta E + \Delta A + \Delta O \quad \text{(4)}$$

For finding the annual rate of change in various land use classes linear time trend equations were estimated on the land use time series data for the country.

RESULTS AND DISCUSSION

The share of different land use categories in the year of 1990, 2001 and 2012 is presented in Table 1. The result revealed that the share of permanent crop (define permanent crops-what are those?) and other land have increased, but forest area and inland water have decreased over the years; Paudel *et al.* 2016 also discussed regarding the decreased in forest area and snow/glacier coverage. The share of forest area was 24.70 percent of the total area which is below the minimum suggested level of at least one-third of the geographical area. The national forest policy in India, 1952 also made similar statement for the protection of forest cover. Efforts should be done to bring more area under forest could be intensified by aforestation on unused and undeveloped potentially productive land.

Table 1: Share of different land use categories to total reported area in Nepal
(Area in '000' hectares)

Land use categories	1990	2001	2012
Country area	14718(100.00)	14718(100.00)	14718(100.00)
Land area	14300(97.16)	14335(97.40)	14335(97.40)
Agricultural area	4144.4(28.16)	4261(28.95)	4121(28.00)
Arable land	2320.4(15.77)	2357(16.01)	2118(14.39)
Permanent crops	29(0.20)	118(0.80)	208(1.41)
Permanent meadows and pastures	1795(12.20)	1786(12.13)	1795(12.20)
Forest area	4817(32.73)	3847.2(26.14)	3636(24.70)
Other land	5338.6(36.27)	6226.8(42.31)	6578(44.69)
Inland water	418(2.84)	383(2.60)	383(2.60)

Source: FAOSTAT, 2016

Note: Figures in parentheses indicate percentages to the total reported area

The average area and changes in land use pattern in Nepal is elicited in Table 2. Land area has increased due to decreased in area of inland water. Agricultural area has decreased in which arable land has decreased by 3.85 percent whereas permanent crops area has increased by 118.06 percent, which might be due to increase in orchard, agro-

forestry and plantation crop. There was not much change in the permanent meadows and pastures areas in the country. Result revealed a great decreased in forest area by 15.57 percent. Other land showed a drastic increased by 12.56 percent.

Table 2: Average area and changes in land use pattern in Nepal
(Area in '000' hectares)

Land use categories	1990-2000	2001-2012	Change in area	Percent change
Land area	14303.18	14335.00	31.82	0.22
Agricultural area	4192.70	4180.47	-12.23	-0.29
Arable land	2337.20	2247.31	-89.89	-3.85
Permanent crops	65.41	142.63	77.22	118.06
Permanent meadows and pastures	1790.09	1790.53	0.43	0.02
Forest area	4358.50	3680.00	-678.50	-15.57
Other land	5751.98	6474.53	722.55	12.56
Inland water	414.82	383.00	-31.82	-7.67

Source: FAOSTAT, 2016

The compound growth rate of various land use categories in Nepal is elucidated in Table 3. In overall period land area has increased by 0.02 percent while inland water has decreased by 0.56 percent per annum. In case of agricultural area; arable land has decreased by 0.37 percent while permanent crop area has increased by 8.05 percent per annum. There was no change in the permanent meadows and pastures areas. Forest area has decreased by 1.37 percent however other land categories showed increment by 1 percent per annum and are significant at 1 percent level of significance. Similar result of increment in land put to non-agricultural uses was found by (Gairhe 2011) while studying land use dynamics in Karnataka, India. Decreased in inland water might be due to loss of water from ponds, lakes and deepening of ground water. This resulted increased in land area. Increased in permanent crops area might be due to establishment of new orchards, agro forestry system. Decreased in forest area might be due to encroachment by people for settlement and illegal selling of woods from the forest. Other land use category has increased much due to increase in roads networks, building, industry and shift of land from other sector. Arable land has decreased due to urbanization and plotting of land for making houses.

Intra-sectoral dynamics of land use in Nepal is depicted in Table 4. In overall period, except permanent crop and permanent meadows and pastures, forest and inland water showed shift of land form ecological sector to other land category. Similarly arable land showed shift in land towards the other land sector.

The inter-sectoral budgeting analysis was carried out to find out the pattern and extent of dynamics in land use shift in the country and presented in Fig. 1 and Table 5. In overall other land sector showed increment in the cost of ecological as well as arable land sector which is very detrimental to the nation. Similar pattern was observed by Gupta and Sharma (2010), Bardhan and Tiwari (2010) and Gairhe *et.al.* (2011).

Table 3: Compound growth rates of various land use categories in Nepal

Land use categories	1990-2000	2001-2012	1990-2012
Land area	0.01	0.00	0.02*
Agricultural area	0.26*	-0.32*	-0.04
Arable land	0.14*	-0.90*	-0.37*
Permanent crops	15.27*	4.08*	8.05*
Permanent meadows and pastures	-0.05*	0.05*	0.00
Forest area	-2.09*	-0.45*	-1.37*
Other land	1.44*	0.47*	1.00*
Inland water	-0.40	0.00	-0.56*

Source: FAOSTAT, 2016

Note: * Significance at 1 per cent level **Significance at 5 per cent level

Table 4: Intra-sectoral dynamics of land use in Nepal
Annual rate of change ('000' ha)

Periods	Arable land	Ecological sector				Other land
		Forest area	Permanent crops	Permanent meadows and pastures	Inland water	
1990-2000	3.33	-91.70	8.50	-0.95	-1.59	82.42
2001-2012	-20.37	-16.62	6.49	0.93	0.00	30.03
1990-2012	-8.38	-56.57	6.81	0.06	-2.25	60.32

Source: FAOSTAT, 2016

The sharp decline in area (51950 ha annually) under ecological sector and (8380 ha annually) under arable land sector and its consequent shift towards as non-agricultural sectors is witnessed. In recent years such shift is more intense towards the non-agricultural sector (60320 ha annually) which is happening at the cost of ecological and arable land sector. These serious ecological implications need to be carefully viewed by the planners. Such shifts from ecological sector to other sectors needs immediate

attention and this could be achieved by using land for non-agricultural uses vertically than through horizontal expansion to cope up with the increasing demand of urbanization and industrialization.

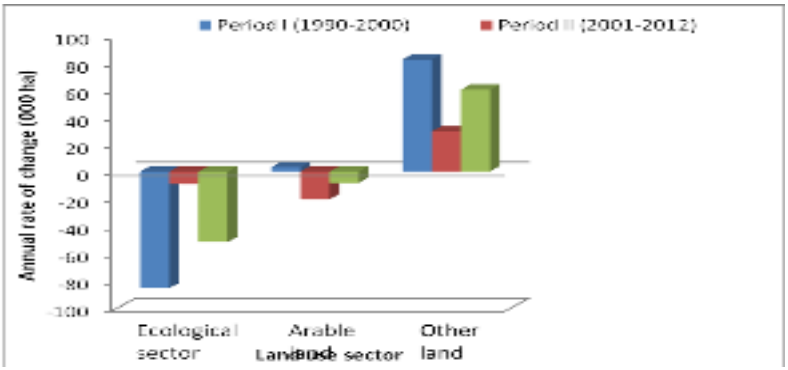

Figure 1: Inter-sectoral land use shift in Nepal

Table 5: Budgeting of inter-sectorial land use shifts in Nepal

Land use sector	Annual rate of change('000 ha)		
	1990-2000	2001-2012	1990-2012
Ecological sector	-85.75	-9.20	-51.95
Arable land	3.33	-20.37	-8.38
Other land	82.42	29.57	60.32

CONCLUSION AND RECOMMENDATION

The share of permanent crop and other land have increased, but forest area and inland water have decreased over the years. Other land sector showed increment in the cost of ecological as well as arable land sector. The share of forest area was 24.70 percent of the total area which is below the minimum suggested level of at least one-third of the geographical area. Efforts should be done to bring more area under forest which could be intensified by afforestation on unused and undeveloped potentially productive land. The horizontal expansion of the area under agricultural uses has limitations. However, there is a scope to explore new cultivable area by diverting unused and undeveloped potentially productive land. Further, the land use policies of the country should ensure that the pressure on cultivable area for want of land for other non-agricultural uses to be regulated from view point of long term food security reasons and proper land use zonation might be a better option. The sharp decline in area (51950 ha annually) under ecological sector and (8380 ha annually) under arable land sector and its consequent shift towards as non-

agricultural sectors is witnessed. In recent years such shift is more intense towards the non-agricultural sector (60320 ha annually) which is happening at the cost of ecological and arable land sector. This serious ecological implication needs to be carefully viewed by the planners. Such shifts from ecological sector to other sectors needs immediate attention and this could be achieved by using land judiciously to cope up with the increasing demand of urbanization and industrialization.

REFERENCES

Bardhan, D and SK Tiwari (2010) An investigation into land use dynamics in India and land under-utilisation. *Indian J. Agri. Econ.,* 65(4): 658-676.

FAO, (2016) FAOSTAT. http://faostat3.fao.org/download/R/RL/E

Gairhe, S. (2011) *Land use dynamics in Karnataka- An economic analysis*. M. Sc. (Agri) Thesis, University of Agricultural Science, Dharwad, Karnataka (India).

Gairhe, S., Kulkarni, G. N. & Reddy, S. V. (2011) Land use dynamics in Karnataka: Post economic liberalization. *Res. J. of Agri. Sci.,* 2(4):921-923.

Gupta, S. & Sharma, R.K. (2010) Dynamics of land utilization, land degradation and factors determining land degradation in Himachal Pradesh, *Indian J. Agri. Econ*., 65(2): 245-260.

MOLRM (2015) Land use policy. Ministry of land reform and management, Government of Nepal, Singh Durbar, Kathmandu.

Pandey, V K and Tiwari, S.K. (1987) Some ecological implications of land use dynamics in Uttar Pradesh. *Indian J. Agric. Econ.* 42(3): 388-394.

Paudel, B, Zhang, Y.J., Li, S.C., Liu, L.S., Wu, X. and Khanal, N.R. (2016) Review of studies on land use and land cover change in Nepal,. *Journal of Mountain Science.* 13 (4): 643-660.

Ramasamy, C, Balasubramanian, R. & Sivakumar, S.D. (2005) Dynamics of land use pattern with special reference to fallow lands- An empirical investigation in Tamil Nadu. *Indian J. Agri. Econ.*, 60(4):629-644.

Sharma, U K and Pandey, V.K. (1992) Dynamics of land use in different states of India. *Agric. Econ. Res. Rev.* 5(1): 24-33.

Wani, MH, Baba, S.H. & Yousuf, S. (2009) Land use dynamics in Jammu and Kashmir. *Agric. Econ. Res. Rev.,* 22(1): 145-154.

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Social dimensions of out-migration in rural Nepal

K. P. Thapaliya & D. Devkota
Agriculture and Forestry University, Rampur, Chitwan
durga.devkota@gmail.com

ABSTRACT

Education and ethnicity are thought as likely determinants of out-migration in the changing context of rural agrarian society. Under this context, a study was conducted to understand the relationship between ethnicity, education, and migration, focusing on the role of gender and how it changes within the rural contexts. Accordingly, a total of 4,628 individual respondents were selected from western Chitwan for this study. Empirical analyses of Chitwan Valley Family Survey (CVFS) indicated that educational attainment hads positive effects on out-migration. The status of migration in terms of education level revealed that majority of the migrants (three-fifths) had attained basic education; only about one-fifth of migrants had attained intermediate level. It was well revealed that majority of the migrants were from Brahmin/Chhetri ethnic group whereas the lowest population of migrants was from Newar ethnic group. In case of status of migration by gender, it was clearly revealed that larger proportions (about two-fifth) of male members were migrants compared to about one-tenth of female migrants regardless of ethnicity. That clearly suggested the need to consider these scenarios of variation while formulating education policy that different pattern; and ways of education delivery was required according to the ethnicity presence in that locality. It was well revealed from the study that majority of the migrants were from Brahmin/Chhetri ethnic group compared to the other.This variation indicates that migration policy should be developed based on equity issue considering ethnicity.

Key word: Migration, ethnicity, education, gender

INTRODUCTION

Migration of people from one place to another has been historically a part of every society's construct. Migration in returns has always affected functioning and features of society through diffusion of practices and acculturation (Donato, 1993, Zlotnik, 1995). Human migration means the process of movement of human being from one location to another for their betterment, often over long distances or large groups. Migration has been perceived as socio-economic and demographic phenomena associated with time and space. It denotes movement of people from one location to another in search of better opportunities. Moreover, social pressure and political instability are the driving force of youth migration as skilled or unskilled labor to the international market (Kollmair et al., 2006).

Historically, there has been a large amount of internal migration in Nepal. Much of the migration is seasonal and is viewed as a strategy to supplement regular farm and household incomes during low periods of the harvest and planting cycle (Wiliams, 2009, Kollmair et al., 2006). Agricultural work is common (HMG et al., 2004), as well as urban wage labor in factories, and informal sector jobs. International migration is also common. Most Nepali's who migrate to other countries go to India where they can work as seasonal laborers in the larger wage labor markets in rural and urban areas (Kollmair et al., 2006). Nepal and India share an open border, so there are no restrictions on Nepali cross-border travel to India, making this international migration no more difficult than migration to other areas of Nepal. This is particularly true for the Chitwan District which is on the Nepal-India border. The 2001 census estimated that 2.5– 5.0% of Chitwan residents were living abroad in 2001 (HMG et al., 2002) and 77% of these international migrants were in India. Data from a nationally representative sample survey allow us to estimate that about as many Chitwan residents are internal migrants (HMG et al., 2004). More recently, the Persian Gulf has become an important destination for Nepali migrants, including those from Chitwan. It is estimated that more than 100,000 and perhaps as many as 200,000 Nepali migrants were living in Gulf countries by the early twenty-first century, including both men and women (Seddon et. al., 2002).

Official data shows that in the last 6 years about 3 lakh youth per year were out-migrated for foreign employment in the international labor market (Ministry of Labor and Employment, 2014). Temporary and/or permanent out-migration of young technical professionals to the developed countries is also creating a huge chaos in economic growth and development of Nepal. In spite of those scenarios, there is also lack of local level employment opportunities available thus enables to provide rapid returns to youth and the capacity to rapidly acquire modern consumer items and a way of life not dependent on high risk of low return from agriculture (Adhikari et al., 2011; Kollmair, 2011).

The current trend in obtaining labour permits from the Department of Foreign Employment in Nepal from fiscal year 2008/09 – 2016/17 is shown in the following table (Table 1). Social change and social mobility are pressurizing youth migration (Adhikari et al., 2011). Moreover, at present context, perhaps due to the influence of western culture and lack of employment opportunities within the country rural youths are flying to overseas even as unskilled labor (Thami and Bhattarai, 2015; Gauchan, 2008). Nepal have less opportunity for off-farm employment thus rural youths by and large, are exhibiting exemplary dynamism, getting increasingly disinterested in agricultural work and are moving out of agriculture and rural areas (Agasty and Patra, 2013; Thami and Bhattarai, 2015). The trends in the destination countries of migrant workers from Nepal are similar to the trends in other South-Asian countries. Countries such as India, Pakistan, Sri Lanka, and Bangladesh have high proportion of their labour migrants destined to Gulf Cooperation Council countries; at 96 per cent; 94 per cent; 88 per cent; and 60 per cent respectively (GIZ and ILO, 2015).

Table 1: Current trend in granting labour permits, 2008/09 – 2016/17

S. N.	Fiscal year	Total no. of Nepali labour migrants		
		Male	Female	Toal
1	2008-09	211,371	8,594	219,965
2	2009-10	284,038	10,056	294,094
3	2010-11	344,300	10,416	354,716
4	2011-12	361,707	22,958	384,665
5	2012-13	423,122	27,767	450,889
6	2013-14	490,517	29,121	519,638
7	2014-15	477,690	21,412	499,102
8	2015-16	385,226	18,467	403,693
9	2016-17	362,766	20,105	382,871

Source*: Department of Foreign Employment, 2013; 2017*

As world system theory suggests that the capitalist countries seek low cost labor, the peripheral countries grow economically dependent on core countries (Jenision, 2007). International labour migration for income generation has become important among other economic sectors at present in Nepal. Developing countries certainly do promote labor migration of unskilled workers in order to ease high unemployment rates and improve the balance of payment situation (Oishi, 2002). The number of Nepalese foreign migrants has rapidly increased. Moreover, the unemployment and the political unrest have been compelled youths to go for foreign employment. Most of the households collect money for this purpose by mortgaging and selling their land, properties and taking loan at high interest rate. Because of illiteracy and lack of skilled training opportunity, they have to work in abroad as an unskilled worker. This paper examines the relationship between social dimensions such as ethnicity, education and migration, and hope to add to this body of knowledge about the effects of education on social life. The relationship between education and migration is not new in theory or research. It is however, a complex relationship, both from the theoretical and empirical standpoint, which is not thoroughly understood. This paper seeks to answer the following research questions in relations to social dimension of out-migration of western Chitwan.

a. How ethnicity, education and gender of the migrants encourage out-migration?
b. Is there any role of ethnicity and education as influencing factors of the migrants for out-migration?

World-system theory has two dimensions such as political and an intellectual endeavor. For Wallerstein (1974), "a world-system is a social system that has boundaries, structures, member groups, rules of legitimating, and coherence. A world-system is what Wallerstein terms a "world economy", integrated through the market rather than a political center, in which two or more regions are interdependent with respect to necessities such as food, fuel, protection, and two or more polities compete for domination without the emergence of one single center forever. Wallerstein (1974)

elaborated that a world-system is a "multicultural territorial division of labor in which the production and exchange of basic goods and raw materials is necessary for the everyday life of its inhabitants."

Conceptual framework

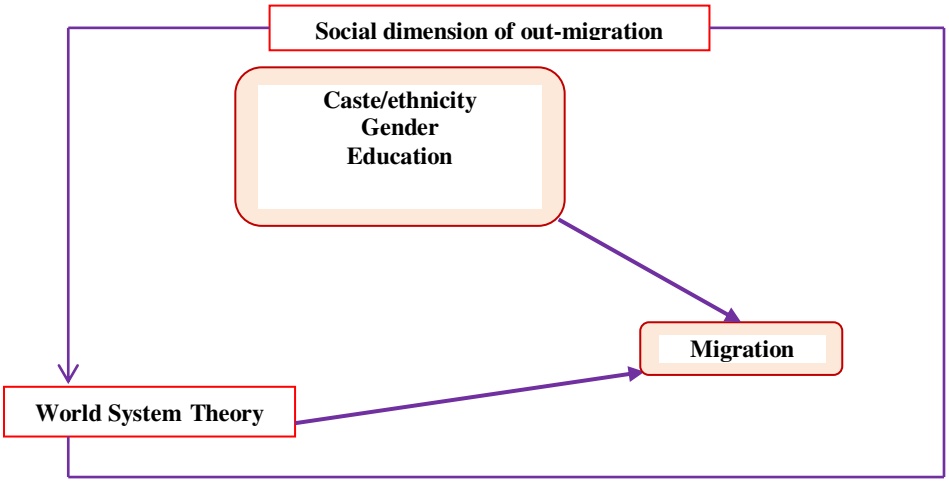

Figure 1: Conceptual framework of the study

This division of labor refers to the forces and relations of production of the world economy as a whole. Wallerstein proposes four different categories, core, semi-periphery, periphery, and external, into which all regions of the world can be placed. Out of four, two are of the uttermost importance: core and periphery. These are geographically and culturally different, where one focuses on labor-intensive, and the other to the capital-intensive production. The core-periphery relationship is structural. Semi-peripheral states acts as a buffer zone between core and periphery, and has a mix of the kinds of activities and institutions that exist on them. The core regions benefited most from the capitalist world economy. Agricultural productivity increased with the growing predominance of the commercially-oriented independent farmer, the rise of pastoralism, and improved farm technology. On the other hand the peripheral zones lacked strong central governments and they were controlled by core nations. Peripheral country exported raw materials in low price. The core country has taken much of the capital surplus generated by the periphery through unequal trade relations and gain sufficient cheap and easily controlled labor from peripheral nations (Wallerstein, 2004). According to this theory, migration is a natural outgrowth of disruptions and dislocations that inevitably occur in the process of capitalist development.

RESEARCH METHODOLOGY

Rural setting

The location of this study is the western side of the Chitwan Valley in rural Nepal. The Chitwan Valley is a flat, agriculturally fertile area in south-central Nepal (Williams, 2009). It was originally inhabited by the Tharu people; however vast structural changes have now rendered the valley home to a wide range of peoples from all over Nepal and even India. Since the mid-1950s, the Government of Nepal has undertaken an intensive campaign to populate the terai, and in particular Chitwan Valley, with peoples from the hill regions of the country. Since 1979, paved roads have been built connecting Chitwan's largest town to Kathmandu in the north and to the east and west of the country. As a result of these changes, provision of land, services, and transportation opportunities, large numbers of people from across the country have moved into the Chitwan Valley, as planned. More than half of the migrants to the study area came from the hill districts adjacent to Chitwan (Williams, 2009). However, significant and increasing proportions of in-migrants come from other districts across the country and border areas of the Indian terai. The Tharu are now a minority group in their native region. The in-migrants since the 1950s have represented almost all ethnic groups in Nepal. In conjunction with the rapid population growth and provision of basic government services to initially attract settlers, Chitwan has experienced extensive social changes (Axinn and Yabiku, 2001). Roads, markets, schools, and health posts have proliferated across the valley. In particular, the late 1950s witnessed a huge influx of government services. Public institutions that had previously been functionally inaccessible became accessible within 50 to 100 minutes walk (Axinn and Barber, 2001). After the late 1950s, service provision continued, but at a slower rate. Similarly, from the late 1950s through the mid-1960s there was a proliferation of private institutions, such as markets, employers, bus stops, and banks. These services are now also generally accessible to most neighborhoods (Williams, 2009).

Study design

The method of a research designates that how you going to demeanor your research and it also lead you on how to advance with your research (Faryadi, 2012). Method is just like a tool utilized by a researcher to measure the activities of the study. The empirical study of migration is hindered by the difficulties of obtaining a representative sample of individuals or households. To study migration, a representative sample requires the inclusion of those who have migrated (many of whom no longer live in the area under study) and those who have not migrated. A long-term prospective survey in an area of origin is arguably the best way to capture all types of migration in a representative population sample. However, this type of data is often not available. The information used in this paper is a primary data generated from the ISER-N through Family Valley Household Survey (CVFS) during 1996-2008. This paper aims to analyze social dimension of out-migration in western Chitawan. CVFS study is the ongoing research project of ISER-N. CVFS is a comprehensive multi-level mixed methods panel study of individuals, families, and communities in the Chitwan Valley of Nepal. The study aims to investigate influence of social variables on population processes and the relationships between the environment and population processes. Variables considered in this

particular research were migration, caste/ ethnicity; gender and education where migration is dependent variables and rest of the others are independent variables. Similarly, level of measurement was nominal (i.e. migration, gender, caste and ethnicity) and ordinal (i.e. education and age). Available data were statistically analyzed using SPSS software and findings presented by using bivariate analysis of statistical tools.

RESULTS AND DISCUSSION

Gender wise respondent's population of the study area was 49.8 % male and 50.2 % female with a total of 4628 population respectively. It was learnt that within a twelve years of time (1996-2008) a total of 24.6 % population were migrated to the international labor market.

Ethnicity and education

Ethnicity and education of the study households has been explained in terms of bivariate analysis that reflects level of education within ethnicity across the study area of Chitwan Valley (Table 2). It is clear from the table that larger fractions of illiterate population are from Terai Janajati that accounts more than two-thirds of the total population of the studied area. This is also similarly reflected for Lower caste and Hill Janajati. On the other hand, nearly half of the respondents were having basic education in all ethnicity compared to very low status in case of those attaining intermediate and higher education for all ethnicity (Table 2).

It is also revealed from the analysis that less than 15% respondents in Brahmin/Chhetri ethnic group had attained higher level education, but nearly half of them had attained basic education. On the other hand less than five percent respondents in case of lower caste ethnic group had attained higher education including intermediate level. This trend is quite similar to the rest of the ethnic group, especially in the case of lower caste as well as hill and Terai Janajati (Table 2).

Table 2: Bivariate analysis of level of education within ethnicity across the study area of Chitwan valley

Ethnicity* education (n=4628)	Level of education (within ethnicity %)				
	Illiterate	Basic education	Intermediate	Higher education	Total Population
Brahmin/Chhetri	727 (33.8)	1032 (48.0)	322 (15.0)	71 (3.2)	2152
Lower Caste	277 (60.2)	172 (37.4)	11 (2.4)	0	460
Hill Janajati	357 (50.6)	303 (43.0)	36 (5.1)	9 (1.3)	705
Newar	94 (32.2)	152 (52.1)	37 (12.7)	9 (3.0)	292
Terai Janajati	590 (66.7)	261 (29.5)	33 (3.7)	1 (0.1)	885
Others	53 (39.6)	62 (46.3)	16 (11.9)	3 (2.2)	134
Total	2098 (45.4)	1982 (42.8)	455 (9.8)	93 (2.0)	4628

Source: CVFS, 2008

Ethnicity and migration

The status of ethnicity and migration of the study households has been explained in terms of bivariate analysis that reflects current position and status of migration within ethnicity across the study area of Chitwan valley (Table 3).

Table 3: Bivariate analysis of ethnicity and migration across the study areas of Chitwan valley

Ethnicity*migration (n=4628)	Migrants within 12 years (1996-2008)		
	Non-migrants	Migrants	Total population
Brahmin/Chhetri	1619 (46.4)	533 (46.8)	2152 (46.5)
Lower Caste	327 (9.4)	133(11.7)	460 (9.9)
Hill Janajati	507 (14.5)	198 (17.4)	705 (15.2)
Newar	234 (6.7)	58 (5.1)	292 (6.3)
Terai Janajati	740 (21.3)	145 (12.7)	885 (19.2)
Others	61 (1.7)	73 (6.4)	134 (2.9)
Total	3488	1140	4628 (100)

Source: CVFS, 2008

It is well revealed from the table that majority of the migrants are from Brahmin/Chhetri ethnic group that also reflects the similar status of non-migrants as well as total sample size considered in this study. On the other hand about one sixth of migrants were also found from other ethnic groups, such as lower caste, Hill Janajati and Terai janajati. Lowest population of migrants as well as non-migrants was from Newar ethnic group (Table 3).

Gender and education

The status of level of education in relation to gender in the study sites of Chitwan valley has been described from bivariate analysis (Table 4).

Table 4: Bivariate analysis of gender and level of education across the study areas of Chitwan valley

Gender*education (n=4628)	Level of education (within gender %)				
	Illiterate	Basic education	Intermediate	Higher education	Total population
Male	750 (16.2)	1144 (24.7)	338 (7.3)	83 (1.8)	2315
Female	1348 (29.1)	838 (18.2)	117 (2.5)	10 (0.2)	2313
Total	2098 (45.4)	1982 (42.8)	455 (9.8)	93 (2.0)	4628

Source: CVFS, 2008

It is clearly revealed from the table that larger proportion of illiterate were female, that accounted nearly one third of the study sample size compared to the male that were less than one fifth in proportion while explaining their situation of illiterate. This scenario was also similarly reflected in total sample size. Reflecting this trend of male dominance in education, comparatively higher proportion of male had attained intermediate as well as higher education than the female. Only less than one percent of female had attained higher education compared to about two percent male members (Table 4).

Gender and migration

In the case of status of migration by gender, it was clearly revealed that larger proportion (about nine-tenth) non-migrants were female member compared to three-fifth of the non-migrant male members. To support this scenario, it was also well revealed that about two-fifth of the male members were migrants compared to about one-tenth of the migrants female members in the studied population (Table 5).

Table 5: Bivariate analysis of gender and level of education across the study areas of Chitwan valley

Gender*migration (n=4628)	Migrants within 12 years (1996-2008)		
	Non-migrants	Migrants	Total population
Male	1425 (61.6)	890 (38.4)	2315
Female	2063 (89.2)	250 (10.8)	2313
Total	3488 (75.4)	1140 (24.6)	4628

Source: CVFS, 2008

Education and migration

The status of migration in terms of education level has been explained in the Table (6. Accordingly, it was clearly revealed that majority of the migrants (three fifths) had attained basic education that only about one fifth of migrants had attained intermediate level of education or they were illiterate. To support this, about half of the non-migrant respondents were illiterate (Table 6).

Table 6: Bivariate analysis of educational status and migration across the study areas of Chitwan valley

Education *migration (n=4628)	Migrants within 12 years (1996-2008)		
	Non-migrants	Migrants	Total population
Illiterate	1849 (53.0)	249 (21.8)	2098
Basic education	1276 (36.6)	706 (61.9)	1982
Intermediate	294 (8.4)	161 (14.1)	455
Higher education	69 (2.0)	24 (2.1)	4628

Source: CVFS, 2008

DISCUSSION

Education has been identified in sociological research as a catalyst of social, economic, and ideational change. Particularly in rural areas and resource-limited countries, where formal education was previously uncommon or even completely inaccessible, the introduction of schools can instigate vast changes in communities and individual behavior (Williams, 2009). Social science has linked education to changes in mortality rates (Sastry, 1996), and gender roles (Niraula and Morgan, 1996). Some studies have indeed found strong positive effects of educational attainment on the propensity to migrate (Stark and Taylor, 1991). However, some studies have found negative effects of educational attainment on migration in certain settings (Lucas, 1985) and still others have found no significant effects at all. In general, the literature appears to favor the prospect that educational attainment does increase the likelihood of migration. However, it is not entirely clear why such disparate results may appear in different studies.

Nepali society is strictly stratified by sex. Men and women experience very different opportunities and expectations regarding work, relationships, and personal autonomy. In this context, migration may be instigated through different mechanisms for men and women. Nepal is ethnically, economically, and geographically heterogeneous and in general it is a patrilineal, and patrilocal society (Niraula and Morgan, 1996). Upon marriage, young couples most often reside with the groom's parents for many years (Bennett, 1983; Shrestha and Bhattarai, 2003). In a minority of cases, the couple moves to their own house, or they live with the bride's parents. Functionally, marriage instigates women to migrate to a much larger extent than men. It is likely that most women will marry and consequently migrate at least once. Studies that analyze the likelihood of migration for some women may actually be analyzing the likelihood of first marriage. Men on the other hand, are much more likely than women to move for reasons other than marriage. In 1980, men in Nepal had much higher rates of employment outside the home, 66% of the labour force was male (World Bank Group, 2004).

Historically, women in Nepal have equally experienced restricted autonomy and decision-making power (Niraula and Morgan, 1996; Devkota and Pyakurya, 2017). This may ultimately limit individual women's ability to decide to migrate and to build a life in a destination community, as well as their decision-making power with regard to family moves. However, norms for women and men differ and are rapidly changing in many Nepali communities. Research has shown that women of higher status families and ethnic groups from the hill regions enjoy more autonomy and decision-making power (Niraula and Morgan, 1996). Sex differences in rural Nepal also affect educational outcomes (Stash and Hannum, 2001; Beutel and Axinn, 2002), and likely the relationship between education and out-migration. For the preceding reasons, the relationship between education and out-migration in this setting may be very different for men and women. The opportunities, expectations, and decision-making process may result in different mechanisms through which education affects migration for women and men. However, because women in Nepal have been increasingly participating and excelling in education

and in the paid workforce in recent decades, the mechanisms that affect their migration decisions may be changing.

CONCLUSION

It was clearly revealed from the findings of this study that there was a distinct variation in terms of education status considering ethnicity whereas larger fraction of illiterate population was from Terai Janajati. On the other hand status of attaining basic education was somehow similar in all ethnic groups that nearly half of the respondents were having basic education in all ethnicity. This clearly suggest the need to consider these scenario of variation while formulating education policy that different pattern and ways of education delivery is required according to the ethnicity presence in that locality.

It was well revealed from the study that majority of the migrants were from Brahmin/Chhetri ethnic group compared to the other. This variation should be thus considered should there be migration policy to be developed based on equity issue considering ethnicity.

It was clearly demonstrated that larger proportion of non-migrant female was illiterate. This suggest the fact that if migration policy is to be gender friendly, literacy related programme should be more focused to the female members.

REFERENCES

Adhikari, J. and M. Hobley. (2011). *Everyone is leaving- Who will show our field? The effects of migration from Khotang district to the Golf and Malaysia*. Kathmandu: Swiss Development Cooperation.

Agasty, M. P. and Patra, R. N. (2013) Migration, Wages and Agriculture: Empirical Evidence and Policy Implication. *IOSR Journal of Humanities and Social Science,* 14 (5): 9-20.

Axinn, W. G., Barber, G. & Jennifer, S. (2001) Mass education and fertility transition, *American Sociological Review, 66:481–505.*

Axinn, W. G., Yabiku, Scott T. (2001) Social change, the social organization of families, and fertility limitation. *American Journal of Sociology,* 106(5):1219–1261.

Beutel, Ann M. & Axinn, W. G. (2002) Gender, social change, and educational attainment. *Economic Development and Cultural Change, 51:109–134*

Bennett, L. (1983) *Dangerous wives and sacred sisters: Social and symbolic roles of high-caste women in Nepal*. New York: Columbia University Press.

Department of Foreign Employment (2017). *Labor Migration for Employment-A Status Report for Nepal.* Kathmandu.

Devkota, D. and K. N. Pyakuryal. 2017. Changed gender roles and rural agricultural system. *Journal of AFU*, 1: 35-47.

Donato, K. M. (1993) Current trends and patterns of female migration - Evidence from Mexico. *International Migration Review, 27:748–771.*

Faryadi, Q. (2012) How to write your proposal: *American International Journal of Contemporary Research,* 2(40)

Gauchan, D. (2008) Agricultural development in Nepal: Contribution to Economic Growth, Food Security and Poverty Reduction. *Socio-economic Development Panaroma,* 1(3): 49-64.

GIZ and ILO (2015) *Labour market trends analysis and labour migration from South Asia to Gulf Cooperation Council Countries, India and Malaysia.* Kathmandu: Author.

HMG, (2002) *Population Census 2001: National Report*, National Planning Commission Secretariat, Central Bureau of Statistics, United Nations Population Fund Nepal.. Kathmandu: UNFPA.

HMG, National Planning Commission, Central Bureau of Statistics. (2004) *Nepal Living Standards Survey 2003/04*. Kathmandu: Central Bureau of Statistics; 2004.

Jennison, R. (2007) Causality chains in the international migration, *Population research and policy review,* 26 (4)

Kollmair, M., Manandhar, S., Subedi, B., and Thieme, S. (2006) New figures for old stories: Migration and remittances in Nepal. *Migration Letters.* 3:151–160.

Kollmair, M. (2011) Labor migration in the Himalayas: Opportunities and challenges. *Sustainable Mountain Development*, *59.*

Lucas, Robert EB. (1985) Migration amongst the Batswana. *The Economic Journal, 95:358–382.*

Niraula, B, & Morgan, S. P. (1996) Marriage formation, post-marital contact with natal kin and autonomy of women: Evidence from two Nepali settings. *Population Studies.* 50:35–50.

Oishi, N. (2002) *Gender and Migration: An Integrative Approach.* San Diego: The Center for Comparative Immigration Studies.

Sastry, N. (1996) Community characteristics, individual and household attributes, and child urvival in Brazil. *Demography*, 33:211–229.

Seddon, D. Adhikari, J. & Gurung, G. (2002) Foreign labor migration and the remittance economy of Nepal. *Critical Asian Studies,* 34:19–40.

Stark, O. & Taylor, J. E. (1991) Migration incentives, migration types: The role of relative deprivation. *The Economic Journal,* 1991; 101:1163–1178.

Stash, S., Hannum, E. (2001) Who goes to school? Educational stratification by gender, caste, and ethnicity in Nepal, *Comparative Education Review,* 45:354–378.

Shrestha, N. R.; Bhattarai, K. (2003) *Historical dictionary of Nepal,* Lanham: The Scarecrow Press.

Thami, P. & Bhattarai, A. (2015) Labor Migration and Skills Training, *Policy Brief*. Centre for the Study of Labor and Mobility (CESLAM).

Wallerstein, I. (1974) *The Modern World System: Capitalist Agriculture and the origins of European World-Economy in the sixteenth Century.* New York: Academic Press.

Wallerstein, I. (2004) *World-Systems Analysis: An Introduction.* New York: Academic Press.

World Bank Group. (2004) World development indicators database. Washington D.C: World Bank Group.

Williams, N. (2009) Education, gender, and migration in the context of social change, *Soc Sci Res., 38(4): 883–896.*

Zlotnik, H. (1995) The south-to-north migration of women. *International Migration Review, 29:229–254.*

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Altitudinal effects on fruit quality parameters of sweet orange (*Citrus sinensis* Osbeck)

D.B. Ayer & G.K. Shrestha
Himalayan College of Agricultural Sciences and Technology
Purbanchal University, Kathmandu, Nepal
dhiru_ayer@yahoo.com

ABSTRACT

The study entitled, "Altitudinal effects on quality parameters of Sweet orange (Citrus sinensis)" was carried out in three different altitudes i.e. 1400 masl, 1700 masl, 2000 masl from spetember,2016 to February, 2017 in Dadeldhura district, Nepal. In this study the fruit weight, fruit diameter, peel diameter of fruit, number of segments in a fruit, number of seed in a fruit, juice content by a fruit, acidity (pH) of the fruit, total soluble solids (TSS) of fruit were considered as fruit quality parameters. For this study 10 trees from each altitude and 10 fruits from each tree were taken. It was recorded that among three altitudes 1400 masl had the good fruit quality parameters (such as weight of fruit, diameter of fruit, peel thickness, juice content, pH value of fruit juice, vit.C content etc) compared to other two altitudes (1700 masl and 2000 masl). The average fruit weight (170.625g) and average fruit diameter (6.97cm) was maximum; and peel thickness was found minimum (0.4mm) in 1400 masl. The TSS, number of segments and number of seeds per fruit was observed high in 1700 masl, i.e.11.13 °Brix and 10.8 and 25.2 respectively. The average juice content (78.89ml)) and pH (4.57) value was observed highest in 1400 masl. The vit.C content was found highest (74.22mg/100ml) in 2000 masl.

Key words: *Citrus sinensis*, altitudinal effects, fruit quality, soluble solids, juice

INTRODUCTION

Sweet oranges (*Citrus sinensis* Osbeck, family: Rutaceae) are native to Southern China or Northeast India. They contain vitamin C, pectin, essential oils and are rich in sugars. The Junar is an excellent and popular variety of sweet orange grown in Nepal (Shrestha, 2016) but in Far-western region of Nepal, Mosambi, a popular Indian variety is widely cultivated. Its peels are used in making marmalades. Juice, sherbets, cordials etc. are important processed products. The orange tree is small, spiny tree, typically growing to 7.5m, but occasionally reaching the heights up to 15m, generally with a compact crown. Fruits when ripen appear orange or yellow. The fruit skin (rind or peel) contains numerous small oil glands. The flesh or pulp of the fruit is typically juicy and sweet, divided into 10 to 14 segments (although there are seedless varieties) and ranges in colour from yellow to orange red.

In Nepal, Dhankuta, Ramechhap, Sindhuli, Palpa, Lamjung, Dadeldhura, Baitadi etc. are major sweet orange producing districts. Total area of cultivation is about 4,833.5 ha with productive area of 3,440 ha. The annual production was 3,47,675 mt with productivity of 10.1 mt/ha (FDD, 2016).

MATERIALS AND METHODS

The study on altitudinal effect on quality parameters of sweet orange was conducted in Dadeldhura district during 2016 and 2017. Three different altitudes (1400 masl, 1700 masl and 2000 masl) were taken. The variety of sweet orange at the study sites was Mousambi (an Indian variety). Fruit samples were collected at the time of harvesting time i.e in February. Ten trees from each altitude with uniform age, size and vigour were selected randomly. Ten fruits from each tree were selected for analysis.

Different physicochemical parameters i.e. fruit weight, fruit diameter, post harvest weight loss, peel thickness, TSS, number of segments, pH of fruit juice, ascorbic acid content, disease and pest incidence were taken to observe effect of altitude on these parameters. Average fruit weight, post harvest weight loss (5 days interval up to 30 days), peel weight, seed weight, pulp weight etc. were measured by using digital weighing balance in gram. Diameter of the fruit and peel thickness were measured using Vermeer calliper in cm. The TSS was measured by using hand refractometer and acidity of fruit juice by calibrated pH meter. The average juice content was measured by using measuring cylinder. The ascorbic acid content was measured by titration methods. The number of segments and number of seeds were counted individually. The incidence of disease and pest was observed by direct field observation. The data was analysed by using statistical tools such as SPSS.

RESULTS AND DISCUSSION

Weight of fruits

Fruit weight varies with the different altitudes and management practices (irrigation and regular application of manures in T1) adopted by farmers. The results show that there was a significance difference between the treatments; it shows that altitudes play the important role on fruit weight. The average weight of the fruits was highest in the altitude of 1400 masl (170.63 g) which was followed by 1700masl (142.70 g) and 2000 masl (128.38 g) (Table-1). It was also observed that the highest individual fruit weight was found in T1 (223.5g) and lowest in T3 (116.0g). The highest weight of fruit was obtained from the lowest altitude; it might be due to the bigger size of the fruit with higher juice content and thin peel thickness as affected by altitude.

Diameter of fruits

The fruit diameter was increased with the maturity. Bhullar, (1983) has reported the increase in fruit size of sweet oranges with advancement of maturity level. The increase

in fruit size along with increased maturity stage is mainly due to cell division and dry matter accumulation. Effect of altitude on fruit diameter was observed in this study. It was observed that average diameter of fruits in the lower altitude of 1400 masl was found highest (6.97 cm). However there was no significance difference between the treatments (Table. 1) statistically although variations in fruit diameter were noted. Table 2 shows that the variations in fruit diameter ranged from 3.52 cm to 7.65 cm.

Table 1. Effects of altitude on quality parameters of sweet orange

Treatments	1400 masl (T1)	1700 masl (T2)	2000 masl (T3)	f-value	Significance (0.05)
Weight of fruits (g)	170.63	142.70	128.38	9.52	0.001
Diameter of fruits (cm)	6.97	6.40	6.28	1.77	0.189
Post harvest weight loss %	20.03	19.4	19.5		
Peel thickness (cm)	0.4	0.5	0.8	38.38	0.000
TSS	10.3	11.13	10.71	5.36	0.011
Number of segments	9.2	10.8	9.2	10.11	0.011
Number of seeds	21	25.2	15	9.69	0.001
Juice content (ml)	78.89	57.57	48.52	39.32	0.00
Acidity of fruit juice (pH)	4.60	4.20	3.80	13.65	0.000
Ascorbic acid content (mg/100g)	53.91	56.93	74.22	50.94	0.000

Post-harvest weight loss

The weight of fruits soon after harvest was taken and then in every five days interval the weight of the fruits was taken up to one month in the room temperature. The result obtained is presented below:

The initial weight was highest in all the treatments but it declined as the fruits were kept in the storage (Table.3). The highest post harvest weight loss percent was noted in T1 (20.03%) and least in T2 (19.40%). The post harvest weight loss percent in T3 was 19.56%.

Peel thickness

The ANOVA table shows that the there was significance difference found between the treatments (altitude). It means that the altitude had the role in the peel thickness of the fruit. The lower altitude i.e. 1400 masl (0.4 cm) had the average peel thickness lower than 1700 masl (0.5cm) and 2000 masl (0.8cm). It was also observed that the highest peel thickness was found in 2000 masl (0.9cm) and lowest in 1400 masl (0.3cm). It was found that the higher altitude fruit had the higher peel thickness. However the fruit diameter was found not significantly different (Table.1). It means that higher the peel thickness of fruits, lesser the weight of fruits.

Total soluble solid (TSS)

In the study the average TSS was found to be highest in the altitude of 1700 masl (11.41) followed by 1400 masl (10.36) and 2000 masl (10.13) (Table 1.). The TSS content varied due to many reasons such as slope of the land, stage of maturity, light intensity and also may be due to the soil factors. Rokaya et al (2016) observed highest TSS (11.63) in 1300 masl mandarin orange in Nepal.

Number of segments

The average number of segments was more in 1700 masl (10.8) compared to other two treatments. 1400 masl and 2000 masl had equal segment numbers i.e. 9.2. It was seen that the size of segments was found larger in 1400 masl followed by 1700 masl and 2000 masl, respectively (Table 1.). The fact behind the higher fruit diameter in 1400 masl was due to larger segments as affected by altitude and environmental factor.

Number of seeds

Generally there are 2- 3 seeds per segment of citrus fruit and that may range from 18- 27 per fruit. In this study the average number of seeds per fruit was highest (25.2) in location of 1700 masl with followed by 1400 masl (21) and least in 2000 masl (15). The number of malformed seeds was slightly higher in the altitude of 1400 masl than others. The number of seed in individual fruit was found maximum in lower altitude while the higher altitude had lower number of seed. These findings agree with the result of Khokhar and Sharma (1984) in sweet orange. There was significance difference between treatments indicating that number of seeds per fruit were highly dependent on the altitude (Table 1).

Juice content

The juice content differed significantly in different locations. It was found that the average juice content was much higher (78.89ml) in 1400 masl (T1) followed by 57.57ml in 1700 masl (T2) and least (48.52ml) in 2000 masl (T3) (Table 1.).

Acidity of fruit juice

The acidity of fruit juice was high (pH-3.8) in the 2000 masl followed by 1700 masl (pH-4.2) and 1400 masl (pH-4.6) (Table 1.). Thus acidity of fruit juice increased with an increase in altitude. The highest pH value of fruit juice was found in 1400 masl (5.1) and lowest in 2000 masl (3.5).

Ascorbic acid contains by fruit

The average ascorbic acid concentration per fruit was found to be higher (74.22mg/100ml) in the altitude 2000 masl followed by 1700 masl (56.93mg/100ml) and least (53.91mg/100ml) in 1400 masl (Table 1.). It was observed that if acidity of fruit was higher than the vit.C content was also found to be higher.

Diseases and pests

Diseases

During my field visit only citrus decline was a main problem in 1400 masl and 1700 masl areas. In 2000 masl area there was no incidence of specific disease was seen. Citrus decline was found up to 1700 masl causes the high loss to the fruit orchard.

Insect pests

None of the pests were seen during my field visit. It may be due to the winter season when I was there at high altitude up to 2000 masl; it could be due to altitudinal effect.

CONCLUSION

It was concluded that the sweet orange can be successfully grown up to the 2000masl altitude. However the quality parameters of sweet orange fruits were remarkably influenced by the altitude factors. The disease and pest incidence was affected by the altitude variation. The higher altitude had the lower incidence of disease and pest. The sweet orange production in Dadeldhura district appeared totally organic type which shows its scope for better marketing opportunities at distant markets.

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REFERENCES

Bhullar, J.S. (1983) Determination of maturity standards of sweet Oranges in Himanchal Pradesh. *Hariyana Journal of Horticultural Science, 12,183-188.*

FDD, (2016) *Citrus fruit farming and disease pest management.* National Citrus Development Programme, Kirtipur, Kathmandu.

Khokhar, U.U. and Sharma, R. (1984) Maturity indices for sweet orange CV. Blood Red. *Haryana Journal of Horticultural sciences, 13, 22-25.*

Rokaya, P.R, Baral, D.R., Gautam, D.M., Paudyal K.P., (2016). Effect of altitude and maturity stages on quality attributes of mandarin. *American journal of plant sciences, 7, 958-966.*

Shreshta, G.K., (2016) *Fruits and plantation crops.* Heritage Publishers and Distributors Pvt. Ltd., Bhotahity, Kathmandu, Nepal.

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Studies on qualities of probiotic yoghurt fortified with apple pulp and honey

B. Adhikari[1] and G. Bajracharya[2]
[1]National Codex Secretariat, Department of Food Technology & Quality Control, (DFTQC), Babarmahal, Kathmandu[1] ; Former DGM of Dairy Development Corporation, Lainchaur
adhikaribharati@gmail.com

ABSTRACT

Fermented dairy products, having the tradition as healthy foods, are a natural choice for their makeover as functional foods.Consumption of fermented dairy products improve host metabolism by maintaining balance of the intestinal micro flora and may thus have a positive effect on the host. Yoghurt is easily digested (because milk protein, fat and lactose components undergo partial hydrolysis during fermentation), has high nutritional value and is a rich source of carbohydrates, protein, fat, vitamins, calcium, and phosphorus. Study entitled 'Studies on qualities of probiotic yoghurt fortified with apple pulp and honey' was conducted in DDC (Dairy Development Co-corporation, Lainchaur, Kathmandu), during the period of November 2016 to February 2017.The products were made and stored at refrigerated condition, at around 5°C, and was subjected to organoleptic, physiochemical and microbiological analysis at 0, 7, 14, 21 and 28th days of storage period. In overall, sensory score the color, texture, taste, mouth feel and overall acceptance attributes were given to the treatments C so called formulation f3 having formulation 6% apple pulp & 3% honey. The microbial analysis revealed that there were enough probiotic organisms in the products ranged from 1.1×10^{7} to 42×10^{8}cfu/ml.Appreciating the nutritional profits and healthy image of yoghurt endorsed by the addition of apple pulp & honey enhance yoghurt functionality, preventive medicine, and residence treatment in the new times requires persistent and transparent public education.

Key words: Probiotics, yoghurt, fortification, functional food

INTRODUCTION

Yoghurt is a fermented dairy product obtained from the lactic acid fermentation of milk. It is one of the most popular fermented milk products in the world. Yoghurts are available in a variety of textures (e.g. liquid, set, and smooth), fat contents (luxury, low-fat, virtually fat-free) and flavors (natural, fruit, cereal). The healthy image of yoghurt is further endorsed by the addition of various fruit preparations in yoghurt to include the health benefits of fruits such as providing fibre and antioxidants (O'Rell and Chandan, 2006). Yoghurt is nutritionally rich in protein, carbohydrate, vitamins and minerals (for example calcium) which contributes to a healthy living including decreasing

the risk of colon cancer, improved digestion and many other benefits (Gray, 2007). Sensory appeal is one of the essential strategies associated with the market success of fermented products like yoghurt. The popularity of yoghurt as a food component has been linked to its sensory characteristics (Routray and Mishra, 2011).

There is a genuine interest in the development of fruit pulp based yoghurt with probiotics because they have taste profiles that are appealing to all age groups and because they are perceived as healthy and refreshing foods. Probiotic yoghurt fortified with apple pulp and honey is an interesting development which has attracted much attention to many consumers for breakfast meal. Generally, the fruit yoghurt is mixed with oats and consumed as first serving of the day. Though, much dairies being established, no commercialization of this product has been developed. The production of probiotic yoghurt fortified with apple pulp and honey helps in new product innovation in Nepalese dairy sector. It is expected that the study will reveal the standard formulation of Probiotic yoghurt fortified with apple pulp and honey and also contribute to the economy of dairy industries. Consumers can get antibiotic as well as therapeutic property by having calorific functional food for healthy living.

Consumption of fermented dairy products improve host metabolism by maintaining balance of the intestinal micro flora and may thus have a positive effect on the host. Fruits and vegetables contain healthy beneficial compounds such as phyto-chemical and antioxidants that are important in maintaining human health. They are also rich in essential nutrients including sugars, mineral, vitamin and dietary fibers making them ideal substrates for probiotics. The practice of fortification of yoghurt with health promoting additives is gaining popularity and is expected to fulfill more nutritional needs also. Being a priority for today's medical and nutritional sciences, probiotics are increasingly considered as functional natural foods.Uniquely, yoghurt is invaluable for infants and elderly with a narrow list of tolerable food choices. Investigations suggest that selected probiotics, especially those of yoghurt, improve digestive and metabolic health and immunity. As a result, they might cease oncogenic reactions and reduce or postpone cancer occurrence (Sanders, 2007). Besides, honey also holds the antibacterial property and antioxidants. Fortification of apple pulp helps in addition of soluble dietary fiber and vitamins. Hence, it would be a great combination of functional food.

MATERIALS AND METHODS

Raw material

Standard milk of 3% fat & 8% SNF was collected from DDC. Skimmed milk powder (SMP) was also obtained from DDC. Apple was purchased from the local market of New Baneshwor; and honey was purchased from Patanjali brand store. Probiotic culture manufactured by CHr, Hansen laboratory (Denmark) was also collected from DDC, Lainchaur. Batch pasteurizer was used to pasteurize the milk. Grinder was used to make

apple pulp. Incubation and cooling chamber of DDC was used; and plastic cup for filling the yoghurt was also provided by DDC.

Formulation of probiotic yoghurt fortified with apple pulp & honey and research design

There were nine variations in the formulation of yoghurt mix. The design of research was arranged to Completely Randomized Design (CDR). A total number of 9 different types of probiotic yoghurt were prepared by using Direct Vat Set (DVS) cultures in the Milk Product Production, Sales and Distribution Scheme, Lainchaur (DDC). Then the product was analyzed for following parameters. The detail of the formulation and treatments are shown in table below.

Table 1: Proportions of ingredients for the different formulation of Probiotic fruit yoghurt

Treatments	**Description**
T	Control Sample (no addition of apple pulp & honey)
T_1	6% apple pulp & 1% honey
T_2	6% apple pulp & 2% honey
T_3	6% apple pulp & 3% honey
T_4	8% apple pulp & 1% honey
T_5	8% apple pulp & 2% honey
T_6	8% apple pulp & 3% honey
T_7	10% apple pulp & 1% honey
T_8	10% apple pulp & 2% honey
T_9	10% apple pulp & 3% honey

Note: The entire product contain 3% milk fat, 10% SNF & 2% probiotic culture

Preparation of probiotic yoghurt fortified with apple pulp & honey

Standard milk containing 3% fat & 8% SNF was collected then 2% SMP was added. Apples were washed with KMS, peeled and cut into small pieces. Pulping was done in aseptic condition. Pulp was blended with the mix. Above formulations were pasteurized (90℃ for 5 minutes) and homogenized (75℃ @ 25 Mpa) along with the honey. The treatments were cooled to 45℃ and followed by inoculation of probiotic culture at 43 ± 1℃. Incubation was done at 43 ± 1℃ for 4 hours. The prepared product was cooled and stored below 5℃. Periodic testing was carried out for the further study.

Sensory (such as color, flavor, mouthfeel, taste and overall acceptance), chemical (TS, fat, protein, reducing sugar, total ash, TSS, acidity & pH) , microbial analysis (coliform, TPC, yeast & mold, probiotic count) was performed and result was analyzed with the help of statistical tool.

RESULTS AND DISCUSSION

Sensory analysis

Color: From the sensory evaluation, the highest score for the color attribute is given to the treatment 3 having the formulation 6% apple pulp and 3% honey containing probiotic yoghurt and the lowest score is given to the treatment 9 having the formulation 10% apple pulp and 3% honey. The Mean ± SE values for color content of the respective formulations: f1 f2, f3, f4, f5, f6, f7, f8, f9 are 6.3 ± 0.37,6.6 ± 0.31,8.3 ± 0.15,6 ± 0.33,6 ± 0.21,6.5 ± 0.17,6.1 ± 0.28,6.1 ± 0.43,5.9 ± 0.28.Here, the sample f3 has the maximum mean value score with the least standard error i.e. 8.3 ± 0.15.The scores for formulation 3 and 9 were statistically different to other treatments ($P < 0.05$). Nevertheless, the color is pale brownish due to addition of apple pulp and honey content. The more is the addition of apple pulp the much is the brown coloration due to browning reaction of apple pulp.

Texture : Likewise, from the sensory evaluation, the highest score for the texture attribute is given to the treatment 3 having the formulation 6% apple pulp and 3% honey containing probiotic yoghurt and the lowest score is given to the treatment 9 having the formulation 10% apple pulp and 3% honey The Mean ± SE values for Texture content of the respective formulations: f1 f2, f3, f4, f5, f6, f7, f8, f9 are 6.1 ± 0.31, 6.7 ± 0.21, 8.2 ± 0.2, 6.3 ± 0.37, 5.8 ± 0.2, 6.6 ± 0.22, 6.4 ± 0.34, 6.2 ± 0.36, 5.7 ± 0.26.And the maximum mean value with least standard error is of the formulation f3 i.e. 8.2 ± 0.2.The scores for formulation 3 and 9 were statistically different to other treatments ($P < 0.05$). Nevertheless, the texture of formulation 3 is smoother than formulation 9 due to addition of apple pulp. The more is the increasing ratio of apple pulp the much thicker is the consistency due to higher content of apple pulp i.e. pulpy.

Taste : Similarly, from the sensory evaluation, the highest score for the taste attribute is given to the treatment 3 having the formulation 6% apple pulp and 3% honey containing probiotic yoghurt and the lowest score is given to the treatment 9 having the formulation 10% apple pulp and 3% honey. The Mean ± SE values for Taste quality of the respective formulations: f1 f2, f3, f4, f5, f6, f7, f8, f9 are 6.7 ± 0.34,7.4 ± 0.31,8.3 ± 0.15,7.3 ± 0.21,6.9 ± 0.23,6.9 ± 0.23,6.3 ± 0.3,6.7 ± 0.26,6.2 ± 0.33.And the maximum mean value for taste quality with least standard error is of the formulation f3 i.e. 8.3 ± 0.15. The scores for formulation 3 and 9 were statistically different to other treatments ($P < 0.05$). Even so, the taste of formulation 3 is mild apple flavoured than formulation 9 due to addition of much apple pulp. The formulation 9 has the highest apple pulp as well as honey content. Hence the formulation was fruity and sweetest among the all formulations which was out of favor and got the least score.

Mouth feel : Correspondingly, from the sensory evaluation, the highest score for the mouth feel attribute is given to the treatment 3 having the formulation 6% apple pulp and 3% honey containing probiotic yoghurt and the lowest score is given to the treatment 5 having the formulation 8% apple pulp and 2% honey. The Mean ± SE

values for Mouth feel of the respective formulations: f1 f2, f3, f4, f5, f6, f7, f8, f9 are 6.5 ± 0.37, 6.4 ± 0.37, 8.1 ± 0.18, 6.3 ± 0.42, 6.1 ± 0.35, 6.8 ± 0.25, 6.2 ± 0.13, 6.2 ± 0.36, 6.5 ± 0.22. And the maximum mean value for Mouth feel with least standard error is of the formulation f3 i.e. 8.1 ± 0.18. The scores for formulation 3 and 5 were statistically different to other treatments ($P < 0.05$). Nevertheless, the mouth feel of formulation 3 is richer than formulation 5. Formulation 3 has fair flavour concentration due to 6% apple pulp with balanced astringency. The more is the addition of apple pulp the much astringency is the product.

Overall acceptance : Also, from the sensory evaluation, the highest score for the overall acceptance attribute is given to the treatment 3 having the formulation 6% apple pulp and 3% honey containing probiotic yoghurt and the lowest score is given to the treatment 5 having the formulation 8% apple pulp and 2% honey. The Mean ± SE values for Overall acceptance of the respective formulations: f1 f2, f3, f4, f5, f6, f7, f8, f9 are 6.1 ± 0.41, 6.8 ± 0.29, 8.3 ± 0.15, 6.3 ± 0.26, 6.5 ± 0.17, 6.6 ± 0.27, 6.4 ± 0.16, 5.9 ± 0.18, 6.4 ± 0.16. And the maximum mean value for overall acceptance with least standard error is of the formulation f3 i.e. 8.3 ± 0.15.The scores for formulation 3 and 5 were statistically different to other treatments ($P < 0.05$). However, the overall acceptance of formulation 3 is richer than formulation 5. Formulation 3 has fair flavor concentration due to 6% apple pulp with balanced astringency.

In overall, sensory score the color, texture, taste, mouth feel and overall acceptance attributes were given to the treatments C so called formulation f3 having formulation 6% apple pulp & 3% honey.The formulations were significantly different in terms of color, taste, texture, mouthfeel and overall acceptance due to varying ratio of apple pulp and honey.

Physicochemical Analysis

The physicochemical analysis such as fat, protein, carbohydrate (lactose), total ash, total solids, and total soluble solid of all the formulations were performed and results has shown in table below. Triplicate samples were analyzed for each physiochemical parameter.

Table 2: Physicochemical analysis of Probiotic Yoghurt fortified with apple pulp and honey

Parameters	Amount (Mean ±SE)
Fat	2.7833±0.01667
Reducing sugar	7.2543±0.27001
Protein	4.3807±0.17689
Total ash	0.6023±0.01793
Total solid	15.3377±0.2078
TSS	13.2000±0.3161

The values were also significantly (P< 0.05) different. The pH decreased to 3.8 at 28 days of fermentation. Similarly, the acidity increased to 1.10 at 28 days.

Microbial analysis

The microbial analysis of the yoghurt prepared were carried out firstly to know whether the product were safe for consumption or not and secondly to know the probiotic organisms present in the probiotic yoghurt fortified with apple pulp & honey are sufficient for providing health benefits or not. The samples from all the treatments were microbiologically examined at 0 day, 7th day, 14th, 21th day & 28th day of fermentation for total plate count, Coliform count, probiotic count and yeast & mold count.

Probiotic counts

The probiotic counts for different treatments were found in the range 1.0×10^{7} to 42×10^{8}.The values of total probiotic were statistically different (P< 0.05). It is generally recognized that the daily dosage of probiotic strains must be between 1×10^{8} to 1×10^{9} cells with a serving size of 100 gm probiotic yoghurt. Probiotic counts here were laid within the reference value.

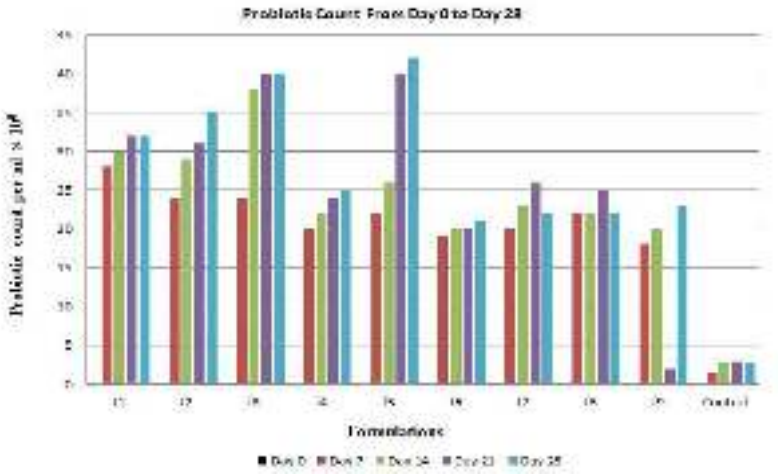

Figure 2: Graphical representation of probiotic count of respective days count for each formulations of probiotic yoghurt fortified with apple pulp and honey

Coli-form count

According to NS-standard, the coli-form count in yoghurt must be nil. The result showed that the coli-form counts in all samples of probiotic yoghurt fortified with apple pulp and honey were found to be nil which might be due to good sanitary practice during the process of manufacturing and handling.

Total plate count

The total plate count in the probiotic yoghurt fortified with apple pulp and honey were found in the range 29×10^2 to 99×10^2. According to NS-standard the total plate count must not be > 50,000 cfu/ml. Hence the values were in the range. The number of bacteria may be few due to inhibiting effect of honey and probiotics.

Yeast and mold

Yeast and mold in different samples of probiotic yoghurt fortified with apple pulp and honey were found to be nil. This result might be due to good sanitary practice during the process of manufacturing and handling.

The increasing emphasis on use of natural food additives in diet has promoted the use of honey, which has been gaining interest as a substitute sweetener because of its wholesome image. Low pH (approximately 3.9) and ability to decrease sourness of solutions make it an attractive additive for acidic products such as yoghurt. However, combinations of honey with yoghurt remain comparatively rare because of its inhibitory effects on lactic starter cultures. Factors related to antibacterial nature of honey are not completely understood, and are expected to be because of "high sugar content" (limiting water available for proper growth of microorganisms), the "relatively high acidity, the presence of organic acids, and the presence, at low concentrations, of hydrogen peroxide". Floral source of the honey is an important factor influencing its antimicrobial characteristics. Studies have shown that during storage at 4 °C, the characteristic microorganisms (*S. thermophilus* and *L. bulgaricus*) in yoghurt are not significantly affected by the presence of honey at 1.0% to 5.0% (w/v). pH and lactic acid levels of the final products were found unaffected by honey, and it highly improved the sensory characteristics of the final product, with approximately 3.0% (w/v) of honey, without having a negative effect on the lactic acid bacteria (Molan, 1992). Hence the product had good number of probiotic bacteria in the range $1.1\times10^7$to 42×10^8cfu/ml, TPC 38×10^2- 95×10^2cfu/ml. Coliform and yeast & mold were nil in the product which proved that the product was safe for the consumption. Finally the formulation f3 (6% apple pulp & 3% honey), probiotic yoghurt fortified with apple pulp and honey was considered as the best formulation for the consumption. The manufacturing cost of the product was Rs. 145/liter.

CONCLUSION

On the basis of sensory evaluation, the probiotic yoghurt prepared from the mixed milk of cow and buffalo followed by fortification of apple pulp and honey of formulation f3 (6% apple pulp and 3% honey) was accepted among the formulations. The probiotic fruit yoghurt had significant effect on color, texture, mouth feel, taste and overall acceptance of the product. All the treatment were found to be significantly different ($p<0.05$) in terms of all physiochemical parameters. On the basis of microbiological analysis, shelf life of the product packed in plastic cup was found to be acceptable for 21

days at refrigerated condition (4°C).Appreciating the nutritional profits and health implications of yoghurt fortified with apple pulp & honey as a functional food, preventive medicine, and residence treatment in the new times requires persistent and transparent public education.

REFERENCES

Gray, C. (2007) *Yoghurt and Your Health*. Washington: Star Base Publication, pp. 6-8.

Molan, P. (1992) The antibacterial activity of honey: The nature of the antibacterial activity.*Bee World*, 73, pp. 5–28.

O'Rell, K. and Chandan, R. (2006) Yoghurt: Fruit preparations and flavouring materials.In:R, Chandan, ed., *Manufacturing Yoghurt and Fermented Milks.*Iowa, U. S. A: Blackwell Publishing. pp 151-166.

Routray, W. and Mishra, H. (2011) Scientific and technical aspect of yoghurt aroma and taste; a review. *Compr. Rev. Food Sci. Food Saf*, 10, pp. 208 - 210.

Saarelaet al. (2002) Gut bacteria and health foods – the European perspective.*International Journal of Food Microbiology*, 78, pp. 99–117.

Sanders, M. (2000) Considerations for use of probiotic bacteria to modulate human health.*J Nutr*, 130, pp. 384S-390S.

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Use of ICTs in higher education: a case study of an E-learning center

A. Jha
Kathmandu University School of Education
Hattiban, Lalitpur, Nepal
anila@kusoed.edu.np

ABSTRACT

The purpose of this research paper is to explore the role of ICTs (Information communication and technologies) tools in pedagogy from the perspectives of learners, administrators and instructors associated with an e-learning center of a University in Nepal. I had followed qualitative case study with an empirical research process and carried on the e-learning center of the university. I had purposively selected twelve research participants, two teachers, two administrators and eight students rigorously engaged in e-learning section of the university. The data were collected by in-depth interview, observation of ICT lab. The findings showed that ICTs have been a pertinent component to enhance the e- learning pedagogy. ICT as a tool helping learner's provided flexibility in terms of geographical situation and time. Furthermore, the learners were found enjoying their study in their respected fields along with their jobs and personal domestic undertakings.

Key words: ICT; Higher Education; E-learning; and Case Study

INTRODUCTION

The history of e-learning is traced back to late eighteenth and beginning of nineteenth century. It emerged in the form of electronic education through computer based training (CBT) since late eighties and beginning of nineties. This was considered as the cornerstone of today's e-learning (Hubackuva, 2015).At the same time, information could be shared only in text format. The first e-learning models emphasized the role of the technology in providing content (information), delivery (access) and electronic (services). However, more recent models focus on pedagogical issues such as online instructional design and the creation of online learning communities (Anderson, 2008).In this sense, e-learning was started to conceptualize as a learning process by interaction with digitally delivered content, network-based services and tutoring support. Moreover, the e -learning is the shift of any technologically mediated learning using computers whether from a distance or in face to face classroom setting. Early developments in e-learning focused on

computer assisted learning, where part or all of the learning content was delivered digitally. E-learning now comprises all forms of electronically supported learning and teaching.

E-learning enables us to learn anywhere and anytime which is computer based education system. There are major two types of e-learning such as asynchronous and synchronous (Jethro, Grace & Thomas, 2012). Asynchronous allows the students to participate based on time and schedule without live interaction with the instructor while synchronous e-learning involves interaction with an instructor via the internet through web or any ICT tools such as Skype, messenger or live chat in real time (Ingirige& Goulding, 2009). An e-learning method is learner centered and flexible, which makes it feasible globally (Nunamaker et al, 2004). Some of the advantages of e-learning include the flexibility for students to schedule their studies at their convenience and faculty can reuse prepared course materials (Neumann 1998). This form of learning currently depends on networks and computers. However, it has been developing into various system consisting of a variety of channels (e.g., wireless, satellite), and technologies (e.g., cellular phones. E-learning is also referred as Web-based learning, online learning, distributed learning, computer-assisted instruction, or Internet-based learning. Historically, there have been two common e-learning modes: distance learning and computer assisted instruction. Distance learning uses information technologies to deliver instruction to learners who are at remote locations from a central site.

ICTs and E-learning center

In order to enhance quality of e-learning center, ICT becomes the major tool. The world, in the recent age, has a great impact of development of Information and Communication Technologies (ICTs) in all the sectors of society including the education. There are many pedagogical and socio-economic factors that have driven higher learning institutions to adopt e-learning. These include greater information access; greater communication via electronic facilities and pedagogical improvement through simulations, virtual learning, and graphic representations (Mahamood, Bokari and Nagvi, 2011). Both instructor and learners can choose more appropriate applications which are flexible in time, in place, personalized, reusable, and adapted to specific domains (Saleem & Rasheed, 2014).

ICTs can be divided into two components: Information and Communication Infrastructure (ICI) and Information Technology (IT). The former refers to physical telecommunications system and network (Cellular, voice, mail, radio and television) while the latter refers to hardware and software of information collection, storage, processing and presentation (Sarkar, 2012). Information and communication technologies consist of hardware, software, network and media for collecting, storing, processing, transmitting and presenting information (voice, data, text and image) as well as related services. ICTs with the educational environments underpin the success of 21st century education (Alemu, 2017). ICTs also add value to the process of learning and to the organization and management of learning institutions. Technologies are a driving force

behind much of the development and innovation in both developed and developing countries. ICTs are considered as mainstreams in higher education. They are being used in many areas such as: developing course materials; delivering content and sharing content; communication between learners, teachers and the outside world; creation and delivery of presentation and lectures; academic research; administrative support and student enrolment (Mandal & Mete, 2012). When applying ICTs in higher education, learning is no longer confined within schedules and timetables (Hattangdi& Ghosh, 2008). In this context, e-learning using ICTs facilities are put into existence. E-learning has increased not only the speed of transferring knowledge, but also the method of transferring from one person to another. E-learning is about learning and teaching philosophies and methodologies within the context of outcome-based education. Education in the 21st century has been directed towards knowledge generation. In order to generate new and fast knowledge production, the role of ICTs is inevitable. Powerful countries are struggling for the integration of radical technology in their higher education to develop the e-learning centers. Many open universities in the world are its examples.

In Nepal, Open University has already been established though it is yet to become functional. It proves that the integration of technology in higher education has been practicing meaningfully. In this context, it is very essential to understand the ICTs integrating in e-learning center of higher education. What are these technologies? How do they work? How do people use them productively? How are they managed and maintained to create productive systems? How are they used in HEI settings in e-learning section? What are the underlying science and technologies behind them and how might those be developed to advance the integrating of ICTs in higher education?

Technology is influencing the learning in schools and universities. It is also supporting to bring the changes in learning. It has made possible to move from content-centered curricula to competency-based curricula or, in other words, teacher-centered forms of delivery to student-centered forms (Reeves &Jonassen, 1996).

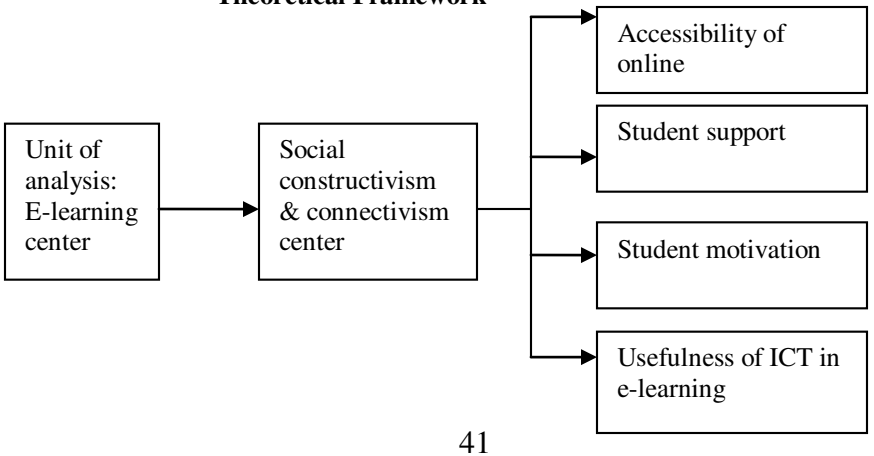
Statement of problem

Students have less time for their study due to their jobs and/or domestic responsibilities. The face-to face of six seven hours teaching within the four walls of the university does not help this category of students. To provide equal access of higher education to them, e-learning can be an effective mode of open learning and distance education. Since Nepal has just started this concept a few years back, it is necessary to know how students enrolled in e-learning are receiving the benefit to pursue higher education. Do students have access to the learning materials in the e-learning center? What is the student support system in the center? How often are the instructors available to help students? How do they do this? What is the system to help any individual to solve their academic problems during study? What resources have been developed by the center and how do students get access to them?

THEORETICAL UNDERPINNING

We used two particular theoretical perspectives such as connectivism and social constructivism to visualize the phenomena of ICTs use in university setting. In the past, learning theory referred to a limited kind of knowledge provided in educational institutions. People would have their career path for lifelong learning based on the knowledge they have acquired in those institutions. Basically, there were three ways of learning. They were behaviorism, cognitivism and constructivism as educational psychology indicates. Many theorists in the past were based on their study and research activities only on these theories of learning. Later, when technology developed and its impact became prominent in education and learning, these three theories as discussed above were not sufficient. Considering this view Siemens (2005) propounded a theory called "Connectivism" which, in his term, is known as a theory of learning at digital age. He explained seven trends in modern learning and discussed how connectivism works. Learners moving to many fields as part of their career have understood that informal education have important role over formal education; learning and work related activities are complementary to each other; technology alters and reshapes human brains; organizational learning is a crucial part of organisms (both human and learning organizations). Moreover learning theories of the past need to be offloaded to the role of technology, know-how and know-what rapidly changing to know-where, are the important thrusts of connectivism (Siemens, 2005). Here connectivism is crucial theory in this technological based paper because connectivism talks about the knowledge which is connected from teacher-content-student via the network based. Similarly, social constructivism is also influences educational innovations. It talks about learning as an active and constructive process while learner creates meaning through interactions with tutor and content. Since two decades many initiatives in education have been optimizing the student's learning in knowledge construction. Among these initiatives the social constructivist learning theory has greatly influenced educational innovations (Duffy &Jonassen, 1992).

Theoretical Framework



The use of information and communication technologies (ICTs) has been increasingly gaining popularity to support teaching, learning, and implementation of e-learning environments in higher education. E-learning offers many advantages, such as allowing learners to learn at their own pace and independency of time and place.

METHODOLOGY

A qualitative case study research design approach was administered for this study in order to explore and study emerging phenomena within the context. Based on Denzin and Lincoln's (2011) recommendations, the data collection was carried out through direct contact with key informants of an e-learning center. There were eight students, two teachers and two managers purposively selected for the purpose of this study. Further, they were chosen because university's academics and managers are amongst those whose attitudes and supports will influence the adoption of e-learning in their organizations. Regarding qualitative case study, constructivism is built upon the premise of a social construction of reality (Stake, 1995).

The data collection was based on in-depth interview. Besides interview, we observed all the facilities of the center in order to assess the capacity and support system of e-learning center. Questions covered in the interview guide were laid out in three sections. The first section targeted general and historical background information on e-learning in the organization. The second section sought to identify the present scenario of technology integration in Higher Education. And the third was observation of field where teaching learning was practiced by integration of ICTs. This e-learning centre has run Master Degree program specialized on Nepali, Curriculum and Health in online and distance learning program.

Unit of case

The unit of case analysis was e-learning center at Sanothimi, Bhaktapur in Nepal. Sanothimi Campus is located at Madhyapur, Thimi Municipality. It was established in 1967 and in 1973 it received affiliation to Tribhuvan University. The aim of this campus is to produce in-service teachers. However, ICT related courses are started since. E-learning center was established on 2014 there were 42 students enrolled in Nepali, Health Curriculum at first batch. In every week of Friday they have contact session. There are well-equipped computer labs with 75 computers with 2 mbps internet bandwidth facilities. Communication with However, very few staffs have basic knowledge in computer operation. The teacher/professors without ICT knowledge in this modern era cannot teach effectively because the knowledge and teaching methodologies now are based on ICT system. There are only a few teachers with this knowledge and technology. Therefore, this program is very essential to aware and train teachers as well as non-teaching staffs. To reduce the digital gap, this program will be a tool (Coordinator of e-learning center, May, 23 2017).

RESULTS AND DISCUSSION

1. Access of E-learning resources

The major version of my research participants:

"*Students have access to e-learning materials. We orient this to them at the time of orientation.*"Similarly, other research participant argued," *Access is ok but many students have problems with their internet speed. So sometimes they ask printed copy of all documents which is not possible.*"

Regarding the accessibility, students who have access to networked computers may have the opportunity to experience a more flexible learning process but students and higher educational institutions could not be able to benefit from this opportunity as students are not able to afford or gain access to a computer (Singh, Donoghue &Worton, 2005). In the same trend another participant manager (M-1) also opined "W*e provide resources access to all the students individually. With their password they can access to all the materials through Moodle*". It means he had provided accessibility to learner through their ID system. Then he claimed that there is sound accessibility to the learners for access of learning resources, instructor, and admin.

Student's version

…….Pass word is given and I try to get it from my computer. Sometimes I do not find materials which I am looking for. I get the reading materials from MOODLE. My internet speed has not helped me much to access the resources. The SLM is available but some chapters are difficult to understand by self-learning".

According to student point of view they have received their own ID but while they go through the self-learning material, they sometimes face difficulties of understanding it.

2. Support services and motivation

Regarding the teacher support system student point of views

"*My internet speed is low but sometimes I'm not able to download. In this condition, I will get self-learning material (SLM)…During the contact session only teachers use to support us. Nothing is available when I try to get it. But our teachers say I can download from the web. Very few materials are available. They are not sufficient for my study. Only self-learning material (SLM) is easily available. It is ok. I enjoy virtual learning. I can find many things in their web site. Sometimes I study directly in computer and sometimes I download and study in my time. No problem in access of materials".*

While observing the facility of the center, I found that the managers have set up each student ID with password. This indicates that all the students have access to whatever

facilities the center has. Based on these data it can be inferred that the Moodle is grounded by social constructivism pedagogy which suggests learners learn best by communicating with one another and creating their understanding in a collaborative environment. It is emphasized that a large role in the cognitive development because learners construct understanding of experience together, not alone (Sarfo & Vidata, 2016). On the other hand, the pedagogical functions of MOODLE learning environments are also governed by social constructivist or social cognitive learning framework by Vygotski. According to social cognitive approach, learning is considered as cognitive and social activities (Brown, Collins &Duguid, 1989). Thus learners construct knowledge (learning experiences) based on their own mental and social activities.

There were many types of student support systems in the e-learning center. However, the following empirical data explained major components through which student could get significant support.
In this perspectives M-1 said:

"…….*regarding the student support system there is provision of group contact session, accessibility of Moodle and individually access of SLM"*. He said that we have plenty of support system to the student. In the similar manner*S-1 ……argued that we have support system mainly from contact session but Moodle helps a lot…..*"

Moreover, our observation to the support system was a little different in this case. The center, in fact, did not have specific support system for the students. They expected students' response first and those responded with them received support such as chat with the teacher, solved their problems, etc. The silent ones did not getting any regular support from the center. On the base of this version student could get from learning management tools that is Moodle. On the basis of empirical data we came to understand that knowledge comes from a variety of domains and disciplines and access to the web. Similarly, Siemens (2008) stresses that in the connectivism the ability to make connections between fields, ideas, and concepts are a core skill. However, as learners become autonomous and seek information on their own, they come to understand the existence of an endless world of knowledge. Considering the wealth of information available on the Web, it is crucial for learners to be able to filter through information and to ensure that it is from a valid, reliable source.

Student motivation

The research reveals that a student desires to take part in, and learn from, a training activity. And motivation can influence what we learn, how we learn and when we choose to learn. Here I would like to link with student motivation with learning process.

Student's point of view

" …*Too much useful for me. I will continue e-learning. I have no other choice. This program is very useful. I look forward finishing my study. When teachers are not in*

contact I find difficulty for self-study, I do not think I can complete good for people like us who have less day time to study. I am getting benefit from a program. Well…sometimes I think I should quit. But study is essential. So I force myself to complete said*, this is very useful. I can manage my own time. How much to study is my decision. But exam at the same time is difficult. Exam options can motivate much. This is beneficial. When reading the text alone at home is very frustrating. But I'm trying to live with it. Very frustrating. Support is required. Contact session alone cannot help. Access to instructors should be open".*

Student motivation naturally has to do something with their desire to participate in learning process. I would like to discuss student motivation on e- learning system. In similar way teacher's point of view: *some students get confused about the validity of e-learning course .Then I advised that now we have Open University. So, there is no need to feel any confusion about the approval***.** In addition, we have subject wise teachers to help each student and contact session once a week at the university. Most of the students said that availability of teacher is very difficult but only in contact session we get them, not other time. From this empirical data, we understood that the major motivation factors included teacher's availability and communication with teachers. Motivation can influence what we learn, how we learn and when we choose to learn (Schunk and Usher 2012).

3. Helping to solve academic problem

In this theme teachers told that if students need support then we are ready to do it. However we do not ask about their academic problems in prior.

In regard to solving the academic problem, students said:

"..In the orientation time, we are new. They say and we listen. After coming home we get confused. Downloading is a problem. Self-study is difficult, whom to ask when we do not understand. Cannot get easy access to the center Problem to understand the content. Self try out. Sometimes it works, sometimes does not, Study time is my problem. Materials I can read myself but I study 11-12 PM in the evening. Sometimes I do not understand how to solve my problem. Some problems of reading SLM. Assignment submission is a pressure. How to write is still confusion. No one is there to help. Some problems of reading and understanding... Submitting assignment is a big problem. How to write, what to write? SLM alone does not help. In the orientation, they tell everything in a group. Individual problem but nobody is responsible. Trying hard but help needed. I have problems in reading SLM and submitting assignments. Sometimes I do not understand the content of SLM. Whom to ask? Who helps? Where to contact"?

Our observation indicated that there were subject-wise expert teachers available in the center; and whenever needed they had provided their services to the center and the

students as well. It showed that the students were achieving more support services from their respective tutors.

4. Usefulness of ICTs

In terms of usefulness of ICTs in higher education, the manager stated:

"*University's alternative program to the students who need flexibility in time for their study. It is useful but most of the students do not give much time to study so they might be weaker ones though they are using the Moodle*".

Furthermore, instructor's point of view

"Usefulness of e-learning center is nucleus for each student as learning center. This provides them the opportunity of learning while earning. It is very useful however, students do not seem active. But student motivation depends upon e-learning to support them.

Students' version on the perception of usefulness of e-learning,

"It's very useful. It helps a lot. Needs more support like Nepali language materials. E-learning is the only way to provide access to HEI for many people. ICT is the demand. This is useful. Without support to individual student this does not work. Very difficult self-study. Furthermore e-learning is very useful. This has helped busy people like me. Earning and learning together! No complains. ICTs helping us in appositive way. We have to work hard but it has given opportunity .E-learning is good for me. I can study and work at the same time. This should be continued in many places. It helps to build our career. It gives equal recognition as my friends get in the university.ICT based teaching is new for us but very beneficial. This is very useful to complete our study."

From their opinion, we have observed the mixed expressions of participants regarding ICTs integration in e- learning center. From the perspectives of the research participants; we came to know that the e-learning and distance education can promote independent and flexible learning. This flexible learning is aligned with network learning; in the similar manner connectivism is also associated with the network topology to represent the knowledge structure as suggested by Hanrandi (2015). In addition, connectivism is also related with nodes of technology. Here, we would like to mention that interrelated flexible learning with connectivism in terms of knowledge is distributed in the network.

DISCUSSION

The finding from the interview reveals that majority of respondents are satisfied with the integration of ICTs in e-learning and their usefulness. There are extensive changes in the technologies over the last decade have the potential to influence the way we engage with knowledge, but the potential will only be realized if we integrate this with an understanding of learning, and design the use of e-learning technologies accordingly within different contexts. Student support system is major component in the e-learning system. (Tait, 2014). Regarding the flexibility, e-learning has become popular because of

its potentiality for providing more flexible access to content and instruction at any time, from any place (Jethro, Grace & Thomas, 2012). Accessibility refers to the user's ability to find what is needed, when it is needed. Improved access to educational materials is crucial, as learning is often an unplanned experience. Updating electronic content is easier than updating printed material: e-learning technologies allow educators to revise their content simply and quickly. Learners have control over the content, learning sequence, pace of learning, time, and, often, media, which allows them to tailor their experience to meet personal learning objectives (Jethro, Grace & Thomas, 2012). Sound information and communication infrastructure plays a key role in successful delivery of online content to distance students (Nanayakkara, 2007). Nanayakkara also reported that more often institutions have at least core ICTs infrastructure needed to support distributed learning.

On the basis of my observation, the center and its facilities are not bad. They are in shape and can be improved in future. The equipment, the software, the experts, the support system, etc. have all been started although in a limited sense. I am not that pessimistic about the –learning scenario in HEI but hopeful with the institution that it will add more on it in future. The center seems to be independent although limited in the sense of autonomy in curriculum development and testing. The teachers and managers are well oriented towards e-learning as well as its support mechanism and they are trying their best to improve the quality aspect of the delivery. However, developing online courses requires additional equipment and specialized software, for example, additional servers and a course management system. Student access requires network bandwidth and modem pools or internet service provider connections. These facilities need to be well managed and maintained to achieve a high degree of reliability. Lack of reliability, performance and timely support on infrastructure could inhibit both the tutor and the student from accepting this technology. Similarly, Tucker and Gentry, (2009) reported that successful implementation of e-learning programs and curriculum depends upon the infrastructure being firmly in place. Galamoyo (2011) noted that the ultimate delivery of an e-learning solution relies on the availability of appropriate and adequate technology.

CONCLUSION AND IMPLICATIONS

Universities can no longer ignore e-learning. Computers and the internet have become an integral part of higher education. E-learning can be viewed as computer assisted learning, and as pedagogy for student-centered system. It is also collaborative learning. Education has changed tremendously with the implementation of e-learning technologies. Interactivity helps to maintain the learner's interest and provides a means for individual practice and reinforcement. Evidence suggests that e-learning is more efficient because learners gain knowledge, skills, and attitudes faster than through traditional instructor-led methods. So, educators recognized the need to offer e-learning to meet the demands of the students of the 21st century. It offers much advantage, such as allowing learners to learn at their own pace, and being independent of time and place.

In terms of implications it is widely acknowledged that implementation of e-learning leads to a fundamental shift in learning styles from teacher-centered to student-centered. However, e- learning will benefit "spoon fed" students who should not remain passive on their learning. It claims that in order to get better results, students must take their responsibility for independent learning.

REFERENCES

Alemu, M. B. (2017) Transforming educational practices of Ethiopia into development and the knowledge .*African Educational Research Journal 5*(1), pp. 1-17

Ammar, M. & Rasheed, I. (2014) Use of E-learning and its Effect on students New Media and Mass Communication 26 ( ) pp 47-51 Retrived: www.iiste.org

Anderson, T (2008) The *theory and practice of online learning*. AU Press, Athabasca University

Blandford, A. (2013) Semi-structured qualitative studies. In: Soegaard, Mads and Dam, RikkeFriis (eds.). *The Encyclopedia of Human-Computer Interaction,* (2nd Ed*).* Aarhus, Denmark: The Interaction Design Foundation. Available online at http://www.interactiondesign.org/encyclopedia/semi-structured_qualitative_studies.htm

Brown, S. J., Collins, A., & Duguid, P. (1989) Situated cognition and the culture of learning. *Educational Researcher. 18*(1), 32-42

Denzin, N. K. and Lincoln, Y. S. (eds) (2011) *The SAGE Handbook of Qualitative Research*. London: Sage

Duffy, T. M. & Jonassen, D. H. (1992) Constructivism: New Implications for Instructional Technology. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the Technology of Instruction: A Conversation* (pp. 1- 16). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Galamoyo, M. (2011) Enhancing the quality of e-learning through mobile technology: A social-cultural and technology perspective towards quality e-learning applications. *Campus Wide Information Systems, 28* (5), 331-344.

Hattangdi, A., & Ghosh, A. (2008) *Enhancing the quality and accessibility of higher education through the use of information and communication technology* Paper presented at the 11th annual convention of the strategic management forum (SMF), Kanpur, India. http://www.iitk.ac.in/infocell/announce/convention/papers/Strategy%20Learning-01-Ashish%20Hattangdi,%20%20Atanu%20Ghosh.pdf.

Hubackova, S. (2015) History and Perspectives of Elearning. Procedia, *Social and Behavioral Sciences,* 191, 1187 – 1190

Ingirige, B. & Goulding, J. (2009) Maximising Social Interactions and Effectiveness within Distance Learning Courses: Cases from Construction, *Journal for Education in the Built Environment4* (1), PP 75-99

Jethro, O.O, Grace, M. A. & Thomas, K. A, (2012) E-Learning and its effects on teaching and learning in a Global Age. *International Journal of Academic Research in Business and Social Sciences, 2*(1), 203-210

Jonassen, D. & Reeves, T. (1996) Learning with technology: Using computers as cognitive tools. In D. Jonassen (Ed.), *Handbook of Research Educational on Educational Communications and Technology* (pp 693-719). New York: Macmillan

Mahmood, A., Bokhari, N. and Naqvi, F. (2011) Effects of use of ICT: students' perception at higher education level *Elixir Social Studies, 38,* 4218-4221 Retrieved from: www.elixirjournal.org

Mandal, A. & Mete, J. (2012) *ICT in higher education: opportunities and challenges.*

Nanayakkara, C. (2007) A Model of User Acceptance of Learning Management Systems, *International Journal of Learning, 13* (12), 223-231.

Neumann, P. (1998) Risks of e-education Association for Computing Machinery, *Communications of the ACM, New York, 41*(10), 136

Nunamaker, J., Zhang, D., Zhao, J. & Zhou L. (2004) Can e-learning replace classroom learning? *Association for Computing Machinery. Communications of the ACM. 47*(5), 75

Sarfo, K.F. & Yidana, I. (2016) University Lecturers Experience in the Design and use of Moodle and Blended Learning Environments, *The Online Journal of New Horizons in Education, 6* (2), 143-154

Sarkar, S. (2012) The role of information and communication technology (ICT) in higher education for the 21st century. *The science probe, 1*(1), 30-41

Schunk, D. H. & Usher, E. L. (2012) Social cognitive theory and motivation. In: R. M. Ryan (ed.) *The Oxford handbook of human motivation* (pp. 13–27). Oxford, UK: Oxford University Press

Siemens, G. (2004) Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Siemens, G. (2005).Age, *International Journal of Instructional Technology and Distance Learning*, *2*(1), 3-10

Siemens, G. (2008) *Description of connectivism. Connectivism: A learning theory for today's learner*. Retrieved from: http://www.conncectivism.ca/about.html

Singh, G., O'Donoghue, J. & Worton, H. (2005) A study into the effects of elearning on higher education, *Journal of University Teaching and Learning Practice, 2*(1), 13-24

Stake, R. E. (1995) *The art of case study research*. Thousand Oaks, CA: Sage

Tait, A. (2014) From place to virtual space: reconfiguring student support for distance and e-learning in the digital age. *Open Praxis, 6*(1), 5-16

Tucker, J. P. & Gentry, G. R. (2009) Developing an e-learning strategy in higher education, *Foresight, 11*(2), 43-49

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Economic analysis of the urea molasses mineral block feeding to lactating cattle of Nepal

N. Upadhyay[1], M.R. Tiwari[2], L. N. Pandey[2], T.B. Karki[1], R.Acharya[1], S.Gairhe[1] and Y.Acharya[1]

[1]Nepal Agricultural Research Council, Singha Durbar Plaza, Kathmandu
[2]Animal Nutrition Division, Khumaltar, Lalitpur
namdevupadhyay@gmail.com

ABSTRACT

The milk production performance of urea molasses mineral block (UMMB) feeding to lactating animals was evaluated in Dadeldhura and Surkhet Districts at Jogbuda and Khanikhola Village Development Committee for 30 days. Similarly, a study was conducted to determine profitability obtained from UMMB supplemented cattle. Rice Bran, Molasses, Cement, Urea, Mineral Mixture, Salt, Calcium Oxide and Soybean Cake at the ratio of 30:30:5:10:6:6:5:8 were used for preparation of UMMB. Ten cows were randomly allotted as control group that were feed 28 kg green grass, 7 kg rice straw and 1.5 kg concentrate mixture and 10 cows were feed with above feed along with UMMB at the rate of 300g/day and 10 cows were under conventional feeding practices. The economic benefits were analyzed by benefit cost ratio and mean comparison between treated and non-treated milking cow. Results showed that average milk production was significantly (P>0.001) higher in UMMB treated cows as compared to non-treated at 1% level with mean difference of 1.58 lit for 30 Days. Cost of production of UMMB was found to be NRs. 53.67 / Kg. The benefit cost ratio was found higher 1.28 for treated cow as compared to non-treated 1.027. Thus, we can recommend that feeding of UMMB at the rate of 300 g/day is beneficial for lactating cattle.

Key words: Lactating cattle, feeding, milk production, economic benefit

INTRODUCTION

Livestock sector plays important roles in human food and nutritional security, livelihood, regional balance, gender mainstreaming, and rural poverty alleviation (Jibachha, 2018). It contributes about 25.68% of agriculture GDP (Karki, 2015).Nepal has largely a smallholder livestock system under which farmers raise small numbers of livestock in small land holdings (Pradhanang, 2015). Feeding is recognized as one of the major constraints in livestock production accounts for a large proportion of the cost of milk production (Singh *et al.*, 1981).The traditional feeding system for dairy cattle is based on

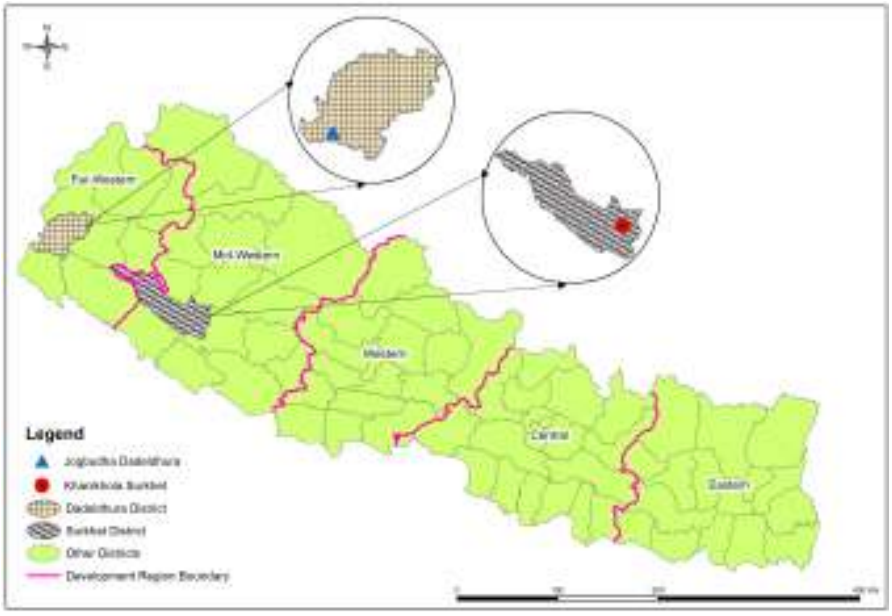
the use of rice straw, natural grasses supplemented with a little or no concentrates and also there is the shortage of green grasses and green fodder, mostly in the winter seasons and animal feed is dominant by crop residues as rice straw, dry grasses which are deficient in crude protein (N) and minerals (Khan, 2012). As a consequence, the feed of the livestock lacks the proper proportion of the nutrients (proportion of roughages and concentrates) resulting in the poor performance in milk and reproduction. Urea Molasses Mineral Block is an excellent supplementary feed that can be formulated and used to increase digestion of roughages, provide protein and energy to ruminant animals (Geleta, 2013). The UMMB provides crude protein (N) often deficient in dry feeds leading to enough microbial protein needed for the maintenance and growth of animals (FAO, 2007; Adugna *et al*., 2000). The urea available in the UMMB is converted to ammonia by the micro-organisms in rumen which is used to make microbial protein and energy is produced on the same time. It helps in digestibility of the raw straw by increased microflora in the rumen this increasing the intake resulting (Bensalem and Nefzaoui, 2003). Microorganisms in the rumen use this ammonia to make microbial proteins, which are then digested by the animals (LPP, 2005). *Molasses is highly palatable and a rich source of sulphur, calcium and B complex. It is economics source of nutrients from the UMMB.* Coupling fermentable nitrogen (urea) with a source of readily fermentable energy, such as molasses in UMMB feed helps the growth of micro-organism in the rumen, increases the digestion and consumption of fibrous feeds, allowing the animal to maintain, and often increase productivity of ruminant animals. *Soybean cake and mineral mixture are also equally important for UMMB.* The various minerals available on the molasses and the fermentable substrates make the UMMB of pleasant taste and smell, and increase the palatability of the animals. The rice or wheat bran serves the multiple purposes of supplying nutrients as fat, protein as well as absorbents giving the structure to the block. The minerals present often provide the elements necessary for the maintenance and growth of the body which are deficient in their diet as Sodium (Na). They also act as the binding agent. So, UMMB is a good source of nutrition for ruminants which is provided with feed of low nutritive value and can enhance the performance of the animals. Block supplementation with crop-residue-based diets has resulted in increased milk production, with a favorable cost– benefit ratio, varying from 1:2 to 1:5, depending on the purchase price of ingredients and selling price of milk (Makkar, 2007).

MATERIALS AND METHODS

Description of study area

The experiment was conducted in two places Jogbuda (29.09°N 80.32°E) and Khanikhola (28° 32’ N 81°55’ E). These were village development committee in Dadeldhura and Surkhet district. The Dadeldhura district is located in Province No. 7 of far-western region of Nepal and covers an area of 1538 square kilometer within latitude 28º 59’’ N to 29º 26” N and Longitude 80º 12” E to 80 º 47” E. Dadeldhura has elevation ranging from 333 m to 2639 m above mean sea level (masl). Subsistence agriculture farming, mainly small scale livestock is the main source of occupation and livelihood of the majority of

the population. Due to low level of agriculture production, the majority of the households face acute food shortage for the most part of the year. As a result of the elevation differences, Dadeldhura has different level of temperature. The average maximum temperature is 32 ºC while average minimum temperature is 3.6 ºC. The annual average rainfall is about 1346.6 mm. Similarly, Surkhet district is located in province no 6 of mid-western region of Nepal. The district's area is 2,451 km². It has elevation ranging from 250 to 1000 m above the sea level. The district is occupied 1.7 % hill and 5.8% terai area of Nepal and mid-western development region. The district has mixed type of climate tropical to temperate region. Surkhet has a more moderate climate. Winter temperatures drop to about 5 °C and in summer it goes up to 38 °C. Monsoon brings sufficient rainfall during the rainy season.



Source: District profile of respective district

Manufacturing process and method of offering the blocks

Urea levels in typical urea-molasses mineral blocks (UMMBs) vary from 4 to 10 percent, and those of molasses and the binder vary from 30 to 45 percent and 6 to 15 percent, respectively. The manufacturing process differs substantially from country to country, depending on the scale of operation. To mix the ingredients, various approaches have been used, ranging from use of a shovel or even bare hands, to mechanical mixing using a dough mixer or concrete mixer. Similarly, moulds made up from metal, wood, cardboard and plastic, with square, rectangular or cylindroid shape, have been used, and in some countries, car and truck tyres and buckets have been used to give shape to the blocks. To

avoid losses due to rats, birds, insects and fungal growth in high humidity areas, polyethylene packing has been the most used method when it is necessary to store blocks for a long period. The blocks have been offered to animals in a wooden box or bucket of dimensions slightly larger than that of the block, which restricts biting of the block by animals. The daily consumption of UMMBs per animal varies: 500 to 800 g for cattle and buffaloes, 60 to 125 g for sheep and goats, and 400 to 600 g for yak. The block should be hard enough to ensure that the animal gets a slow release of nutrients through the licking process. This slow release of nutrients, particularly of nitrogen and carbohydrates, increases the efficiency of utilization of these nutrients. However, in Indonesia, a variation to produce soft blocks has also been found to be popular and effective in increasing milk production. The amount of the block given to the ruminants depends upon the type of animal and its body weight. The formulation of the UMMB is given in Table 1.

Table 1: Formulation of the Urea molasses mineral block

S.N.	Ingredients	Parts per 100 Kg
1	Rice Bran	30
2	Molasses	30
3	Cement	5
4	Urea	10
5	Mineral Mixture	6
6	Salt	6
7	Calcium Oxide	5
8	Soya Cake	8
Total		100

The UMMB prepared were feed to the milch cows in farmers barn and 20 cows, 10 as treatment with supplement of the UMMB and 10 as control with no supplement of the UMMB in two places Jogbuda and Karaikhola each in Dadeldhura and Surkhet Districts, respectively were recorded for their milk production continuously for 3 months. The cows were selected in the small holder farmers and were mostly stall fed with rice straws and cut-and carry grass. The data obtained were analyzed for the difference in milk production in MS Excel. The criterion fulfilled for giving the UMMB the cows for the research study were as follows.

- The milch animals were given dry feeds (plant residues as rice straw) as per their want.
- Green grasses were given as $1/4^{th}$ of the total weight of the dry matter given.
- Concentrates equal to 1% of the bodyweight of the animals were given per day.
- 150 g of the urea molasses is given as lick two times a day.
- Water is provided as much as the animal desires.

Statistical Analysis

Statistical analysis mean comparison of milk production was analyzed between treatment and control groups. Economic analysis benefit cost analysis was performed considering

variable costs (Grass, Rice straw, Concentrate Mixture, Labor Charge, Medicine and Vaccination, UMMB cost and Land charge) and sale of milk produced.

RESULTS AND DISCUSSION

Cost of Production of UMMB

The cost of production was calculated using the price of the raw materials in the districts of research study i.e. Dadeldhura and Surkhet. The price of the raw materials on those districts was quite high being rural district and distant from the regular market of those raw materials.

Table 2: Cost of UMMB production

S.N.	Items	Amount (Kg)	Unit Price (NRs)	Total (NRs)
A	**Raw Material**			4425
1	Rice Bran	30	28	840
2	Molasses	30	30	900
3	Cement	5	17	85
4	Urea	10	30	300
5	Mineral Mixture	6	210	1260
6	Salt	6	20	120
7	Calcium Oxide	5	80	400
8	Soya Cake	8	65	520
B	Handling loss @ 1%			442.5
C	Packaging, bagging and sticker	1		25
D	Labor cost	1	500	500
	Total cost of Production	100		5367.5
	Per Unit cost (NRs)			53.67

Figure 1 shows the share of cost for different items in preparation of UMMB. Majority of cost incurred in raw material purchase, 82%, followed by labor cost 9%. The handling loss is estimated to be 10%. The overall production cost for preparation at local level is estimated to be NRs. 53.67 as shown in Table 3. There is still the scope of reducing cost by reducing the handling loss, purchasing the raw material at lower cost and mass scale production.

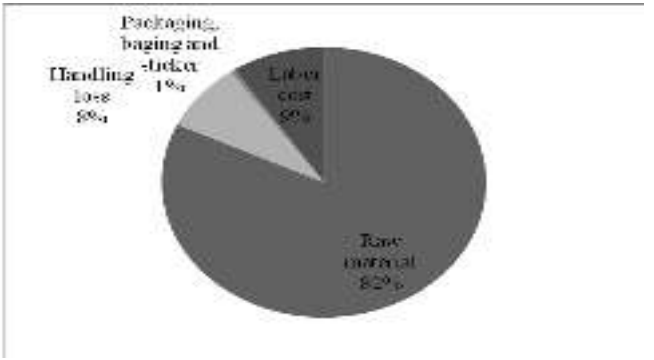
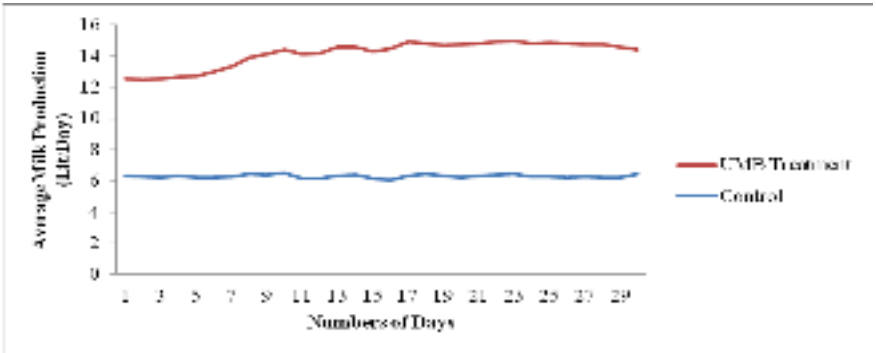


Figure 1: Share of cost items

Effect of UMMB Supplementation on milk Production

The results showed that the average milk production per day per cow in UMMB fed cow was found to be significantly (P>0.001) more i.e. be 7.87 Lit/days in UMMB treated cow as compared to control group 6.29 lit/day/cow Table 3. It is 25.11% more production as compared to control group. Similarly, UMMB causes increase in milk yield in subsequent days up to 30 days while the milk production is stagnant in non-treated cows.



Source: Yield data, 2017

Figure 2: Milk Yield of treated and non-treated cow

Table 3: The milk production of UMMB treated and non-treated cow

Category	Mean (Lit/day/cow)	SD	SE	t
UMMB Treated	7.87	1.21	0.16	9.39***
Control	6.29	0.47	0.06	

*** signifies level 1% level of significance

Average is mean of 5 cows for 30 days of lactation

BENEFIT COST ANALYSIS

Table 4 showed the benefit cost analysis of UMMB treated and control cow farming. Benefit cost is the ratio of total revenue and total cost. The results showed that total revenue of the UMMB treated household was 24.5% more as compared to control group. Net revenue of UMMB treatment was found to be NRs. 2341.50. The B/C ratio was found to be higher for UMMB treated cow farming i.e. 1.28 as compared to control group i.e. 1.027. In control group, cow farming was found to be only sustainable but commercial farming UMMB can plays significant role.

Table 4: Benefit cost analysis of UMMB treatment

Control					UMMB supplemented				
Item	Unit	Rate	Amount	Total	Items	Unit	Rate	Amount	Total
Inputs				9300.6	Inputs				9314.1
Grass	Kg	3.75	840	3150	Grass	Kg	3.75	840	3150
Rice straw	Kg	2.86	210	600.6	Rice straw	Kg	2.86	210	600.6
Conc. Mixture	Kg	20	45	900	Conc. Mixture	Kg	20	45	900
Labor Charge	Unit	1	4000	4000	Labor Charge	Unit	1	4000	4000
Medicine and Vaccination	NRs.	1	150	150	Medicine and Vaccination	NRs.	1	150	150
Land charge	per month	1	500	500	Land charge	per month	1	500	500
				0	UMMB cost @ 300 g	g	300	0.045	13.5
Production				9547.5	Production				11902.5
Milk Yield @ 6.29 lit/day		50	188.7	9435	Milk Yield @ 7.86 lit/day		50	235.8	11790
Dung @ 1.5 Kg/day/cow		2.5	45	112.5	Dung		2.5	45	112.5
Net Revenue (A)				246.9	Net revenue (B)				2588.4
B/C ratio =1.026546674					B/C ratio	1.277901246			
Net revenue of UMMB treatment (A-B)					NRs. 2341.5				

CONSTRAINTS OF UMMB PRODUCTION AND LESSONS LEARNT

Various problems encountered during the production, storage and feeding of UMMBs were discussed here.

Local feeding practices and farmer's awareness

Feeding practices varied from location to location. It was very difficult to remove imprint of local practices in farmers due to their subsistence nature of farming. In most of the area, farmers were observed to follow their local practices of feeding despite the massive interaction between scientist and farmers about benefits of UMMB technology. The nature of their practice and orientation needs to be elevated from the ongoing traditional to commercial level which could be only achieved with raising their level of knowledge.

Cost and availability of molasses, soya cake and mineral mixture

Availability of the raw materials and the difference in the price against the major markets of milk production gives the farmers, the lower comparative advantage. The price of molasses was as high as NRs 30 per kg which often discourages the farmers for using the UMMB on a regular basis.

Lack of extension education and business orientation of farmers

Farmers were illiterate and due to the lacking business orientation among them, they are reluctant to embrace the technology with ease. The technology needs to be flourished with the benefits brought by it in terms of money and the health of animals.

Storage problems

Farmers need mass scale production for continuous feeding. This demands storage of produce. Due to their poor economic status they are unable to store produced UMMB properly thereby loss in quality is more.

Lesson Learnt and future of the UMMB Technology

In view of the above-mentioned constraints, we advise the following to agencies that are willing to popularize the UMMB technology in their areas of operation.

- The UMMB technology is suitable for areas where UMMB ingredients were easily available or they can be access in nearby market at lower transportation cost. In food scarce area it is difficult for farmers to manufacture. This brings the scope of UMMB production industry in local scale.
- There is need to popularize the use of a specially-designed feeder for feeding UMMB which prevents over-ingesting the feed block.

- Educate the milk producers, cooperative and Farmers group about the safe use of UMMB and the benefits accrued from its regular use.
- Link the production of UMMB to market so that they could sell their produce also.
- In Nepal the cow farming is going to be commercial. In this case UMMB could be best alternative to increase milk yield.

CONCLUSION

Feeding of Urea molasses mineral block at the rate of 300 g/day increases milk production and thus it could be recommended as supplements for commercial dairy farmers to increases the profitability. However there are problems of availability, cost effectiveness of raw material for preparation of the UMMB and farmers awareness.

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REFERENCES

Pradhanang, U., S. Pradhanang,, A. Sthapit, N. Krakauer, A. Jha and T. Lakhankar (2015) National Livestock Policy of Nepal: Needs and Opportunities. *Agriculture. 5*(4):103-131. doi:10.3390/agriculture5010103.

Khan, M., K. Peters and M. Uddin (2012). Feeding Strategy For Improving Dairy Cattle Productivity In Small Holder Farm In Bangladesh. *Bangladesh Journal of Animal Science.* 38(1-2): doi:10.3329/bjas.v38i1-2.9914

Jibachha Animal Husbandry PDF. (n.d.). Retrieved March 04, 2018, from https://www.scribd.com/doc/289747492/Jibachha-Animal-Husbandry-PDF

Karki, Y. (2015). Nepal Portfolio Performance Review (NPPR) 2015 Ministry of ... Retrieved March 4, 2018, fromhttp://www.mof.gov.np/uploads/document/file/Agriculture_NPPR-2015_20150913011507.pdf

Singh, C. B., J.P. Dhaka, and P.K. Sharma (1981). Labour absorption and factors influencing levels of employment in crop, dairy and poultry enterprises. *Indian J. of Agric. Econ*. **36**: 4–10.

Geleta, T. (2013). Effect of supplementing grazing Arsi-Bale sheep with molasses-urea feed block on weight gain and economic return under farmers' management condition. *Journal of Cell and Animal Biology. 7***(10):** 125-131. doi:10.5897/jcab11.030

FAO (2007). Food and Agricultural Organization. Experiences with urea-molasses multinutrient blocks in buffalo production and reproduction in smallholder dairy farming, Punjab, India. Food and Agriculture Organization of the United Nations Rome. pp. 59-70.

Adugna, T., M.C. Roger, G.L. Arthur, S. Tilahun and N. Tegene (2000). Nutritional constraints and future prospective for Goat Production in East Africa. In: proceeding of the conference on opportunities and challenges of enhancing goat production in east Africa, November

2000, Langston University, Langston, USA and Debub University, Awassa, Ethiopia. pp. 1-21.

Makkar, H. P. (2007) Feed supplementation blocks: urea-molasses multinutrient blocks; simple and effective feed supplement technology for ruminant agriculture. Rome: Food and Agriculture Organization of the United Nations.

Factors affecting the adoption of livestock insurance by dairy farmers in Nawalparasi District, Nepal

G. Kandel[1] and R. H. Timilsina[2]
[1]Nepal Agricultural Research Council, Lalitpur, Nepal
[2]Agriculture and Forestry University, Chitwan, Nepal
brightgshyam24@gmail.com

ABSTRACT

Livestock sub-sector contributes 24% to the Agricultural GDP which faces lots of risks resulting from the disease, parasites, accident, and infertility. Livestock insurance is the most appropriate strategy to manage the different risk related to livestock farming but insurance coverage is still low with respect to total national herd and failure to cover small and marginal farmers under insurance coverage. In 2016,a household survey was conducted in Nawalparasi district of Nepal, which was purposively selected to assess the factors affecting adoption of livestock insurance. Cluster sampling was done to select sample cluster and respondent farmers were selected randomly from Rajahar cluster. Information was collected from 40 livestock insured farmers and 40 livestock non-insured farmers by using pre-tested interview schedule. The data were analyzed using descriptive statistics and a binary logistic regression model was used to identify the determinants of livestock insurance adoption. It was found that all insured and farmers (100 percent) and the majority of non-insured farmers (75 percent) were aware of livestock insurance. The majority of insured farmers (82.5 percent) and only 32.5 percent of non-insured farmers were aware of premium subsidy schemes of insurance provided by the government. Farmers perceived that that current risk coverage, premium subsidy, insurance procedure were good but they were dissatisfied with claim settlement

procedure and time taken to settle claim. Key factors affecting the livestock insurance adoption were found as variables such as total adult dairy animal (p=0.04), holding membership by the farmers (p=0.037), extension contact of farmers (p=0.024) and knowledge about the premium subsidy schemes (p=0.005).Major constraint for not joining livestock insurance is found as not aware of insurance facilities (82.5%).

Key words: Farmers, claim settlement, livestock insurance, risk coverage, premium subsidy

INTRODUCTION

Nepal is an agricultural country which contributed to GDP by 31.23 percent and acts as major sources of income for 65.6 percent people (MOAD, 2015). The livestock subsector contributes 24 percent of the total agricultural GDP, and also plays important roles in human food and nutritional security, livelihood, regional balance, gender mainstreaming, and rural poverty alleviation (Pradhanang et al, 2015). Nepalese livestock system is characterized by the small holding system which farmers raise small numbers of livestock in small land holdings. The livestock sector acts as a backbone to sustain the livelihood of Nepalese people as it is the major sources for income and employment (MEDP, 2013).There are lots of risk and uncertainties in agriculture sectors some of which are resulted from natural hazards such as floods, drought, fire, earthquake, and disease outbreak and pest attack. Since the farmer cannot predict the probability of occurrence of any of these and cannot bear these risks and uncertainties alone, he is faced with the option of transferring or sharing the risks involved in the day-to-day management of his farm with one or more individuals or firms (Ajieh, 2010).Insurance is an important risk management tool to safeguard against unforeseen loss .The simple definition of insurance is the equitable transfer of a risk of small loss to prevent a large and possibly catastrophic loss. Agricultural insurance is special type of property insurance confined to agricultural firms (Iturrez, 2009).

It is well known that the insuring livestock is the most appropriate strategy to manage the different risk related to livestock farming but there is little attention to address the livestock insurance needs of dairy farmers (Khan, Chander & Pradhan, 2013). Although most widespread in the livestock sector, insurance coverage is still low at 0.1percent of the national herd in 2009. The lack of an insurance market is another potential constraint to expanding investments in agricultural sectors (World Bank, 2009). Commercial insurers in Nepal are not financially and technically capable to cover the large agricultural sectors and have focused their network in the urban and semi urban areas only and lack of reinsurance have discouraged them to enter in crop and livestock sectors, whereas in the part of farmers, they are illiterate toward livestock and crop insurance and reluctant to pay for the services in advance which they may not receive risk in future (Ghimire, 2013). A study such as this which assesses the factors affecting the adoption of livestock insurance has become very relevant for policy makers in Nepal.
The study was conducted with following objectives:

- To find out the level of awareness among the farmers (both insured and non-insured) about livestock insurance.
- To evaluate the insured farmer perception about different aspects of livestock insurance.
- To assess the factor affecting farmers participation in livestock insurance program.
- To assess the constraints for not joining the livestock insurance.

MATERIALS AND METHODS

Selection of the study area

Nawalparasi district was purposively selected for thepurpose of studybased on the farmers' involvement in livestock farming and livestock insurance (Key informant interview with District Livestock Service office, Nawalparasi, 2016).Nawalparasi district is located in Terai region and tropical climate is found in majority areas of the district. Based on the first class livestock service center coverage, four different clusters were identified. Rajahar cluster was selected purposively for the purpose of the study through the discussion with District Livestock Service Office (DLSO) and insurance company.

Sampling frame and sample size

The list of insured farmers and non-insured farmer was prepared in consultation with milk co-operative and insurance company. From the list of insured and non- insured farmers 40 insured and 40 non-insured farmers were selected by using simple random sampling method using lottery method. Final sample size consists of 80 farmers involving both livestock insured and non- insured farmers.

Data collection

The pretested interview schedule was used for the collection of primary data. Focus Group Discussion (FGD) and Key Informant Interview were done with the help of checklist to triangulate the data collected through interview schedule. Secondary data were collected from the insurance board of Nepal, Shikhar insurance company, Siddhartha insurance company and District Livestock Service Office (DLSO) Nawalparasi.

Data analysis

Collected data were entered in MS Excel and cleaned to improve the quality of data. Data analysis was done by using SPSS software. Descriptive statistics such as mean, frequency and percentage was calculated and expressed in table and figure. Binary logistic regression model was used to determine the factor affecting farmers' participation in livestock insurance program.

Model specification

Following the Gujariti (1999), the model is specified as below:

$$\text{Ln}\ (P_i/(1-P_i)) = ß0 + ß_1\ X1 + \ldots. + ß_i\ X_i + e_i\ .$$

Where,
P_i = Probability of adoption of livestock insurance.
1-P_i = Probability not adopting livestock insurance.
ß0 = Intercept
ßi =Regression coefficient
Xi =Independent variable
ei =Error term

The independent variables specified as factors affecting adoption of agricultural insurance are defined below:

X1 = Total adult dairy animals (female in numbers)
X2 = Holding membership in any organization (1 yes, 0 otherwise)
X3 = Years of education (years)
X4 = Extension contact (1 yes, 0 otherwise)
X5 = Knowledge about the premium subsidy scheme (1 yes, 0 otherwise)
X6 = Age of the respondents (years)
X7 = Access of mass media for agricultural information (1 yes, 0 otherwise)
X8 = Beginning year of livestock rearing (years)
X9 = Own land (kattha)

RESULT AND DISCUSSION

Farmers' awareness about livestock insurance

Findings revealed that all insured (100 percent) and majority of non-insured farmers (75 percent) were aware about livestock insurance. In case of premium subsidy scheme 82.5 percent of insured and only 32.5 percent of non-insured farmers were aware.The results was also correlated with the study of Sundar and Ramakrishnan (2013) where all the insured farmers were aware but only 53.8 percent of non-insured farmers were aware of agriculture insurance. Similar findings were reported by Falola, Ayinde & Agboola where *77.5%* of the farmers were aware of agricultural insurance. Low level of awareness among farmers about crop insurance was reported by Uvaneswaran & Mohanpriya (2014).

Table 1: Farmers awareness about livestock insurane

Awareness	Insured	Non insured
Awareness of livestock insurance		
Yes	40(100)	30(75)
No	0 (0)	10(25)
Awareness of premium subsidy schemes		
Yes	33(82.5)	9(32.5)
No	7(17.5)	31(77.5)

Sources: Field survey, 2016; Notes: Figures in the parentheses indicate percent.

Farmers' perception on different aspect of livestock insurance

Farmers who had insured their livestock indicated their level of satisfaction or how good they felt about various aspects of their insurance policy using a 3-point scale. As shown in the table the participants felt that the current risk coverage, premium to be paid and insurance procedure and requirements is good. Participants felt that current valuation techniques of animal and the subsidy policy of government are very good. However, they were less satisfied with claim procedure and requirements and the time taken by insurance company for claim settlements. Farmers less satisfaction towards the manner at which claim settlement takes place is also reported by Chizari, Yaghoubi & Lindner (2003).

Determinants of livestock insurance adoption

The logistic regression model was run considering the dependent variable as adoption of livestock insurance ('Yes' or 'No') against various explanatory variables to determine the adoption factors on livestock Insurance. Here the Adoption of livestock insurance was the dichotomous dependent variable. The explanatory variables tested in the model were total adult dairy animal (number), holding of membership in any groups/organization (1 for yes,0 otherwise), years of education of the respondent(in years),extension contact of farmers with DLSO member (1 for yes,0 otherwise), knowledge about premium subsidy given on insurance premium by government (1 for yes, 0 otherwise), age of the respondents, access of mass media for agricultural information (1 for yes,0 otherwise), beginning years of livestock farming (years). R Square value shows about 45 percent variance covered by this model. Among the different explanatory variables total adult dairy animal (p=0.04), holding membership by the farmers (p=0.037), extension contact of farmers (p=0.024) and knowledge about the premium subsidy schemes (p=0.005) were found to be the key factors for significantly contributing the adoption of the insurance.

Table 2: Farmers perception of different aspect of livestock insurance

Perception	Very good	Good	Not good
Risk coverage	13(32.5)	26(65)	1 (2.5)
Valuation of animals	21(52.5)	13(32.5)	6(15)
Premium amounts	15(37.5)	25(62.5)	0(0)
Subsidy policy of the governments	29(72.5)	11(27.5)	0(0)
Insurance procedure and requirements	13(32.5)	25(62.5)	2(5)
Claim procedure and requirements	0(0)	5(12.5)	35(87.5)
Quickness in paying payments	1(2.5)	13(32.5)	26(65)

Sources: Field survey, 2016; Notes: Figures in the parentheses indicate percent.

Table 3: Determinants of livestock insurance adoption

Explanatory variables	Odd ratio	S.E.	P-value
Total adult dairy animals	1.175	0.080	0.04**
Holding of membership by farmers (1 Yes, 0 otherwise)	0.101	1.103	0.037**
Years of education (years)	1.039	0.089	0.666
Extension contact of farmers (1 Yes,0 otherwise)	0.174	0.780	0.024**
Knowledge about the premium subsidy scheme (1 Yes,0 otherwise)	0.158	0.666	0.005***
Age of respondents	0.957	0.038	0.260
Access of mass media for agricultural information (1 Yes, otherwise)	0.234	1.004	0.148
Beginning years of livestock rearing (years)	1.035	0.037	0.352
Own land (Kattha)	0.955	0.042	0.272
Constant	23.52	2.496	0.2058
Log likelihood	63.26		
Cox & Snell R square	0.449		

Note: *** Significant at 0.01, and ** significant at 0.05; S.E= Standard Errors
Sources: Field survey, 2016

The odds ratio indicated that it is about 17.5 percent likely to have increased adoption of livestock insurance if the adult dairy animal number increases by 1. Also it is 90 percent more likely to reduce adoption of livestock insurance if farmers don't hold membership in any group or organization as compared to those who hold membership in group and organization. Similarly, it is more than 83 percent likely to reduce adoption of livestock insurance if farmers have no contact with extension agents of DLSO as compared to those who have regular contact with extension workers of DLSO. . Finding was supported by the study of Falola, Ayinde & Agboola (2013) as access of agriculture extension contact positively affects the farmers willingness to join the insurance. Such positive relationship between extension contact and insurance adoption were also identified by Nahvi et al. (2014), Mohammed & Ortmann (2005) and Kumar et al.,(2014). Similarly it is more than 84 percent likely to reduce adoption of insurance if farmers are unaware of insurance premium subsidy scheme as compared to those who know about insurance premium subsidy scheme. Similar finding was reported by Akinola (2014) as higher level of awareness of insurance policy contributes for increase adoption of agricultural insurance.

Constraints for non-insured farmers in joining livestock insurance program

The study finding revealed that more number of farmers (82.5 percent) were unaware about the different facilities of insurance available which was the major reason for not joining livestock insurance. About 67.5 percent farmers explained their reason as inadequate publicity of the scheme followed by complex documentation (57.5 percent) and delay in claim payments (45 percent). Similar findings were reported by Sunder & Ramakrishna (2013) where major reason for not joining the insurance were lack of awareness, No need of insurance, delay in claim payments and complex documentation. Findings were supported from the study of Abdulmalik, Oyinbo & Sami (2013) where the major constraints were delay in indemnity payment (22.06 percent), which rank first in terms of constraints faced by farmers. Findings were also correlated with the study of Ajieh (2010) where major constraints for joining insurance were inadequate knowledge on benefits of insurance and late payments of claims.

Table 4: Constraints for non-insured farmers in joining livestock insurance program

Reason for not joining to livestock insurance	Frequency	Percentages	Rank
No aware of facilities available	33	82.5	I
No need of insurance	14	35	V
Lack of premium paying capacity	3	7.5	VII
No faith in insurance company	5	12.5	VI
Delay in the claim payments	18	45	IV
Inadequate publicity of the scheme	27	67.5	II
Complex documentation	23	57.5	III

Sources: Field survey, 2016

CONCLUSION

The findings of the study revealed that all the insured farmers and majority of non-insured farmers were aware about livestock insurance scheme but only few of non-insured farmers were aware about the insurance premium subsidy given by government of Nepal. Farmers perceived that insurance procedure is easier but claim settlement procedure is tedious that it requires recommendation from different agency. So for increasing the adoption of livestock insurance it is necessary to make claim settlement procedure easier. Farmers were satisfied with the premium percentages and subsidy given by government.The result of the binary logistic regression analysis showed different factor affecting farmers participation in livestock insurance adoption are total adult dairy animal , holding membership by the farmers , extension contact of farmers and knowledge about the premium subsidy given by government. The major constraints associated with low participation in livestock insurance scheme were lack of awareness, inadequate publicity, complex documentation and delay in claim payment. There is need

for organizing farmers in a group and creating awareness among them about premium subsidy scheme in insurance given by government for increasing the adoption of livestock insurance.

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REFERENCES

Ajieh, P. C. (2010) Poultry Farmers' Response to Agricultural Insurance in Delta State, Nigeria. *J. Agric. Sci*, *1*, 43-47.

Chizari M, Yaghoubi, A., & Lindner, J. (2003) Perceptions of rural livestock insurance among livestock producers and insurance specialists in Isfahan Province, Iran. *Journal of International Agricultural and Extension Education*, *10*(1), 37-42.

Falola, A., Ayinde, O. E., &Agboola, B. O. (2013)Willingness to take Agricultural Insurance by Cocoa farmers in Nigeria. *International Journal of Food and Agricultural Economics*, *1*(1), 97-107.

Ghimire, R. (2013) Crops and Livestock Insurance Practices in Nepal. *Journal of Business and Social Sciences, 1*(1)

Gujarati, D. (1999) *Essentials of Econometrics* (Second Edition).Irwin/McGraw-Hill. A Division of the McGraw-Hill Companies. pp. 449.

Iturrioz, R. (2009) *Agricultural Insurance*. World Bank, Washington D.C.

Khan, M. A., Chander, M., & Pardhan, D. (2013) Willingness to pay for cattle and buffalo insurance: an analysis of dairy farmers in central India. *Tropical animal health and production*, *45*(2), 461-468.

Kumar, D. S., Barah, B. C., Ranganathan, C. R., Venkatram, R., Gurunathan, S., & Thirumoorthy, S. (2011) An analysis of farmers' perception and awareness towards crop insurance as a tool for risk management in Tamil Nadu. *Agricultural Economics Research Review*, *24*(1), 37-46.

Micro Enterprise Development Program (2013) *Micro enterprise development programs for poverty alleviation*. Ministry of industry. United nation development programs.

MOAD. (2015) *Krishi Dairy.* Ministry of Agriculture Development. Lalitpur: Agriculture Information and Communication Center.

Mohammed, M. A., & Ortmann, G. F. (2005) Factors influencing adoption of livestock insurance by commercial dairy farmers in three zobatat of Eritrea. *Agrekon*, *44*(2), 172-186.

Nahvi, A., Kohansal, M.R., Ghorbani, M., & Shahnoushi, N. (2014) Factor affecting rice farmers to participate in agricultural insurance. *Journal of Applied science and Agriculture*.

Pradhananga, U. M., Sthapit, A., Pradhananga, S. M., Krakauer, N. Y., Jha, A., & Lakhankar, T. (2015) National Livestock Policy of Nepal: Needs and Opportunities.

Sundar, J., & Ramakrishnan, L. (2013) A study on farmers' "awareness, perception and willing to join and pay for crop insurance. *International Journal of Business and Management Invention*, *2*, 48-54.

Uvaneswaran, M., Mohanapriya, T. (2014) Farmers" perception and awareness about crop insurance in Tamil Nadu – a descriptive analysis. Intercontinental Journal of Marketing Research Review, 2(3), 15-22.

World Bank., (2009) *Agricultural Insurance Feasibility Study in Nepal.* Washington DC.

Situation analysis of dry matter availability and its consequences during winter season to the buffalo in relation to climate change: an evidence from Gandaki river basin, Nepal

B. Shah[1], N. R. Devkota[2] & S. Chaudhari[3]

1. District Livestock Service Office, Paanchthar
2. Agriculture and Forestry University, Rampur, Chitwan
3. District Livestock Service Office, Khotang

ABSTRACT

The livestock sector in Nepal plays a significant role in the agricultural development and economic empowerment of the country. Feed deficit conditions are gradually emerging as a central problem of livestock production in Nepal. There is harsh condition for dry matter supply, especially during October to March. There is a gross deficit of 31% dry matter (DM) to fulfill the requirements of existing livestock feed in the country. This could result in serious consequences when Dry matter is taken as a key indicator of nutrient supply. Considering this scenario into account a study was conducted during January to April, 2015 in Chitwan, Tanahun and Gorkha district, Nepal with the objective to assess DM availability to the mature Buffalo. Accordingly 30 households were selected from each district. One buffalo in each selected household were used as experimental animal. Farmer mainly supplied rice straw, green fodder, wheat bran and maize flour to their buffalo. The total quantity of feed were weighed and recorded on daily basis in each household. 100g of feed sample from each type of offered feed (rice straw, green fodder, maize flour, wheat and others) was collected from each household each week from the entire three district to analyze DM and chemical constituents. Body weight was estimated by the formula 25.156 y-960.232, where y is heart girth in inches.

Tanahun had the highest feed deficit condition (25.42%) followed by Gorkha (20.97%) and Chitwan (19.98%) during the 4 month of winter season. Crop residue i.e. straw, contributes almost 50% of total DM supplied to the buffalo in all the districts which is low in nutrient content. The proximate analysis of samples in all district revealed fairly poor presence of CP in all major ingredients. These findings thus fairly suggest to develop appropriate feeding plan for buffalo rearing to help mitigate DM shortage during winter.

Keywords: Feed deficit, Climate Change, Buffalo, Winter

INTRODUCTION

Livestock plays an important role in Nepalese economy in contributing 14 percent to the national gross domestic products (GDP) and 32 percent to the agricultural gross domestic products (MoAD, 2012). Nepal has currently 7.27 million cattle, 5. 24 million buffaloes, 10.17 million goats, 0.8 millions sheep, 48 million poultry and 0.37 million ducks (MoLD, 2016). The percentage of improved livestock accounts for only 13% in cattle, 25.9% in buffalo, 4.6% in sheep, 6.1% in goats, 34.2% in pigs and 54.2% in poultry (MoAD, 2012).

Livestock is an indispensable component of the agricultural production system in the country, the second highest next to field crop to agriculture. However, Buffalo is of paramount importance amongst the livestock enterprises as it contributes 53% to the total livestock GDP (Singh & Chapagain, 1999). Buffalo contributes 70.08% to the total milk and 64.1% to the total meat production (Karki & Bauer, 2005). Due to enormous potentialities of buffalo farming, Nepal imports about 120,000 head of buffaloes annually primarily to supply meat in the Kathmandu Valley (Shrestha et al., 1998). Its multipurpose use makes it more valuable in national economy than any other species. Nepalese leather industry is primarily based on buffaloes as the hides collected from this species, is about three times greater than that of cattle (LMP, 1993). Buffaloes in Nepal have the total population of 5.2 million as of 2015/2016, with their major regional-agroecological concentrations in Western hills (863 thousands), followed by central Hills (716 thousands), Eastern terai (587 thousands) and central Terai (779 thousands) (MoAD, 2017). In 2015/16, the milk production from buffalo (1,210 thousand MT) constituted 65% of the total milk production, and the buffalo meat production (175 thousand MT) constituted 54% for the total meat produced in the country (MoAD, 2017). While buffalo is the main source of milk and meat in Nepal, the country plans to meet the deficits in minimum annual per capita consumption, about 30% milk and 15% meat, by 2018/19 (MoLD, 2017).

Feed deficit is one of the most limiting factor of reduced production and productivity of livestock in Nepal. Nepalese livestock are undernourished, getting nutrients below their maintenance level. In terms of dry matter (DM) content, there is a 31% shortage of DM

to fulfill the requirements of existing livestock in the country (Upreti and Shrestha, 2006). This necessitates about the consideration to improve feed deficit condition. Fodder tree leaves, grasses and legumes from bunds, fallow land, forest areas, grazing lands, and crop residues are major sources of roughages for ruminant animals in Nepal. From July to December there is little problems in feeding livestock, after January to late June all the green roughage sources are scarce (Sherchand and Pariyar, 2002). During these periods buffaloes are depends only on straw (Rice and wheat), fodder trees leaves (Panday and Upreti, 2005) and cultivated green forges (Upreti, 2005). Due to unbalanced nutrients and unavailability, buffalo production (Milk and meat) goes down and animals looks like lean and thin during these lean periods (Shrestha, 2005). Considering these facts measures are necessary to mitigate feed deficit.

Changing climate is the global issue. There is a changing pattern of climate i.e. temperature, humidity, rainfall, etc. all over the world (IPCC, 2007). This pattern may even degrade the availability of feed and fodder supply during winter season if environmental factors get worst (ICIMOD, 2007). This may lead adverse impact on fertility, production, weight gain, disease susceptibility, etc (Thornton et al., 2009). So, adaptation to such condition is only possible by making policies of improving rangeland and pastureland. Change in climatic pattern are said to have a slow but alarming impact in this region especially to the forage availability, livestock feeds availability and managemental options within small livestock farmers (ICIMOD, 2007 and Dhakal and Devkota, 2012). Therefore, this study was conducted to assess the DM situation and associated chemical constituents of ruminants feed during the winter season in line with understanding feed supply situation to help improve ruminant feeding system in Nepal.

MATERIALS AND METHODS

Approach

This study was conducted in three districts i.e. Chitwan, Tanahun and Gorkha, Nepal considering different eco-zones. Accordingly 30 households were selected from Chitwan, Tanahun and Gorkha district for a precise, concrete and pilot type of study so that further study could be done on the basis of collected data. Only one milching buffalo in each selected household were used as experimental animal. Each farmer was provided with a digital balance to weigh the feed offered for identified animal per day basis. The daily feed consumed by the buffalo was measured for about 4 months at each household by directly weighing the intake/supply every day and by deducting the residue if any, in the early next morning

Study site: Chitwan, Tanahun and Gorkha district.

Duration of study: Study was done for 4 month duration.

Data recording: Farmer mainly supplied rice straw, green fodder, wheat bran, maize flour, etc. to their buffalo. They were provided a printed copy of consumption table of

rice straw, green fodder, wheat bran, maize flour and others to keep daily consumption of the study buffalo.

Sample collection: The daily feed offered by the farmer was weighed with the help of digital weighing machine that provided information of total quantity of feed consumed by the ruminants each day. There were 30 farmers from each district, total of 90 farmers in three districts. Feed samples were collected every week from each farm for 4 months.

Dry matter and proximate analysis: 100g sample from each type of offered feed (rice straw, green fodder, maize flour, wheat and others) was collected from each study household each week. The samples collected from the three districts were brought to the Animal Nutrition Laboratory, Rampur where dry matter was calculated. Then further nutrient composition (Crude protein, Crude fiber, Ether extract and Total Ash) of the feed were also analyzed.

Body weight estimation: Equations for the estimation of live weight from heart girth measurements for buffaloes were calculated as follow:
Body weight in Ib. = 25.156 y-960.232, where y is heart girth in inches (Mullick, 1950)
Body weight in pound is then converted to kilogram by dividing the result by 2.2

Dry matter requirements: The requirements of the quantity of dry matter depend on the body weight of the animal and also with the nature of its production. Cattle will generally eat daily 2.0 to 2.5 kg dry matter for every 100 kg of live weight. Buffaloes and cross breed animals are slightly heavy eaters and their dry matter consumption varies from 2.5 to 3 kg daily per 100 kg body weight (Banerjee, 2007). Off this $2/3^{rd}$ of the dry matter should be from roughages and $1/3^{rd}$ of the dry matter should be from concentrates. In context of roughages, $2/3^{rd}$ of the roughages required should be dry and $1/3^{rd}$ of the roughages required should be green.

Data analysis: Data obtained from research subjected to analyze were tabulated in Excel 2007. Descriptive analysis was performed for calculation of mean using SPSS. Analysis of Variance (ANOVA) was performed for significance test ($P<0.05$). Mean comparison was performed by LSD ($P<0.05$) using MSTAT-C version 1.3.

RESULTS AND DISCUSSION

Dry matter availability in different districts

This finding revealed that the total dry matter supplied per buffalo per day in Chitwan district in January, February, March and April was 8.773±0.045, 8.686±0.060, 8.701±0.072 and 8.822±0.024, respectively. The total dry matter supplied per buffalo per day in Tanahun district in January, February, March and April was 6.884±0.102, 6.986±0.025, 7.004±0.027 and 7.105±0.065, respectively. The total dry matter supplied per buffalo per day in Gorkha district in January, February, March and April was 6.979±0.082, 6.910±0.062, 7.031±0.046 and 7.002±0.061, respectively.

Table 1. Mean ± standard error of daily DM (kg) consumption per buffalo per day in Chitwan from January to April, 2015

Source	January	February	March	April
green	1.807±0.010	1.756±0.026	1.751±0.041	1.902±0.019
Straw	4.994±0.033	4.997±0.017	5.030±0.003	5.023±0.009
wheat bran	1.134±0.009	1.113±0.037	1.132±0.043	1.095±0.001
maize flour	0.632±0.004	0.591±0.012	0.600±0.002	0.609±0.003
Others	0.205±0.001	0.227±0.001	0.186±0.002	0.191±0.002
Total	8.773±0.045	8.686±0.060	8.701±0.072	8.822±0.024

Table 2. Mean ± standard error of daily DM (kg) consumption per buffalo per day in Tanahun from January to April, 2015

Source	January	February	March	April
green	1.310±0.026	1.403±0.016	1.352±0.008	1.378±0.023
Straw	3.863±0.062	3.938±0.006	3.953±0.054	3.941±0.009
wheat bran	0.949±0.039	0.945±0.016	1.002±0.027	1.084±0.041
maize flour	0.566±0.027	0.500±0.004	0.497±0.003	0.502±0.001
Others	0.194±0.004	0.198±0.002	0.198±0.002	0.199±0.002
Total	6.884±0.102	6.986±0.025	7.004±0.027	7.105±0.065

Table 3. Mean ± standard error of daily DM (kg) consumption per buffalo per day in Gorkha from January to April, 2015

Source	January	February	March	April
green	1.397±0.005	1.363±0.018	1.37±0.009	1.371±0.003
Straw	3.780±0.054	3.796±0.066	3.921±0.050	3.877±0.062
wheat bran	0.902±0.026	0.852±0.037	0.834±0.007	0.847±0.007
maize flour	0.68±0.011	0.687±0.005	0.693±0.001	0.690±0.003
Others	0.213±0.002	0.211±0.001	0.206±0.001	0.214±0.001
Total	6.979±0.082	6.910±0.062	7.031±0.046	7.002±0.061

Table 4. District wise body weight of buffalo, 2015

District	Heart girth (inch)	Body weight (kg)
Chitwan	76.41 [a]	437.28 [a]
Tanahun	70.88 [b]	374.01 [b]

Gorkha	69.08 [c]	353.43 [c]
Probability	<0.01	<0.01
F-value	55.12	55.12
SE	0.51	5.89
CV %	3.91	8.30
LSD	1.44	5.23

Means in column with different super-script differ significantly by LSD (P<0.05)

The finding revealed that the Tanahun district had the highest feed deficit condition (25.42%) followed by Gorkha (20.97%) and Chitwan (19.98%) during 4 months of winter season. Nepalese livestock are undernourished. In terms of dry matter (DM) content, there is a 31% shortage of DM to fulfill the requirements of existing livestock in the country (Upreti & Shrestha, 2006).

Dry matter deficit in different districts

Deficit of DM in term of roughages and concentrates in different district per buffalo per day

There was no problem regarding the supply of dry roughages in all three districts. Chitwan had dry roughages surplus of 2.13% in term of DM. Only 3.08% and 6.50% DM deficit of dry roughages was found in Gorkha and Tanahun district respectively. This research finding is close as reported by Pande(1997). However, these crop-residues are poor in nutrient composition and digestibility, and they cannot meet the livestock nutrient requirements in the country (Upreti, 2004). This finding revealed that there is very low supply of concentrate to the buffalo in all the three district. Buffalo of Chitwan district had the highest concentrate deficit 46.91% followed by Tanahun 43.87% and Gorkha district 40.01% in term of DM. In Nepal, there is huge deficit of concentrates (-66.7%) (Pande,1997).

Table 5. Deficit of DM in Chitwan district in different month, 2015 per buffalo per day

Month	DM required (kg)	Total DM supplied (kg)	Deficit (kg)	Deficit (%)
January	10.93	8.773	2.157	19.73
February	10.93	8.686	2.244	20.53
March	10.93	8.701	2.229	20.39
April	10.93	8.822	2.108	19.28

Table 6. Deficit of DM in Tanahun district in different months, 2015 per buffalo per day

Month	DM required (kg)	Total DM supplied (kg)	Deficit (kg)	Deficit (%)
January	9.35	6.884	2.466	26.37

February	9.35	6.986	2.364	25.28
March	9.35	7.004	2.346	25.09
April	9.35	7.105	2.335	24.97

Green roughages availability was also found to be very poor. Tanahun had the highest deficit 34.16% followed by Gorkha 29.49% and Chitwan 25.32% of green roughages in term of DM. Pande (1997) reported that Nepal face the green fodder deficit of 54% which supported my finding.

Table 7. Deficit of DM in Gorkha district in different month, 2015 per buffalo per day

Month	DM required (kg)	Total DM supplied (kg)	Deficit (kg)	Deficit (%)
January	8.835	6.97	1.85	21.00
February	8.835	6.91	1.92	21.78
March	8.835	7.03	1.80	20.37
April	8.835	7.00	1.833	20.74

Table 8. Average dry roughages deficit/surplus of different districts per buffalo per day

Districts	Required dry roughages	Supplied dry roughages	Deficit/surplus	Deficit /surplus%
Chitwan	4.906477	5.011436	+0.10496	+2.13
Tanahun	4.197215	3.924026	0.273189	6.50
Gorkha	3.966032	3.843816	0.122215	3.08

Table 9. Average green roughages deficit of different districts per buffalo per day

Districts	Required green Roughages	Supplied green roughages	Deficit	Deficit (%)
Chitwan	2.416623	1.804619	0.612004	25.32
Tanahun	2.067285	1.360988	0.706298	34.16
Gorkha	1.953419	1.377256	0.576162	29.49

Table 10. Average Concentrate deficit of different districts per buffalo per day

District	Required concentrates (kg)	Supplied concentrate (kg)	Deficit (kg)	Deficit (%)
Chitwan	3.6069	1.914828	1.692072	46.91
Tanahun	3.0855	1.731698	1.353802	43.87
Gorkha	2.91555	1.749017	1.166533	40.01

Chemical constituents of different feed stuff fed to buffalo in different districts

The different feed stuffs fed to the buffalo were straw, green roughages, wheat bran, maize flour and others (concentrate based home-made feed). Chemical constituent of those fed feed stuff were similar in all districts. Crude protein of wheat bran was found the highest in all district (~14%) while straw had lowest crude protein in all districts (~4.5%). The finding is supported by the result of Conceicao, (2016) who reported the crude protein of Wheat bran 15.2. The crude protein of straw analysed is similar to Khajarem and Khajarem (1985) who reported crude protein of straw 4.2. Similarly CF was the highest in straw (~ 24%) and lowest in maize flour (~4%) in all three districts. The finding of CF of straw is higher than the finding of Khajarem and Khajarem (1985) who reported CF of straw 15.2. Ether extract was the highest in case of maize flour (~ 3.9) and lowest in rice straw (~1.3). This finding is very close to the finding of Upreti (2006) who reported the EE of maize flour 3.21. Total Ash of maize flour was found to be lowest and this is supported by finding of Upreti (2006) who reported the Total Ash ranges from 1.05 to 6.31.

Table 11. Nutrient content of different feed stuffs fed to buffalo in Chitwan

Source	DM	CP	CF	EE	Total ash
Straw	88.7%	4.42	23.5	1.3	8.3
Green Fodder	28.6%	13	22.3	2.9	11.8
Wheat bran	91.5%	14	11.3	3.3	10.9
Maize flour	88.3%	11.02	2.7	3.9	5.8
Others	89.3%	14.2	8.0	3.8	14.8

Table 12. Nutrient content of different feed stuffs fed to buffalo in Tanahun

Source	DM	CP	CF	EE	Total ash
Straw	89.2%	4.24	24.2	1.2	8.1
Green Fodder	35.4%	11.7	23.8	3.4	11.6
Wheat bran	91.6%	14.0	11.3	3.5	10.6
Maize flour	87%	11.0	2.9	3.7	5.6
Others	89.2%	15.2	7.4	3.2	13.5

Table 13. Nutrient content of different feed stuffs fed to buffalo in Gorkha

Source	DM	CP	CF	EE	Total ash

Straw	88.5%	4.3	23.7	1.2	8.64
Green Fodder	34%	11.4	22.2	2.7	11.5
Wheat bran	92.1%	13.8	11.5	3.4	1.8
Maize flour	88.6%	11.1	2.6	3.6	5.8
Others	87.8%	13.6	8.2	3.4	13.2

CONCLUSION

All district faced the problem of feed deficit during January to April. The condition of feed deficit was low in Chitwan and Gorkha but was the highest in Tanahun. Crop residue i.e. straw contributes almost 50% of total DM supplied to the buffalo in all the districts which was low in nutrient content. The supply of green roughages was almost 30% deficit of required amount in all districts due to low availability of green roughages during the period of January to April. The feeding of concentrates was not practiced in required amount because livestock are traditionally reared in all the districts. These results suggest the need to promote DM supply to mitigate gross deficit during winter.

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REFERENCES

Banerjee, G. C. (2007) *A Text Book of Animal Husbandry*. Reprint. 662p.

Dhakal, B. and Devkota, N. R.. (2012). Impacts of climate change on livestock production system in hilly region of Nepal. *Abstract published on Sixth national conference on Nepal Academy of Science and Technology* (NAST), Kathmandu, Nepal. pp. 8-9.

ICIMOD, (2007) Good practice in watershed management-Lesson learned in the Mid Hills of Nepal. *International Center for Mountain Development*. Kathmandu, Nepal. 72p.

IPCC. (2007) Climate Change: Synthesis Report (Intergovernmental Panel on Climate Change) Summary for Policymakers. Website: http://www.ipcc. ch/pdf/ assessment report/ar4/syr/ar4_syr_spm. pdf.

Karki, L.B. and Bauer, S. (2005) Economics of raising livestock: Does market liberalization policy promote rural employment in the case of subsistence farming. A paper published in the proceedings (vol. 2) of an *International Conference on "Integrating Livestock-Crop Systems to Meet the Challenges of Globalization" jointly organized by British Society of Animal Science and the Animal Husbandry Association of Thailand* held on 14-18 November, Thailand. pp. 142-143.

Khajarem, S. and Khajarem, J.. (1985) The utilization of crop by-products as animal feed in Thailand. In P. T. Doyle (ed). *The utilization of fibrous agricultural residues as animal feeds*. IDP, Canberra. pp. 3-17.

LMP, (1993). *Livestock Master Plan. Ministry of Agriculture and Cooperatives*. Kathmandu, Nepal.

MoAD, (2017) Statistical information on Nepalese agriculture, 2015/16. Ministry of Agricultural Development, Kathmandu, Nepal. Accessed on October 10, 2017 from :*http://moad.gov.np/public/uploads/1142453195* STATISTIC%20AGRICULTURE%20BOOK_2016.pdf.

MoAD, (2012) Ministry of Agricultural Development, Agribusiness Promotion and Statistics Division, Agri Statistics Section, Singhdurbar, Kathmandu Nepal. Statistical Information on Nepalese Agriculture. (Accessed 10 February 2016).

MoLD, (2016) Ministry of Livestock Development. Commitment paper (Nepali). *http://www.mold.gov.np/uploads/files/pratibaddata.pdf* (Accessed 10 April 2016).

MoLD, (2017) Data on meat and milk sufficiency. Ministry of Livestock Development. Data obtained accessed on October 9, 2017 from http://wwwmyrepublica. com/news/24532.

Mullick, D. N. (1950) The estimation of the weight of cattle and buffalo from heart girth measurements. *Indian Journal of Dairy Science*, *3*, 52-58.

Pande, R.S. (1997) *Fodder and Pasture Development in Nepal*. Udaya Research and Development Services (P) Ltd. Kathmandu, Nepal, pp 5. Feed the Future Innovation Lab for Livestock Systems Nepal: ASF Production and Marketing Brief 12.

Pandey, S. B. and Upreti, C. R. (2005) Nutritional status of different feed resources of Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation*. March 8-11, 2005. Kathamndu, Nepal. Temperate Asia Pasture and Fodder Network FAO. 132- 139.

Sherchand, L. and Pariyar, D. (2002) Pasture forage and agroforestry technology and their dissemination status in Nepal. *Proceedings of the 6th National Outreach Workshop held at NARC,* Kathmandu, Nepal.

Shrestha, H. R., Kunwar,B. S., Mandal, P., Thapa, M. S. and Pandey, S. B. (1998). Effect of feeding urea and molasses treated rice and wheat straw diet on the body weight gain and carcass characteristics of male buffalo calves. *Proceeding of 8th World Conference on Animal Production Seol, Korea,* pp. 70-71.

Shrestha, N.P. (2005). Importance of different feed resources in livestock improvement in Nepal. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation. March 8-11, 2005*. Kathamndu, Nepal. Temperate Asia Pasture and Fodder Network FAO. pp. 111-119.

Singh, S. B. and Chapagain, D. P. (1999) Livestock sector in the Agriculture Perspective Plan. In: *Proceedings of the first national workshop on animal genetic resources conservation and genetic improvement of domestic animals in Nepal- April 11-*

13, 1994 (Ed. J.N.B. Shrestha). Nepal Agricultural Research Council, Khumaltar, Nepal. pp. 1-117.

Thornton, P., van de Steeg, J., Notenbaert, M.H. and Herrero, M. (2009) The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agri. Systems,* 101: 113-127.

Upreti, C. R. (2004) *Rice bran and Leucaena Supplementation on the Growth and Digestibility by Goats and Urea Treated Rice Straw*. Ph.D. Dissertation. CLSU: The Philippines.

Upreti, C.R. and Shrestha, B.K. (2006) *Nutrient contents of feed and fodder in Nepal*. (Accessed 27 February 2016).

Upreti, C.R. (2005) Livestock feeding systems and the place of fodder oats in Nepalese systems. *Proceedings of the Workshop on Fodder Oats, Fodder Technology Packages and Small Farm Income Generation.* March 8-11, 2005. Kathmandu, Nepal. Temperate Asia Pasture and Fodder Network FAO. pp. 77-82.

Prevalence of common gastrointestinal nematode parasites in pigs based on different altitudes and seasons in Dhankuta and Sunsari districts of Nepal

R. P. Sah
Agricultural Research Station, Pakhribas, NARC, Nepal
rpsnarc@yahoo.com

ABSTRACT

Gastrointestinal nematode parasites are one of the major constraints to swine production. This study was designed to determine the prevalence of common gastrointestinal nematodes of pigs based on different altitudes and seasons in Dhankuta and Sunsari districts of Nepal from February 2013 to January 2014. Ranges of altitudes of selected sites were 1800-2200 masl in Murtidhunga; 800-1200 masl in Dhankuta and 100-200 masl in Inaruwa of Sunsari district. Seasons were divided into three viz. summer, rainy and winter. A total of 1022 faecal samples (Murtidhunga-400, Dhankuta-395 and Inaruwa-227) from pigs of different sexes and ages were collected in every two months' interval from same study sites and examined microscopically for the presence of eggs of gastrointestinal nematodes using the floatation technique. A total prevalence of 51.4% (95% confidence interval (CI): 48.26-54.48) was recorded; with Strongly spp 27.3% followed by Ascaris suum 19.8% and Trichuris suis 4.3% while mixed infestation was found 7%. Significantly higher prevalence was found in female (56.3%, 95% CI: 51.76-60.67, p=0.0024) pigs than in males (46.8%, 95% CI: 42.44-51.14); and also higher prevalence in adults pigs (55.7%, 95% CI: 51.96-59.39, p=0.0001) than young pigs (41.5%, 95% CI: 35.95-47.18). There was higher prevalence in Dhankuta (63%)

followed by Murtidhunga (53.3%) and Inaruwa (27.8%) which was found significant (p<0.05) difference. Similarly significantly prevalence was found in winter season (60.4%) followed by rainy (49.8%) and summer (40.1%). High prevalence of gastrointestinal nematode parasites in pigs in eastern Nepal warrants intervention policies to control this problem. This study therefore confirms the prevalence of gastrointestinal nematodes in pigs and it was therefore recommended that farmers improve on their bio-security and also adhere to routine de-worming regimen.

Key words: Gastrointestinal nematodes, pigs, altitudes, seasons,

INTRODUCTION

Swine production is one of the fastest growing livestock sector worldwide and forms an integral part of the rural economy in many parts of the world by providing an additional animal protein sources for human consumption, generating employment and reducing poverty (Seid and Abebaw, 2008). Pig (*Sus scrofa)* farming enterprise is one of the important economic activities in Nepal. Livelihood, food and nutritional security and employment opportunities of several communities are also associated with pig husbandry. The population of pigs is estimated to be about 1.2 million (1,203,230) heads in Nepal and pork meat production is 20,135 metric ton (CBS, 2016). Pig farming trend is increasing in Nepal due to reduced cultural biases against pigs and new government programs to support pig farming as a low cost means to create income for poverty alleviation and to improve food security (Sah *et al.*, 2017).

Among the parasitic helminthes, gastrointestinal nematodes (GINs) in pig are considered as the most important worldwide. Most of them are unable to multiply inside the host and consequently they must leave it before the next generation can reach sexual maturity. Eggs and larvae are passed out of the body usually in large numbers. It follows, therefore, that each adult parasite must enter the host while still young, either as a contamination of pasture, food or water (Soulsby, 1983).

One of the biggest constraints to pig confinement is the cost of feed which usually accounts for up to 80 % of all costs in intensive pig production (Mutua *et al,* 2011; Muhanguzi *et al.*, 2012). Infections with gastrointestinal parasites may reduce production as they potentially cause lower average daily gains (ADGs) and may also result in poorer feed conversion ratios (Hale *et al.*, 1985). In the tropical and sub-tropical areas, parasitic infections in pigs are estimated to be second to African swine fever (Permin *et al.*, 1999). Infection with parasites is associated with significant economic losses evidenced by decreased litter size, poor growth rate, reduced weight gain, organ condemnation at slaughter and death (Nsoso *et al.*, 1999). Nansen & Roepstorff (1999) reviewed the helminthes in domesticated pigs. It appeared that *Ascaris suum, Oesophagostomum* spp. *Trichuris suis, Hyostrongylus rubidus, Strongyloides ransomi, Metastrongylus* spp. and *Stephanurus dentatus w*ere found to be the common helminths of veterinary importance in domesticated pigs.

Gastroenteritis in pigs and parasitic infestation has been reported in Dhankuta and Terhathum (Sah *et al.,* 2017). These parasites can cause serious economic loss to the producer in many ways including decrease in feed efficiency and conversion, increase time to market weight and decrease in carcass value. Information on the epidemiology of parasite of animals is very important in assisting farmers to develop preventive measures. There are limited published reports about parasites of pig in Nepal. Prevalence of the parasites in pigs in the study areas has not been properly documented. Therefore this study aimed to determine prevalence of common gastrointestinal nematodes (GINs) in pigs based on altitudes and seasons in Dhankuta and Sunsari districts of Nepal.

MATERIALS AND METHODS

Study area

Nepal is a landlocked country located between two big countries China in North and India in South, East and West (Figure 1). The studied sites were located at two districts of eastern region of Nepal. Sites were differentiated into three altitudes- high hill, hill and lowland or plain to know the variation of prevalence. Ranges of altitudes of selected sites were 1800-2200 meter above sea level (masl) in Murtidhunga; 800-1200 masl in Dhankuta of Dhankuta district and 100-200 masl in Inaruwa of Sunsari district. Similarly latitude and longitude of study sites were as: Murtidhunga (27^0 09' 64.87" N; 87^0 36' 37.94" E); Dhankuta (26^0 97' 09.96" N; 87^0 34' 31.09" E) and Inaruwa (26^0 63' 43.79" N; 87^0 18' 60.72" E).

Figure 1: Map of Nepal showing study districts (star)

Study design

A total of 1022 fecal samples were collected randomly from pigs of different sexes and ages in different three sites from February, 2013 to January, 2014. Age was categorized into two: adult (above 6 months old) and young (below 6 months old). Seasons were categorized into three viz. summer (March to June), rainy (July to October) and winter (November to February). The samples were collected from pig farms and household animals of three different sites of Dhankuta and Sunsari districts namely Murtidhunga (400), Dhankuta (395) and Inaruwa (227) representing three different altitudes. Samples were collected in every two months' interval from same studied sites.

Laboratory Examination

Fecal samples were collected per rectum from the animals. Each samples of 5-10 g of fecal material was collected in polythene bag containing 10% formalin as preservative. The samples were properly labeled and brought to the laboratory of Agricultural Research Station, Pakhribas, Dhankuta. The samples were tested microscopically for the presence of nematode eggs using floatation technique (Soulsby 1983). Saturated salt solution was used for floatation of eggs.

Statistical Analysis

Obtained data were compiled in MS Excel and analyzed using SPSS version 16.0 for windows. The data obtained were expressed in percentages and presented in tables. Chi Square test was used to determine significant difference in the GINs among the groups. The relationship of altitude with prevalence of GINs and season with prevalence of GINs was investigated. Spearman's Chi-square Test was used to compare the effect of season and altitude on the prevalence of GINs in pigs. The level of significance was considered and P-value (<0.05) was calculated to show significant.

RESULTS

Three gastrointestinal nematodes (GINs) parasites of veterinary importance were identified from a total of 1022 faecal samples collected, with an overall prevalence of 51.4%. *Strongly* spp had the highest prevalence 27.3% followed by *Ascaris suum* (19.8%) and *Trichuris suis* (4.3%) while mixed infestation was 7% as shown in Table 1.

Table 1: Prevalence of common gastrointestinal nematodes (GINs) of pig in different sites

Study site	*Ascaris suum*	*Strongly* spp	*Trichuris suis*	Mixed infestation
Murtidhunga (No. positive)	109	87	17	29
Dhankuta (No. positive)	85	147	17	43
Inaruwa (No. positive)	8	45	10	0
Total (No. positive)	202	279	44	72

% prevalence	19.8	27.3	4.3	7

There was higher prevalence of GINs in female pigs than male which was significantly different (P<0.05) (Table 2). Similarly, in relation to age, there was higher prevalence of GINs in the adult pigs (55.7%) than in young pigs (41.5%) which was significantly different (P<0.05) (Table 3). It was observed that GINs in pigs was present in all seasons and in all altitudes (Table 4 and 5). Prevalence was found highly significant difference (p=<0.00001) and reported high in winter season and in Dhankuta (800-1200 masl).

Table 2: Prevalence of gastrointestinal nematode parasites of pig in relation to sex

Sex	Positive/Tested animal	Prevalence %	95% Confidence interval (CI)	Chi Square test	p-value <0.05
Male	246/526	46.8	42.44-51.14	9.1875	0.00243
Female	279/496	56.3	51.76-60.67		
Total	525/1022	51.4	48.26-54.48		

Table 3. Prevalence of gastrointestinal nematode parasites of pig in relation to age

Age	Positive/Tested animal	Prevalence %	95% Confidence interval (CI)	Chi Square test	p-value <0.05
Adult	396/711	55.7	51.96-59.39	17.506	0.00003
Young	129/311	41.5	35.95-47.18		
Total	525/1022	51.4	48.26-54.48		

Table 4. Prevalence of GINs in pigs in different season in Nepal during 2013-14

Season	Positive/ Tested animal	Prevalence %	95% Confidence interval (CI)	Chi-square test	p-value<0.05
Summer	124/309	40.1	34.62-45.83	29.964	<0.00001
Rainy	139/279	49.8	43.80-55.84		
Winter	262/434	60.4	55.59-65.00		

Table 5. Prevalence of GINs in pigs in different altitude level in Nepal during 2013-14

Altitude (masl)	Positive/Tested animal	Prevalence %	95% CI	Chi-square test	p-value <0.05
1800-2200	213/400	53.3	48.23-58.22	72.774	<0.00001
800-1200	249/395	63.0	58.07-67.81		
100-200	63/227	27.8	22.03-34.06		

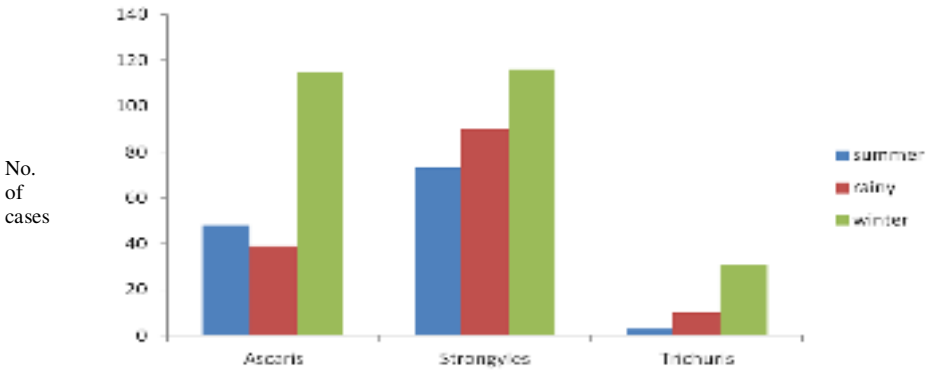

Figure 2. Prevalence of common gastrointestinal nematodes (GINs) of pig by season

Considering season, all the three common nematodes were recorded high in winter season and in rainy season Strongyles reported high among three common GINs as shown in Figure 2.

DISCUSSION

According to the results, the infestation of GINs was common in pigs kept under smallholder conditions and persisted round the year in the study areas. This may be due to the suitability of the climate for intermediate host and their egg masses to persist throughout the year. In this study three parasites were found as common gastrointestinal nematodes (GINs) viz. *Ascaris suum*, *Strongly* spp and *Trichuris suis*. This could be attributed to the extensive system of management widely practiced within the study area and also lack of veterinary services. This finding agrees with the reports having high prevalence of similar gastrointestinal parasites in pigs (Sowemimo *et al.,* 2014; Tidi *et al.,* 2011).

Common GINs eggs were found in more than half of the pigs; infections with *Strongly* spp and *A. suum* were the most common in all study sites. This is consistent with other studies conducted in Uganda (Waiswa *et al.,* 2007; Nissen *et al.*, 2011), although those reported higher overall prevalence rates around 90 %; especially, levels of infection with *Metastrongylus* spp and *A. suum* were much higher.

The higher prevalence of gastrointestinal parasites observed in female pigs (56.3%) than the male ($P<0.05$), was possibly due to the fact that female pigs are kept much longer for breeding purposes as compared to the male pigs, which are usually fattened and sold off (Sowemimo *et al.,* 2014). Meanwhile, the lower prevalence in younger pigs compared to adults ($P<0.05$) can be attributed to the fact that piglets and small pigs are most times confined in the pens which tend to reduce their chances of contact with the disease agents. It could also be because of the developing immunity of younger pigs at that age

due to the maternal immunity at birth. This finding also agrees with the report of Atawalna *et al* (2016) who also reported higher prevalence in adults than younger pigs.
Significant difference was found in different altitudes. The higher prevalence observed in high altitude Murtidhunga (53.3%) and mid altitude Dhankuta (63%) as compared to low land Inaruwa (27.8%) could possibly be because of the higher number of samples collected from this region, as more pig farms were located within this region and less anthelmintic use in this region than Inaruwa.
Similarly this study found significant variation among seasons. Winter season found higher prevalence (60.4%) than rainy and summer. This indicates that the pigs were exposed to the infective stage at least 1-2 months earlier i.e. in the monsoon season (Sah et al ., 2017). These findings indicate that pasture infectivity could be higher in the monsoon seasons when the temperature and moisture levels are the most favorable for nematode developmental stages and farmers feed these infective grasses to pigs.

CONCLUSION AND RECOMMENDATION

This study found overall prevalence of 51.4% with three common GINs parasites viz. *Ascaris suum*, *Strongly* spp and *Trichuris suis* in study areas but prevalence varies according to seasons and altitudes. Dhankuta and winter season showed high infestation of GINs in pigs. Control measures should be taken for elimination of parasite. Periodic anthelmintic treatment should be given for getting maximum productivity from the pigs. Strategic deworming in high risk period like winter season and Dhankuta is recommended along with measure to prevent pasture contamination with pig droppings.

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REFERENCES

Atawalna, J., Attoh-kotoku, V., Folitse, R.D. and Amenakpor, C. (2016) Prevalence of gastrointestinal parasites among pigs in the Ejisu Municipality of Ghana. *Scholars journal of Agricuture and Veterinary Science*. (3), 33-36.

CBS. (2016) *National Sample Census of Agriculture, Nepal*. Central Bureau of Statistics.

Hale, O.M., Stewart, T.B., and Marti, O.G. (1985) Influence of an experimental infection of *Ascaris suum* on performance of pigs. *J Anim Sci*. 60, 220–225.

Lekule, F.P. and Kyvsgard, N.C. (2003) Improving pig husbandry in tropical resource poor communities and its potential to reduce risk of porcine cysticercosis. *Acta Tropica.* 87, 111-117.

Muhanguzi, D., Lutwama, V., Mwiine, F.N. (2012) Factors that influence pig production in Central Uganda-case study of Nangabo Sub-County, Wakiso District. *Vet World*. 5, 346–351.

Mutua, F.K., Dewey, C.E., Arimi, S.M., Ogara, W.O., Githigia, S.M., Levy, M., Schelling, E. (2011) Indigenous pig management practices in rural villages of Western Kenya. *Livest Res Rural Dev* 23, 144, http://www.lrrd.org/lrrd23/7/mutu23144.htm. Accessed 23 August 2016.

Nansen, P. and Roepstorff, A. (1999) Parasitic helminths of the pig: factors influencing transmission and infection levels; *International Journal for Parasitology*, 29:877–891.

Nsoso, S.J., Mosala, K.P., Ndebele, R.T. and Ramabu, S.S. (2000) The prevalence of internal and external parasites in pigs of different ages and sexes in Southeast District, Botswana**.** *The Onderstepoort J.Vet.* 67(3), 217-20.

Permin, A., Yelifari, L., Bloch, P., Steenhard, N., Hansen, N.P. and Nansen, P. (1999) Parasites in cross-bred pigs in upper East region of Ghana. *Vet. Parasitol*. 87(1), 63-71.

Phiri, I.K., Ngowi, H., Afonso, S., Matenga, E., Boa, M. and Lubega, G.W. (2003) The emergence of *Taenia solium* cysticercosis in Eastern and Southern Africa as a serious agricultural problem and public health risk. *Acta Tropica*. 87(1), 13-23.

Sah, R.P., Jha, S.K., Karki, S., Katuwal, R.B. and Ansari, A.R. (2017) Management system including health care and marketing of pigs adopted by farmers in Dhankuta and Terhathum districts. *Proceedings* of the 12th National Outreach Research Workshop .pp157-161.

Seid, A. and Abebaw, G. (2008) Production systems dynamism and parasitic interaction of swine in and around Holetta, Ethiopia. *Ethiopia veterinary journal.* 14(1), 71-81.

Soulsby, E.J.L. (1983) Helminths, Arthropods and Protozoa of Domesticated Animals. 7th edition, Lea and Febeiger, Philadelphia, USA, pp. 763–777.

Sowemimo, O.A., Asaolu, S.O., Adegoke, F.O. and Ayanniyi, O.O. (2014) Epediomiological survey of gastrointestinal parasites of pigs in Ibadan, Southwest Nigeria. *International journal of pure applied science technology*. 20(2), 53-57.

Tidi, S.K., Ella, F.A. and Ella, A.B. (2011) Prevalence of Gastrointestinal Parasites of pigs in Jos, Plateau State, Nigeria. *Nigerian Journal of Parasitology*. Vol 32 No.1

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Response of pomegranate to indole butyric acid concentration for rooting of stem cuttings

K. Poudel[1], M. K. Sah[1], J.L. Mandal[1] & J. Shrestha[2]
[1] Agricultural Research Station, Pakhribas, Dhankuta,
[2]Nepal Agricultural Research Council, National Commercial Agriculture Research Program, Pakhribas, Dhankuta, Nepal
krishnapoudel08@gmail.com

ABSTRACT

The study was conducted to evaluate the effect of Indole Butyric Acid (IBA) on pomegranate propagation through stem cuttings. The experiment was carried out under the poly-house condition at horticulture farm of Agricultural Research Station, Pakhribas. The experiment comprised of five levels of IBA (0, 3000, 6000, 9000, 12000ppm) concentrations for treating hardwood stem cutting of pomegranate crop. During the study period, data on success percentage of the cuttings, number of roots, length of roots, fresh and dry weight of the roots were recorded. The concentration of the IBA played a role in the success in rooting of the hardwood cuttings. The maximum number of sprouts per cuttings (4.1), number of roots per cutting (14.92), fresh weight of roots (1.04g) dry weight of roots per cutting (0.68g) was observed from the treatment with 9000ppm concentrations of IBA while the length of root (10.65cm) from the treatment with 12000ppm concentration of IBA. The experiment showed that 9000ppm concentration of IBA was better among the other treatments as it gave 67.5 per cent success in rooting of the hardwood cuttings of pomegranate crop.

Key words: Concentration, cutting, hardwood, pomegranate and propagation

INTRODUCTION

Pomegranate (*Punica granatum* L.) is a well-known table fruit of tropical and subtropical regions of the world. It belongs to the Punicaceae family with two species namely: *Punica granatum* L. and *P. protopunica* Balf. The tissues of pomegranate fruit, flowers, bark and leaves contain bioactive phytochemicals that are antimicrobial, reduce blood pressure and act against serious diseases such as diabetes and cancer. Even juice works as medicines for curing of dyspepsia Negi *et al.*, 2003. For healing of diarrhoea and dysentery, there is a practice of use of seeds, bark and rind of the fruits. Pomegranate can be grown from terai to mid hills region of Nepal. The crop shades its leaves and acts as deciduous nature while grown in sub-tropical region while, evergreen in nature in tropical i.e. terai region. It grows best in hot dry summer and cold winter. Propagation by seeds as well as cutting are the usual practice of propagation while, grafting and layering are also practiced for propagation Hartmann *et al.*, 1997. Seed as a propagation is not used for establishing the orchard commercially. Propagation from seed takes longer time for fruiting as well may not be true to the type. Compared to the seed; saplings produced from cuttings produce true to the type to parents in both vegetative and reproductive traits. It broadly favours cutting to be the best suited method of propagation in pomegranate Saroj *et al.* (2008).

Pomegranate can easily root from the cuttings without any treatments as auxins. It has been reported that the exogeneous application of auxins favours success of rooting in cuttings. Auxins help in induction of roots from cuttings. It is reported that the rooting percentage is increased by three folds in pomegranate crop when treated with auxins (Saroj *et al*., 2008 and Polat and Caliskan, 2009). Multiplication of the pomegranate cuttings depends on concentrations of IBA, type of cuttings and even the media used for rooting of cuttings (Singh, 2017). Thus, the objective of the work was to study the rooting capacity of pomegranate in different concentrations of IBA.

MATERIALS AND METHODS

The experiment was carried out at Agricultural Research Station, Pakhribas, Dhankuta during February to June 2017. The experiment was set-up under the poly-house structure constructed within the nursery area of horticulture farm. The study was aimed to find the effect of different concentrations of IBA on success of rooting of hardwood cutting of pomegranate. A total of four concentrations of IBA (3000, 6000, 9000, 12000ppm) and a control (without treatment) were placed for evaluation. The hardwood cuttings of length 20-25 cm were taken from the pomegranate plant for the experiment purpose. The proximal ends of the prepared cuttings were dipped for 10 seconds to each IBA concentrations and in water for control as treatment before they were placed in the experiment plot. The cuttings were placed 8cm deep in the poly-bags filled with two parts of virgin forest soil and one part of well decomposed farm yard manure.

The response of pomegranate cuttings to IBA concentrations were recorded for the success percentage of the cuttings, number of roots per cutting, root length, fresh and dry weight of roots per cuttings. Randomized Complete Block Design (RCBD) was the design used where; each treatment was replicated four times. A total of 20 hard wood cuttings of pomegranate were placed in each treatment. Data was analyzed using Gen STAT and the differences between the means were compared by using the least significant difference at $p < 0.05$.

RESULTS AND DISCUSSION

The effect of IBA concentrations on success and vegetative performance of hardwood cuttings of pomegranate are presented in Table 1. According the result, number of sprouts per cuttings is highly significant different among the concentrations of IBA while success percentage of cuttings, number of roots per cuttings and length of roots per cuttings is significant difference. The hardwood cuttings treated with 9000ppm IBA had a highest success percentage (67.50) followed by 12000ppm IBA (58.3) and the least (49.2) percentage was observed from control. The findings on Bougainvillea by Bose *et al*. (1968) also reported the similar result in success percentage of cuttings. The maximum number of sprouts per cuttings (4.1) was observed in the treatment 9000ppm IBA and minimum (2.7) in 3000ppm IBA. Singh, 2017 has also reported maximum number of sprouts (7.33) from a treatment of 5000ppm of IBA. Pratima and Rana (2011) have also reported the similar type of result for sprouting in the cuttings. The maximum number of roots per cuttings (14.92) was recorded for 9000ppm of IBA followed by 12000ppm of IBA (11.55). The result agreed with the findings of Koyunce and Senel, 2003. The maximum average length of root (10.65cm) was recorded for 12000ppm of IBA followed by 9000ppm of IBA (8.38cm) and the minimum (6.78cm) from 3000ppm of IBA treatment.

Table 1. Effect of IBA concentrations on success and vegetative performance of hardwood cuttings of Pomegranate

Treatments	Success percentage of cuttings	Number of sprouts per cuttings	Number of roots per cuttings	Length of roots (cm)
3000ppm IBA	51.7	2.7	10.17	6.78
6000ppm IBA	52.5	2.98	10.7	8.03
9000ppm IBA	67.5	4.1	14.92	8.38
12000ppm IBA	58.3	3.32	11.55	10.65
Control	49.2	2.8	9.42	7.93
Mean	55.80	3.18	11.35	8.35
F-test	*	**	*	*
$LSD_{0.05}$	10.94	0.63	3.31	1.99
CV%	12.7	13.00	19.00	15.50

The Figure 1 shows the diameter of the roots, fresh and dry weight of the roots of hardwood cuttings of pomegranate crop. The maximum diameter of the roots (4.13 mm) was observed in 6000ppm of IBA treatment followed by 9000ppm of IBA with (4.10 mm). This finding agrees with the findings of Mahros (2002) in Bougainvillea. The fresh and dry weight of the roots per cuttings was recorded maximum under 9000ppm of IBA with (1.04g) and (0.68g) respectively. The minimum fresh weight of the roots per cuttings (0.96g) and dry weight of the roots per cutting (0.60g) was recorded in control. Mahros (2002) and Kaur and Kaur (2016) have also reported the similar result with respect to the fresh and dry weight of the roots of the cuttings. Owais (2010) has also reported the best concentration of IBA for favourable rooting of the cuttings of pomegranate to be 6000 to 9000ppm.

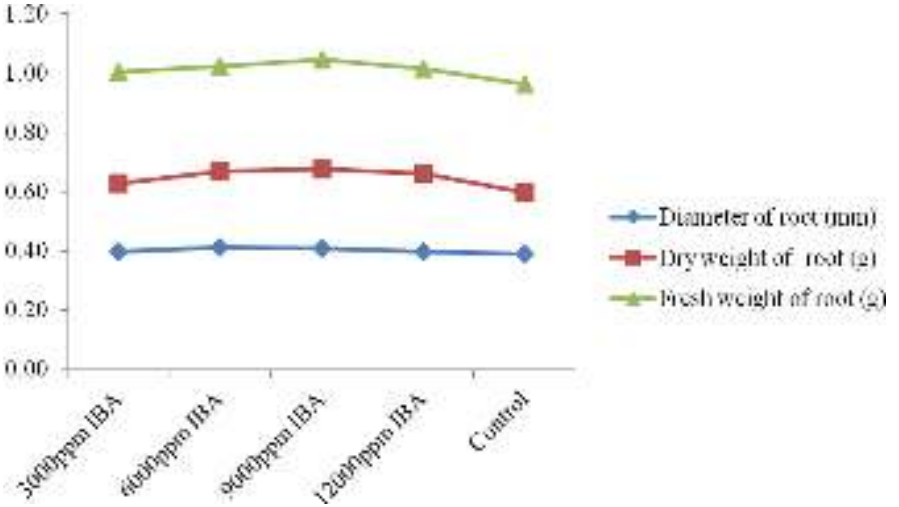

Figure 1: Effect of IBA on diameter of root, fresh weight of root and dry weight of root in pomegranate cuttings

CONCLUSION

The present study signified the difference in the success of the rooting of the hard wood cuttings of pomegranate crop when treated with different concentrations of indole butyric acid (IBA). Among the four concentrations of IBA and a control, IBA with a concentration of 9000ppm showed the best performance. The success percentage of the cuttings, number of sprouts per cuttings, number of roots per cuttings, fresh weight of the roots and dry weight of the roots were recorded maximum in the treatment with 9000ppm concentration of IBA. Hence, it can be concluded that, the treatment with 9000ppm concentration of IBA is better for rooting of hard wood cutting of pomegranate crop.

REFERENCES

Bose, T.K., Singh, P.K. & Bose, S. (1968) Propagation of tropical ornamental plants from cutting under mist. *Indian J. Hort*, 27: 213-217.

Hartmann, H.T., Kester, D.E., Jr. Davies, F.T. & Geneve, R.L. (1997). *Plant Propagation: Principles and Practices*. 6th Edn., Prentice Hall of India Pvt. Ltd., New Delhi, India.

Kaur, S. & Kaur, A. (2016) Effect of IBA and PHB on rooting of pomegranate (*Punica granatum* L.) cuttings cv. Ganesh. *Int. J. Bio. Forum* 8(2): 203-206.

Koyunce, F. & Senel, E. (2003) Rooting of Black Mulberry (*Morus alba* L.) Hard wood cutting. *J. Fruit and ornamental plant Research*. 11: 53-55.

Mahros, O.M. (2002). Rootability and growth of some types of Bougainvilleas cutting under IBA stimulation. *Assiut. J. Agri. Sci*. 31(1): 19-37.

Negi, P.S., Jayaprakasha, G.K. & Jena, B.S. (2003) Antioxidant and anti-mutagenic activities of pomegranate peel extracts. *Food Chem*. 80: 393-397.

Owais, S.J. (2010) Rooting response of five pomegranate varieties to Indole butyric acid concentration and cutting age. *Pakistan J. Bio. Sci*. 13(2): 51-58.

Polat, A.A. & Caliskan, O. (2009) Effect of Indole butyric acid (IBA) on the rooting cutting in various pomegranate genotypes. *Acta. Hortic*. 818: 187-192.

Pratima, P. & Rana, V.S. (2011) Effect of pre-conditioning treatments, IBA and collection time on the rooting of semi- hardwood cuttings of kiwifruit, *Actinidia deliciosa* Chev. *Int. J. Farm Sci.,* 1(2): 30-36.

Saroj, P.L., Awasthi, O.P., Bhargava, R. & Singh, U.V. (2008) Standardization of pomegranate propagation by cutting under mist system in hot arid region. *Indian J. Hort*., 65 (1): 243-250.

Singh, K.R. (2017) Vegetative Propagation of Pomegranate (*Punica granatum* L.) through Cutting- A Review. *Int. J. Curr. Microbiol. App. Sci*., 6(10): 4887-4893.

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Effect of inclusion of sickle pod (*Cassia tora* l.) seed meal in diets on performance of Japanese quail (*Coturnix coturnix Japonica*)

S. Malla[1], M. Sapkota[2], I.C.P. Tiwari[3] and R. Sah[4]
Institute of Agriculture and Animal Science, Tribhuvan University, Nepal

ABSTRACT

A study was conducted at IAAS Livestock Farm, Rampur, Chitwan from June 9 to July 20, 2011 with an aim to find out the effect of inclusion of Sickle pod (Cassia tora L.) seed meal in the diets on the performance of Japanese quail to reduce the cost of production. The experiment was conducted in complete randomized design (CRD) consisting of five treatments, i.e. 0% (T_1), 5% (T_2), 10% (T_3), 15% (T_4) and 20% (T_5) of Cassia tora L. seed meal in diets with three replications having seven birds in each treatment replication. The isocaloric, isonitrogenous diet each containing 2750 ME Kcal/kg and 27% CP was fed to the ten days old chicks ad libitum for thirty-two days. The chemical composition of C. tora seed was found to contain 87.6% DM, 20.51% CP, 13.8% CF, 4.3% EE and 12.6% total ash. Cumulative feed intake of birds in T_2 was significantly higher than T_5 ($P<0.05$), but did not differ from that of T_3 and T_4 ($P>0.05$). The cumulative body weights of birds in T_1, T_2, T_3 and T_4 were significantly higher as compared with T_5 ($P<0.05$). Overall average feed conversion ratio was significantly narrower ($P>0.05$) in T_2 (4.62) than T_5 (5.28). Benefit cost ratio was the highest for T_4 (1.58) and the lowest for T_5 (1.40). C. tora seed meal could be included up to 15% in the diets without any detrimental effect on the performance of Japanese quail.

Key words: *Cassia tora*, Japanese quail, feed intake, body weight, benefit cost ratio

INTRODUCTION

Availability of quality feed at a reasonable cost is a key to successful operation in poultry industry. To sustain in the competitive market, it would be wise to use unconventional feed to the diet formulation to reduce the production cost for poultry. Use of oilseed cakes and industrial byproducts could have better practical importance but due to adoption of genetically modified crops there is need of other unconventional protein source be incorporated in feed (Chadd, 2004) and it needs large experimentation and trial before recommendation to farmers level.

Cassia tora L. also known as taapre, sickle senna or ringworm plant is an annual weed or shrub, widely distributed in the tropical region of the world and in Nepal, it covers moist tropical and sub-tropical region whose seeds are 2 mm in diameter; light grey and cylindrical in shape (Baral and Kurmi, 2006). *Cassia tora* is specifically used in the medicinal purposes from the long time period (Baral and Kurmi, 2006). *Cassia tora* seed contains 21.12% CP, 64.5% NFE, 7.73% EE, 16.64% DCP, 59.4%TDN, 5.56% total ash, 0.87% calcium and 0.72% Phosphorous (Banerjee, 2004). In some preliminary research *Cassia* seed have been safely incorporated upto 10% in animal feed without affecting animal health and performance (Sood *et al.,*1990).

Quail is a poultry species that is easy to rear, do not need large amount of capital and can be kept in empty areas around the house by family members with fast return within six weeks time. Moreover, they require less amount of feed (780 gm-1 kg) than broilers and are more resistant to diseases. They are also fast growing birds; day-old chicks matured at 4 weeks period for table purpose and lay eggs in 36 days of age (Osti, 2002).

In the present study, an attempt has been made toassess the potential of including *Cassia tora* L. seed meal in diets on the performance of Japanese quail.

MATERIALS AND METHODS

The experiment was conducted at livestock farm of Institute of Agriculture and Animal Science (IAAS), Rampur, Nepal from June to July, 2011 to study *Cassia tora* L.as a feed ingredient in Japanese quail ration. The experiment was started with 10 days old quail chicks and continued upto 42 days of age. The experiment was laid out in Completely Randomized Design (CRD) with five dietary treatment groups (T_1, T_2, T_3, T_4 and T_5) and three replications. Each dietary treatment group consists of 21 chicks distributed in three replicated pens (R_1, R_2 and R_3) with seven chicks in each. The layout of experiment is shown in table 1.

Table 1: Layout of experiment

Dietary treatments	Number of birds per replication			Total number of birds
	R_1	R_2	R_3	
T_1	7	7	7	21
T_2	7	7	7	21
T_3	7	7	7	21
T_4	7	7	7	21

T_5	7	7	7	21
Grand total				105

T_1 = 0% inclusion of *Cassia tora* seeds in diets, T_2 = 5% inclusion of *Cassia tora* seeds in diets, T_3 = 10% inclusion of *Cassia tora* seeds in diets, T_4 = 15% inclusion of *Cassia tora* seeds in diets, T_5 = 20% inclusion of *Cassia tora* seeds in diets

Experimental starter/grower quail diets were prepared which include *C. tora* L. seed meal excluding the basal diets. Nutrient levels of the diets were adjusted in accordance with NRC (1984) feeding standardizing the computer based feed formulation program (WINFEED 2.8, 2010). The composition of the diets in the experiment is shown in Table 2.

Table2: Percentage of ingredients composition of Japanese quail starter/grower diets

Feed ingredients	T_1	T_2	T_3	T_4	T_5
Maize	41.05	35.6	29.61	23.74	17.43
Rice polish	5.38	6.03	6.56	7.04	7.75
De-oiled cake (DOC)	0.50	1.54	3.38	5.58	6.41
Cassia tora seed	0.00	5.00	10.00	15.00	20.00
Soya cake	41.81	39.03	36.03	33.00	30.06
Molasses	0.50	0.50	1.01	1.15	2.64
Meat and bone meal	5.00	5.00	5.00	5.00	5.00
Calcium dust	1.06	1.46	1.34	1.22	1.08
Vitamin + minerals	0.04	0.04	0.04	0.04	0.04
DL methionine	0.03	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00

T_1 = 0% inclusion of *Cassia tora* seeds in diets, T_2 = 5% inclusion of *Cassia tora* seeds in diets, T_3 = 10% inclusion of *Cassia tora* seeds in diets, T_4 = 15% inclusion of *Cassia tora* seeds in diets, T_5 = 20% inclusion of *Cassia tora* seeds in diets

The experimental quails were managed properly including housing environment, providing floor space, feeder and waterier space, litter management, sanitation and medication.

RESULTS AND DISCUSSION

Chemical composition of *Cassia tora* seed

The chemical composition of *C. tora* seeds and roasted *C. tora* seeds were analyzed in the laboratory and the result is presented in the Table 3. The results showed that the chemical composition of *C. tora* seed changes with roasting. The DM and CF percentage of the seeds increases with roasting whilst the CP content, EE and total ash decreases on roasting.

Table 3: Analyzed chemical composition of *C.tora* seeds and roasted *C. tora* seeds used in the diets

	DM %	CP %	CF %	EE %	TA%
C. tora seeds	87.6	20.51	13.8	4.3	12.6
Roasted *C. tora* seeds	91.6	18.28	14.4	3.2	11.8

DM= Dry matter, CP= Crude protein, CF= Crude fiber, EE= Ether extract, TA= Total ash

The findings of chemical composition of *C. tora* seed through proximate analysis was well supported by the findings of Sigh (1964), Gohl (1975) and Taparia *et al.* (1978).The CP content was found slight higher than that found by Siruguri *et al.* (2009) and Yen *et al.*(1998) which was 17.8 and 17.7 percentage respectively. The percentage of CF and EE found was well supported by findings of Siruguri *et al.* (2009) which was 13.6 % and 6.0 %.

Feed consumption, growth and feed conversion ratio

Inclusion of 5% *C. tora* significantly increased the feed intake than any other higher inclusion percentage. However, it was statistically similar to the control diet. Inclusion of *C. tora* had no influence on feed intake up to 15%, but inclusion of 20% significantly reduced the feed intake than control diet. Lower feed intake with increased amount of *C. tora* seed in the diets may be due to the presence of tannins and saponins in the seed which resembles the results by Katoch *et al.*(1978).

Table 4: Effect of *C. tora* seeds in diets on performances of Japanese quailsat Rampur, Chitwan during 2011

Treatments	Feed intake	Final Body Weight	Feed Conversion ratio
T_1 = 0% inclusion of *C. tora* seed	680.94 ± 3.08^{ab}	147.14 ± 5.67^{a}	4.63 ± 0.19^{b}
T_2 = 5% inclusion of *C. tora* seed	688.44 ± 8.58^{a}	149.09 ± 4.02^{a}	4.62 ± 0.09^{b}
T_3 = 10% inclusion of *C. tora* seed	674.68 ± 4.31^{bc}	142.38 ± 2.97^{a}	4.74 ± 0.08^{b}
T_4 = 15% inclusion of *C. tora* seed	672.58 ± 3.38^{bc}	145.24 ± 0.82^{a}	4.63 ± 0.03^{b}
T_5 = 20% inclusion of *C. tora* seed	666.95 ± 3.78^{c}	126.43 ± 3.98^{b}	5.28 ± 0.14^{a}
F-value	8.009^{**}	16.805^{**}	16.893^{**}
CV %	0.75	2.70	2.49
$LSD_{0.05}$	9.18	6.980	0.2153
SEM	2.91	2.22	0.014

Means in column with different superscripts differ significantly ($p<0.05$).

LSD= Least significant difference, CV= Coefficient of variation, SEM= Standard error of mean, NS, not significantly different; * significant at 5% level of significance; ** significant at 1% level of significance.

Inclusion of *C. tora* up to 15% gave similar body weight as control diet; however, increased inclusion of 20% significantly reduced the final body weight as compared to other treatments. The present results are well supported by the findings of Singh *et. al.* (2001) who recorded increased body weight gain in all *C.tora* fed up to 15%. The non significant difference in body weight gain in control diet and 10% inclusion of *C. tora* seed meal on the diets are in the agreements with findings of Murty and Iyer (1957).

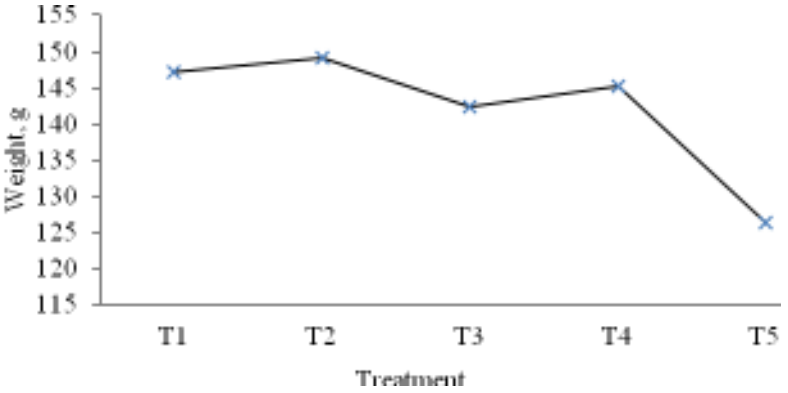

Figure 1: Trend of final body weight of Japanese quail under different level of *C. tora* seed meal included in their diets

Figure 1 shows that, weight was significantly difference with inclusion of different level of *C. tora* seed meal in Japanese quail diets. It was found slight increased in 5% inclusion of *C. tora* seed meal but sharply decreased with 20% inclusion of *C. tora* seed. Feed conversion ratio was significantly higher in 20% C. tora inclusion in quail diet as compared to all other treatments. The remaining treatments were statistically similar, showing no differences in feed conversion ratio up to 15% inclusion as compared to control diet. The feed consumption was higher on 20 percent inclusion of *C. tora* seed meal in diets due to higher level of feed consumption than weight gain.The present result was well supported by the findings of Singh *et al.* (2001) who reported the lower feed conversion ratio in *C. tora* fed groups with lowest in 5% inclusion in broiler diets.

Economics of quail production

Except feed cost, other cost was constant and feed cost was only factor that differ the total production cost of Japanese quail. Economic analysis of Japanese quail under different level of *C. tora* seed meal included in the diets is presented in Table 6. The production cost per kg starter/ grower diets was maximum (Rs. 29.61) for T_1 and inclusion of *C. tora* seed in the diets had gradually decreased the production cost with minimum (Rs. 24.43) for T_5 as *C. tora* is an unconventional feedstuffs and the price per

kg was lower than other feed ingredients used. Cost of production per bird was high in T_1 (Rs. 58.01) and low in T_5 (Rs. 54.14). The net income per bird was maximum (Rs. 32.17) on T_2 and minimum (Rs 21.71) on T_5. However, benefit/cost (B/C) ratio was high for T_4 (1.58) than T_2 (1.56) and low benefit/cost ratio was recorded on T_5 (1.40).

The results showed that the inclusion of *C. tora* seed meal in the diets of Japanese quail decreases the cost of production of starter/grower diets; thus were more profitable than basal diets. However, higher percentage of inclusion decreases the benefit/cost ratio.

Table 5. Economic analysis of Japanese quail under different level of *C. tora* seed meal included in the diets at IAAS, Rampur, 2011

Particulars	Treatments				
	T_1	T_2	T_3	T_4	T_5
Cost of starter/ grower feed/kg, Rs	29.61	28.22	26.96	25.69	24.43
Cost of production/bird, Rs	58.01	57.28	56.04	55.13	54.14
Income/bird, Rs	82.27	89.45	85.42	87.14	75.85
Net income/bird, Rs	24.26	32.17	29.38	32.01	21.71
Benefit/cost (B/C)	1.41	1.56	1.52	1.58	1.40

T_1= 0% inclusion of *C. tora* seed, T_2= 5% inclusion of *C. tora* seed, T_3= 10% inclusion of *C. tora* seed, T_4= 15% inclusion of *C. tora* seed and T_5= 20% inclusion of *C. tora* seed

CONCLUSION

Feed intake, final bodyweight and feed conversion ratio was highest in 5% inclusion of *C. tora* seed meal in the diets. However, the total body weight, total feed intake and feed conversion ratio are non significant among control diet and diet containing 15% *C. tora* seed meal, and benefit cost ratio was highest for 15% *C.* tora included meal, *C. tora* seed could be included up to 15 % of the total feed in Japanese Quail diet.

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REFERENCES

Banerjee, G. C. (2004) *A textbook of animal husbandry*. (8th ed.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India. 636 p.

Baral S. R. and Kurmi, P. P. (2006) *A compendium of medicinal plants of Nepal*. IUCN, Kathmandu. 372 p.

Chadd, A. S., Davies, W. P. and Koivisto, J. M. (2008) Practical production of protein for food animals. *Protein sources for the animal feed industry*. FAO, Italy, Rome. 72 p.

Katoch, B. S., R. C. Katoch, N. C. Mahajan and K. B. D. Bhowmik. 1978. Utilization of Indian horse-chesnut (*Aesculus indica*) kernals and wild isbgol (*Plantago lanceolata*) plant-meal as poultry feed ingredients. Indian Veterinary Journal 55: 781-87.

National Research Council. (1984) *Nutrient requirements of poultry* (8th ed.). National Academy Press. Washington D.C., USA. 230 p.

Osti, N. P. 2002. Supplementation of methionine and lysine in locally available feed ingredient based diets on the performance of broiler chicken and quail. Unpublished Thesis, M. Sc. (Animal Science), Tribhuvan University, Nepal. 72 p.

Sigh, N. (1964) Leaf protein extract from some plants of North India. *Journal of Food Science and Technology* 3: 37-39.

Singh, J., R. Kumar and Yadav, R. K. (2001) Impact of feeding chakwar (*Cassia tora*) seed on growth and meat production in broilers. *Indian Journal of Poultry Science*. 36(3): 308-310.

Siruguru, V., C. Ganguly and R. V. Bhat. 2009. Utilization of mouldy sorghum and *Cassia tora* through fermentation for feed purpose. African Journal of Biotechnology 8(22): 6649-6654.

Sood, A. K., Sharma, M. and Katoch, B. S. (1990) Improvement in the nutritive value of Indian horse-chesnut kernel and cassia seeds by chemical treatments for feeding of chicks. *Indian Journal of Animal Sciences.* 60(11): 1364-1369.

Yen G., Chen, H. and Duh, P (1998) Extraction and identification of an antioxidative component from Jue Ming Zi (*Cassia tora* L.). *Journal of Agricultural Food Chemistry*. 46:820-824.

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Effect of sowing dates on yield and yield components of different wheat varieties

M. Yadav[1], M. Wasti Devkota[2], S. K. Sah[3] and R. Bhatt[4]
[1]NWRP, Bhairahawa [2], CIMMYT, Kathmandu, [3] AFU, Rampur and [4]PAU, Ludhiana, India
mathura_03@yahoo.com

ABSTRACT

A field experiment was conducted in split plot design comprised of three sowing times allotted to main plot starting on 5th November, 25th November and 10th December and three wheat varieties Vijay, NL971 and BL4316 were to sub plot with three replications at National Wheat Research Program, Bhairahawa, Rupandehi, Nepal during 2015 and 2016 with main objective to find out effect of sowing dates and varieties on grain yield. Data on yield and yield attributes collected and analyzed using Genstat statistical package. During 2015, days to maturity, 1000 grains weight, total biomass, grain yield and harvest index variables were significantly difference but spikes m^{-2} and grains per spike were not significant in different sowing dates. Higher grain yield was obtained when crop sown on 5th and 25th November than 10th December sowing but two dates of November sowing were not significant for grain yield. All variables were significantly different in three wheat varieties. NL971 produced higher grain yield than Vijay and BL4316. Similarly in during 2016, , days to maturity, 1000 grain weight variables were significantly difference but spikes m^{-2}, grains per spike, total biomass, grain yield and harvest index were not significant in different planting dates. November 5th and 25th sowing dates recorded higher yield than 10th December sowing date but these three dates were at par. All variables were statistically different in Vijay, NL971 and BL4316 wheat varieties. NL971 produced higher grain yield than rest two varieties. Based on two years combine result it could be concluded that yield reduced significantly if wheat sowing goes beyond November. NL971(3753 kg ha^{-1}) was found high yielding variety followed by BL4316 (3565 kg ha^{-1}) and Vijay (3243 kg ha^{-1}) and highest grain yield recorded in NL971 at 5th, 25th November and 10th December sowing dates.

Key Words: Sowing dates, varieties, interaction, grain weight, yield

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the third important cereal after rice and maize in Nepal. It plays an important role in national food security. It is grown in the Terai, mid hill and high hills during the winter season. Wheat covers nearly 0.75 million hectare in Nepal (MoAD, 2016). Total production of wheat in Nepal is 1.81 million ton with 2.404 ton ha^{-1} average productivity. Among various factors responsible for low yield of wheat crop, sowing time and varietal selection are of key importance. Wheat is sown in winter and it has its own definite requirements for temperature and light for emergence, growth and flowering (Dabre *et al.,* 1993). Too early sowing produces weak plants with poor root system as the temperature is above optimum. Temperature above optimum leads to irregular germination and the embryo frequently dies and the endosperm may undergo decomposition due to activities of bacteria or fungi. Late planting results in poor tillering and crop grow generally slow because of low temperature. In late planting the wheat variety should be short duration that may escape from high temperature at the grain filling stage (Phadnawis and Saini, 1992). Wheat planting on December 5^{th} and 20^{th} caused 45 and 60 kg day-1 ha-1 yield loss respectively (Annual report, (2006), NWRP, Bhairahawa,). Many high yielding varieties have been evolved and recommended for general cultivation in the country. These varieties are loosing their yield potential due to changes in various edaphic and environmental conditions. Therefore, it is essential to evaluate newly developed wheat genotypes at different sowing dates to increase production and productivity in the country. Keeping these in view, the present study was therefore, designed to determine the effect of sowing dates on growth and yield of different wheat varieties at National Wheat Research Program, Bhairahawa, Rupandehi, Nepal.

MATERIALS AND METHODS

Experiment was laid down in split plot design with three replications. Three sowing dates, 5^{th} & 25^{th} November and 10^{th} December were allotted to main plot and three wheat varieties, Vijay, NL971 and BL4316 were to sub plot. Plot size 4X3 m^{-2} was maintained with 25 cm spacing. Chemical fertilizers were applied @ 100:50:50 N: P_2O_5:K_2O kg ha^{-1}. The soil texture of experimental plots was silt loam with 8.0 pH, low organic matter (1.35 %), low N% (0.08%), medium available phosphorus (53.21 kg ha^{-1}), and medium potash (119.42 kg ha^{-1}) .Two time irrigation was applied at crown root initiation and flowering stage. Sulfosulfuron @ 30gm ha^{-1} herbicide was applied to control weed populations in all experimental plots at 35 days after sowing (DAS). Data on yield and yield attributes were collected and analyzed using Genstat statistical packages in 2015 and 2016 both years.

RESULTS AND DISCUSSION

a. Effect of sowing dates

Combine result of 2015 and 2016, different sowing dates on yield and yield components revealed that except grains spike and harvest index; rests of variables were significant in different sowing dates (Table 1, 2 &3). Sowing done at 5th November (128 days) date took statistically more days to mature followed by 25th (119 days) November and 10th December (112 days). Spikes m^{-2} produced at 25th November (290 m^{-2}) and 10 December (285 m^{-2}) sowing date were not significant with each other but superior over 5th November (266 m^{-2}) sowing date. Might be due to temperature was not according to the tillering requirement which results in less number of spikes m^{-2} (Tahir, *et al*, 2009). December 10th sowing had recorded lower number of grains per spike than November sowing. Less number of grains per spike in late sowing was due to less production of photosynthates due to shorter growing period. These results are similar with those of Shahzad *et al*., (2002). 1000 grains weight was significantly highest in 5th November (47 gm) sowing date followed by 25th November (43 g) and 10th December (42 g). The early sowing resulted in better development of the grains due to longer growing period. These findings are strongly supported by those of Spink *et al*., (2000) and Shahzad *et al*. (2002) who had also reported decreased 1000-grain weight with delay in sowing. Similarly, Qasim *et al*. (2008) reported that delay sowing shortens the duration of each development phase which to leads to reduces grain filling period and lowers the grain weight. Total biomass and grain yield variables were not significant at 5th (9185 kg ha^{-1}) & (3673 kg ha^{-1}) and 25th (8806 kg ha^{-1}) & (3680 kg ha^{-1}) November sowing dates but these two sowing date were significant over 10th December (7895 kg ha^{-1}) & (3208 kg ha^{-1}) respectively. Shah et. al, 2006 also reported that 1st November sowing date produced more grain yield and total biological yield than rest of sowing dates. Significantly highest harvest index was recorded in 25th November sowing than 10th December and 5th November sowing dates.

b. Effect of varieties

Due to genetic diversity in different varieties showed varying response on yield and yield components. Combine result during 2015/2016 revealed that days to maturity, spikes m^{-2}, grains per spike, 1000 grains weight, total biomass, grain yield and harvest index variables were significant in different tested wheat varieties (Table-1, 2 &3). NL971 (122 days) was statistically found as late maturing variety than BL4316 (119 days) and Vijay (118 days) NL971 (309 m^{-2}) produced statistically higher spikes m^{-2} than Vijay (273 m^{-2}) and BL4316 (258 m^{-2}) and Vijay was also significantly superior over BL4316 in spikes m^{-2}. Differences in number of tillers m^{-2} among varieties might be attributed to their genetic diversity. These results are in accordance with those of Aslam *et al*., (2003), Khaliq (2004) and Shah *et al*., (2006). NL971 (42 grains) and BL4316 (44 grains) were comparable but both varieties had significantly higher grains per spike than Vijay (32 grains). Differences in number of grains per spike among varieties might be attributed to their genetic variability. These results are similar those reported by Haider (2004). 1000

grains weight was higher in Vijay (48 g) followed by NL971 (43 g) and BL4316 (41 g).

Treatments	Days to maturity			Spikes (m2)			Grains/spike		
Date of planting									
Year	2015	2016	Combined	2015	2016	Combined	2015	2016	Combined

These results are in accordance with those of Spink *et al.,* (2000) and Aslam *et al,* (2003). NL971 recorded statistically higher grain yield (3753 kg ha^{-1}) and total biomass (9886 kg ha^{-1}) than BL4316 (3565 kg ha^{-1}) & (8275 kg ha^{-1}) and Vijay (3243 kg ha^{-1}) & (7725 kg ha^{-1}) respectively. It might be due to higher spikes per unit area and 1000 grains weight contributed to grain yield and total biomass. Similar result was reported by Jain *et al.* (1992). Highest harvest index was found in BL4316 followed by Vijay and NL971.

5th Nov	130	126	128	260	271	266	41	40	41
25th Nov	118	119	118	304	276	290	39	39	39
10th Dec.	112	112	112	280	290	285	39	37	38
P- value	<0.001	<0.001	<0.001	0.105	0.545	0.015	0.240	0.454	0.135
LSD (P= 0.05)	1.77	1.62	0.756	41.84	45.6	13.3	2.93	5.72	2.48
Varieties									
Vijay	117	118	118	277	273	275	33	31	32
NL971	123	121	122	305	309	307	42	42	42
BL4316	119	119	119	262	255	258	45	44	44
P-Value	<0.001	0.001	<0.001	0.028	<0.001	0.002	<0.001	<0.001	<0.001
LSD(P= 0.05)	1.14	1.47	0.957	30.56	18.03	17.25	5.08	3.47	2.56
CV%	1.2	1.8	1.6	15.4	13.7	14.7	20	17.5	18.2

Table 1. Effect of sowing dates on yield components (2015 & 2016)

c. Interaction of sowing dates and varieties

Interaction was significant between sowing dates and varieties. Statistically NL971 produced higher grain yield than BL4316 and Vijay at 5th and 25th November sowing dates. Jain et al, 1992 also reported similar result. Yield recorded in BL4316 was significantly higher than Vijay at both dates of November sowing. Similarly NL971 gave higher yield than BL4316 and Vijay but yield was not significant between NL971& BL4316 at 10th December sowing date. Yield obtained in Vijay was statistically inferior to other two varieties at 10th December sowing date. 25th November sowing date produced higher grain yield and significant over 10th December sowing but yield difference was not significant between 5th & 25th November sowing date in Vijay variety. NL971 produced significantly higher grain at 5th and 25th November sowing than 10th December sowing. Similarly 5th and 25th November sowing were not significant but statistically superior over 10th December sowing in BL4316 (Figure 1 & Table 4).

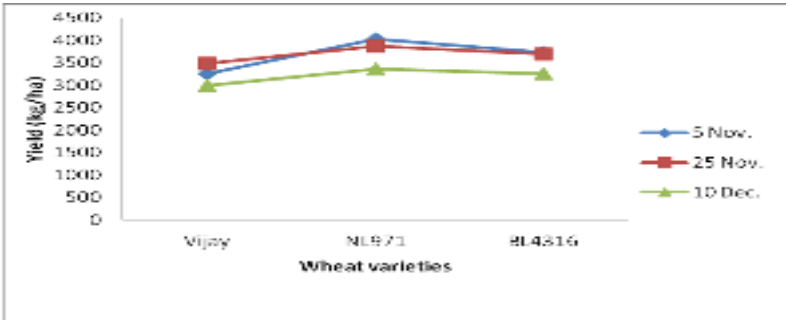

Figure1: Interaction of sowing dates and varieties on yield during 2015/2016

Table 2: Yield and yield attributes influenced by sowing dates and wheat varieties (2015 and 2016)

Treatments	1000 grains wt.(g)			Total biomass (kg ha^{-1})			Grain yield (kg ha-1)		
Date of Planting									
Year	2015	2016	Combined	2015	2016	Combined	2015	2016	Combined
5th Nov	43	52	47	10148	8222	9185	3736	3610	3673
25th Nov	41	46	43	9266	8346	8806	3701	3659	3680
10th Dec.	38	45	42	8056	7735	7895	3087	3329	3208
P- value	0.002	0.006	<0.001	0.002	0.524	0.004	0.003	0.423	0.010
LSD(P= 0.05)	1.71	2.8	1.39	654.5	1451.4	488.4	243.8	675.7	255
Varieties									
Vijay	44	52	48	8025	7426	7725	3152	3335	3243
NL971	40	47	43	10679	9093	9886	3784	3721	3753
BL4316	37	44	41	8765	7784	8275	3588	3541	3565
P-Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
LSD(P= 0.05)	1.4	2.05	1.78	273.5	391.5	293.6	122.4	169.3	99.2
CV%	4.3	5.8	5.7	6.6	10.6	9	7.4	13.1	11

Table 3: Harvest index as influences by sowing dates and wheat varieties

Treatments	Harvest index (%)		
Date of Planting			
Year	2015	2016	combine
5th Nov	37.29	44.09	40.69
25th Nov	40.06	44.05	42.06
10th Dec.	38.48	43.12	40.8
P- value	<0.001	0.42	0.057
LSD(P= 0.05)	0.63	2.1	1.17
Varieties			
Vijay	39.3	44.95	42.12
NL971	35.61	40.93	38.27
BL4316	40.93	45.39	43.16
P-Value	<0.001	<0.001	<0.001
LSD(P= 0.05)	1.18	1.51	0.89
CV%	3.6	6.5	5.3

Table 4: Interaction of sowing dates and wheat varieties on yield (2015 /16)

Treatments	Grain yield (kg ha^{-1})		
	Vijay	NL971	BL4316
5th November	3251	4030	3737
25th November	3478	3863	3699
10th December	3001	3365	3258
P- value			0.019
LSD (P=0.05) (For comparing sub at same level of main treatment			171.8
LSD (P=0.05) (For comparing main at same or different level of sub treatment			257.3

CONCLUSION

Based on two years result it could be concluded that November planting is best for optimum grain yield and if wheat planting goes beyond November leads to significant yield reduction. NL971 was found higher yielding variety than BL4316 and Vijay. NL971 recorded higher grain yield at 5th, 25th November and 10th December sowing dates.

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REFERENCES

Aslam, M., Hussain, M., Akhtar, M., Cheema, M.S. and Ali, L. (2003). Response of wheat varieties to sowing dates. Pak. J. Agron., 2003, 2(4): 190-194.

Dabre. W.M., Lall, S.B. and Lngole, G.L. (1993) Effects of sowing dates on yield, ear number,stomatal frequency and stomatal index in wheat. *J. Maharashatra Agri. Univ*., 18: 64-66.

Haider, R.S. (2004) *Growth and yield response of three wheat varieties to N alone and in combination with P and P+K under late sown conditions*. M.Sc. (Hons.) Agri.Thesis, University of Agriculture, Faisalabad, Pakistan.

Jain, M.P., Dixit, J. P., Pillai, P.V.A. and Khan, R.A. (1992) Effect of sowing date on wheat varieties under late sown irrigated condition. *Indian J. Agric. Sci.* 62:669-671.

Khaliq, D. (2004) *Modeling the growth, radiation use efficiency and yield of wheat under different sowing dates and varying nitrogen levels under rainfed conditions.* M.Sc. (Hons.) Thesis, University of Agriculture, Faisalabad-Pakistan.

MoAD (2016) *Statistical Information on Nepalese Agriculture,* Agri-Business Promotion and statistical Division

NWRP (2006) *Annual report*. National Wheat Research Program, Bhairahawa, Rupandehi, Nepal

Phadnawis, B.N. and Saini. A. D. (1992) Yield models in wheat based on sowing time and phenological developments. *Ann. Pl. Physio.* 6: 52-59.

Qasim, M., Qamer, M, Faridullah and Alam, M, (2008) Sowing date effect on yield and yield components of different wheat varieties. *J. Agric. Res.* 46(2), 135-140.

Shah, W.A., Bakht, J., Ullah, T., Khan, A.W., Zubair, M. and Khakwani, A. (2006) Effect of sowing dates on yield and yield components of different wheat varieties. *J. Agron.,* 5(1), 106-110.

Shahzad, K.., Bakht, J., Shah, W.A., Shafi, M. and Jabeen, N. (2002) Yield and yield components of various wheat cultivars as affected by different sowing dates. *Asian J. PI. Sci.,* 1(5), 522-525.

Spink, J.H., Semere, T., Sparkes, D.L., Whaley, J.M., Foulkers, M.J., Clare, R.W. and Scott, R..K. (2000) Effect of sowing date on plant density of winter wheat. *Ann. App. Biol*., 137: 179-188.

Tahir, M.A., Ali Nadeem, M A., Hussain, A. and Khalid, F. (2009) Effect of Different Sowing Dates on Growth and Yield of Wheat (*Triticum aestivum* L.) Varieties in District Jhang, Pakistan,. *Pak. J. Life Soc.Sci.* 7(1):66-69.

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Performance of Boer x Khari crosses at goat research station, Bandipur

R. Kadel, S. Malla and D. P. Adhikari
Goat Research Station, Bandipur, Tanahun
raju_kadel@yahoo.com

ABSTRACT

A study was conducted in Goat Research Station, Bandipur to evaluate the performance of Boer x Khari cross kids. A total of 74 kids born on FY 2072/73 were used for the analysis of mean of birth weight, weaning weight, eight month weight and twelve month old weight. Out of all born F1 kids, 38 kids were male and 36 kids were female and the kid mortality rate was 26.38%. The birth weight for Boer x Khari cross kids were 2.24 ± 0.42 kg for male and 2.03 ± 0.56 for female kids. The mean body weight at weaning, eight month and twelve month weight were 7.62 ± 1.37 kg, 17.28 ± 1.37 kg and 27.38 ±1.24 kg respectively. The body weight gained from birth to weaning, weaning to twelve month and birth to twelve month were 45.75, 82.33 and 69.18 gmday^{-1} respectively. From the study, it can be concluded that the Boer x Khari kids may have better growth performance with improved genetic selection, feeding method and management system.

Keywords: Boer, Growth performance, Weaning, Twelve Month, Weight

INTRODUCTION

Livestock is an important and integral component of agriculture in Nepal as it provides the animal protein for growing human population. Goats have great role in economy of the farming community, especially the small-holders farmers in Nepal. Small ruminants are particularly vital livestock for supporting food security because of their high reproductive capacity and low initial investment suiting them for resource poor farmers (Deribe, *et. al*., 2015). Khari**,** one of the principle breed of goat in the country which is available across the hills and represents 56 % of the total goat population and known for their high prolificacy and wider range of adaptability (Oli, 1987 and Neopane, 1997) and are reared on poor nutritional regime without supplementation. On the other hand, Boer is considered to be one of the most desirable goat breed for meat production and has gained worldwide recognition for excellent body confirmation, fast growing rate and good carcass quality (Lu, 2001). Boer breed can improve productive performance of many indigenous breed through crossbreeding.

MATERIALS AND METHODS

Study area

This study was conducted at Goat research station, Bandipur of Tanahun district which is located 135km from capital city Kathmandu, at an altitude of 850 masl and at 27˚56'48"

N and 84˚25'4"E. The mean annual temperature is 21.01˚C and annual rainfall is 340.8mm with average relative humidity of 74.65%.

Animal Management
Animals were kept in farm managed condition of GRS with seasonal mix fodder mainly provided in groups during evening and grazing of Khari goats for atleast 5 hours. They were also provided with concentrate mixture @ 1% of b. wt. on an average during morning and after grazing and free access to drinking water. All flocks were dewormed and dipped for internal and external parasites and vaccinated against PPR and FMD.

Study animals
This study was performed in FY 2072/73 of GRS, Bandipur. A total number of 74 kids were produced from the breeding Khari does served with boer bucks, among which 38 are male kids and 36 are female. Kids were allowed with their dams in nursing pen for 4 months before weaning.

Measurements and Observations
Birth weight (BW), weaning weight (WW), eight month weight (EMW) and twelve month old weight (Y) were recorded in morning before feeding and watering. All weight measurement except BW were taken at monthly interval by Honda electronic weighing balance capacity 200 kg and 200 gm precision.

Statistical analysis
All data collected was analysed by using Statistical Package for Social Science (SPSS) version 16.0 for windows. For qualitative factors, descriptive statistics were used. Standard error of mean (SE) was used while describing mean.

RESULTS AND DISCUSSION

Pre-weaning kid mortality of Boer x Khari cross
The experiment kids were considered of FY 2072/73 of GRS, Bandipur of which total 74 kids were born from 43 does at kidding rate of 1.72 kids/doe and out of all born F1 kids, 38 were male and 36 kids were female respectively. Until weaning, 23 kids died at mortality rate of 31.08% which is slightly higher than the mortality rate of Khari (25.9%) reported by Rasali and Khanal (2002) and Khanal *et. al.*, (2005).

Birth weight, weaning weight and pre-weaning growth rate
The birth weight of Boer x Khari cross kids were 2.24 kg for male and 2.03 kg for female respectively which is lower than the birth weight of Boer kids ranging from 3 to 4 kg with male kids weighing about 0.5 kg heavier than female (Lu and Potcoiba, 1988) but resembles the birth weight of Khari kids (2.013 for male and 2.158 kg for female) reported by Rasali and Khanal, 2002. Heavier birth weight of male is supported by findings of Neupane and Sainju (1995) and Upreti and Mahato (1995).

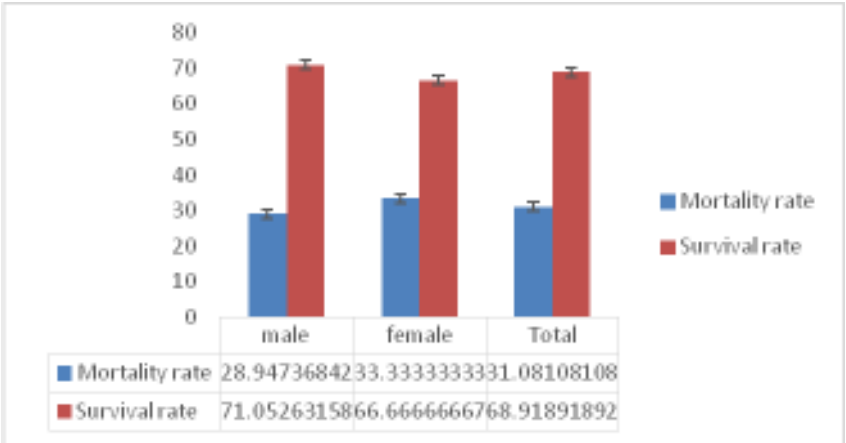

Figure 1: Pre-weaning kid mortality rate of Boer x Khari cross

The overall mean of weaning weight of Boer x Khari cross kids varies by sex which is 8.25 kg for male and 7.00 kg for female kids respectively (Table 1) which is similar with Boer x Central highland cross kids (9.02 ± 0.18 kg) reported by Deribe and Taye (2013) however significantly lower than pure Boer weaning kids which is 25 kg (Lu and Patcoiba, 1988). The kids have lower birth weight and weaning weight which might be a result of feed shortage and low protein feed supplied to does due to earthquake and blockade in 2072 with insufficient milk to the kids.

Table 1: Birth weight, weaning weight and body weight gain of Boer x Khari Cross kids in GRS, Bandipur
(Mean ± SE)

Sex	Birth weight (kg)	Weaning weight (kg)	Body weight gain/day (g/day)
Male	2.24 ± 0.42	8.25 ± 1.50	50.08
Female	2.03 ± 0.56	7.00 ± 1.22	41.41
Total	2.13 ± 0.49	7.62 ± 1.37	45.75

The overall mean of pre weaning kids daily weight gain is also presented in Table 1. Pre weaning weight gain obtained 45.75 $gmday^{-1}$ is similar to Khari goats raised under traditional management system, but lower than Boer x Arsi Bale cross kids (173.83± 6 $gmday^{-1}$) reported by Debele *et. al.* (2015). The difference in pre weaning weight gains

are closely associated with difference in level of milk intake during milk feeding period and the nutritional status of the doe (Negi *et. al.*, 1987). The pre weaning growth rate of Boer x Khari cross kids were affected by sex, male kids weight gain is better than female (50.08 $gmday^{-1}$ vs 41.41 $gmday^{-1}$), which is in agreement with report of other scholars (Belay and Mengisite, 2013), but argue with report of Rasali and Khanal (2002).

Twelve month weight and post weaning growth rate

The overall mean of eight month weight and twelve month weight of Boer x Khari cross goats were 17.28 ± 1.37 kg and 27.38 ± 1.24 kg respectively, which is higher than nine month weight and twelve month weight of Khari (14.19±0.87 kg and 18.84±1.09 kg) reported by Khanal *et al.* (2005). The mean of post weaning body weight gain per day and overall body weight gain per day from birth to one year old was found 82.33 $gmday^{-1}$ and 69.18 $gmday^{-1}$ respectively which is comparatively higher than findings of Deribe *et al.*, 2015 (33.01±0.77) $g.day^{-1}$ at one year of Boer x Central highland cross). The post weaning weight of Boer x Khari cross kids varies by sex, but is increased in respect to pre weaning body weight gain.

Table 2: Body weights and gain of Boer x Khari Cross at different ages at GRS, Bandipur

Sex	Eight month weight (kg)	Twelve month weight (kg)	Post weaning Body weight gain/day (g/day)	Overall body weight gain/day from birth to a year age (g/day)
Male	17.89 ± 1.32	28.92 ± 1.49	86.12	73.09
Female	16.68 ± 1.46	25.85 ± 1.29	78.54	65.26
Total	17.28 ± 1.37	27.38 ± 1.24	82.33	69.18

CONCLUSION

From this study, it can be concluded Boer x Khari cross kids have better growth performance at mid hills of Nepal. The significant effect of sex at different ages indicates potential of the breed for better productivity under improved management system. Moreover, continuous improvement in genetic selection, feeding method and management system may contribute to even faster growing rate in Boer crosses in future.

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The authors sincerely acknowledge Nepal Agriculture Research Council (NARC) for funding. The support of Goat Research Station (GRS) staffs during data collection period is highly appreciated.

REFERENCES

Debele, S., Habta M., Yinessu, A. and Admassue, B. (2015) Pre Weaning Performance of Boer Cross with Local Goat in Gedio Zone, Ethiopia. *International Journal of Agricultural Sciences and Veterinary medicine.* 3 (3),14-20

Deribe , B. and Taye, M. (2013) Growth Performance and Carcass Characteristics of Central Highland Goats in Sekota District. *Agricultural Advances,*2 (8), 250-258.

Deribe, B., Tilahun, M., Lakew, M., Belayneh, N., Zegeye, A., Walle, M., Ayichew, D., Ali, S.T. and Abriham ,S. (2015). On Station Growth Performance of Crossbred goats (Boer x Central highland) at Sirinka, Ethiopia. *Asian Journal of Animal Sciences*. 9 (6), 454-459.

Khanal, R. C., Rasali, D. P., Dhaubhadel, T.S., Joshi, B. R. and Karki, N. P.S. (2005) Comparative Performance of Indigenous Khari and Khari x Sinhal Goats Raised On-station in Nepal. *Journal of Biological Sciences*. 5 (2), 124-128

Lu C. D. and Potcoiba, M. J. (1988) Milk Feeding and Weaning of Goat Kids. *Small Ruminant Research*. 1, 105-112.

Lu, C. D. (2001) *Boer Goat Production: Progress and Perspective.* Available at:https://hilo.hawaii.edu/uhh/vcaa/documents/BoerGoatProductionProgressand Perspective2002.pdf

Negi P. R., Bhatt, P. P. and Garg, R. C. (1987) Factors affecting Pre-weaning body weights in Gaddi Sheep and its Crosses. *Indian Journal of Animal Sciences*. 57 (5), 489-492.

Neopane, S. P. (1997). *The Genetics of Productivity Traits in a Nepalese Hill-Goat Herd*. Ph.D. University of London, UK.

Neopane, S. P. and Sainju, A. P. (1995) Performance of Kiko crossbred goats in the mid-hills of Nepal. In: *Promotion of Animal Production through Research and Development.* Nepal Animal Science Association, Lalitpur. pp 100-104.

Oli, K. P. (1987) Goat breed comparison study in Hattikharka Panchayat. In: *PAC Working Paper No 11*. Pakhribas Agricultural Centre, Dhankuta, Nepal

Rasali, D.P. and Khanal, R. C. (2002) Comparative performance of Indigenous Crossbreds of Goats at Lumle Farm, Nepal. *Nepal Journal of Science and Technology*.4. pp 129-134.

Upreti C. R. and Mahato, P. S. (1995) Study on the genetic and phenotypic characteristics of indigenous goat breed (Sinhal) at Karnali Region. In: *Promotion of Animal Production through Research and Development*. Nepal Animal Science Association, Lalitpur. pp 82-84.

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Persistence of *Eisenia foetida* to different levels of humic acid on soil

A. Subedi[1] and S.P. Vista[2]
[1]Himalayan College of Agricultural Science and Technology, Kalanki, Kathmandu, and
[2]NARC, Khumaltar, Nepal
satyamabinash@gmail.com

ABSTRACT

An experiment was conducted out in a laboratory condition at Khumaltar, Lalitpur from 25th January to 12th February 2017. The experiment was carried out in order to determine the most preferred level of humic acid that can be persisted by Eisenia foetida in 72 hours after the application of treatments. For the experiment, the initial soil sample taken was found to be acidic in reaction, with very high organic matter content. Humic acid was prepared by rapid method based on principle of solubility of humic substances. The experiment was laid out in a completely Randomized Design (CRD) with 7 treatments and 3 replications. The treatments used were based on different soil and humic acid proportions. The treatments used were control i.e. only soil (T1), HA: Soil ratio of 1:10 (T2), HA: Soil ratio of 1:20 (T3), HA: Soil ratio of 1:30 (T4), HA: Soil ratio of 1:40 (T5), HA: Soil ratio of 1:50 (T6) and HA: Soil ratio of 1:100 (T7). HA showed a significant result in an earthworm avoidance test post 72 hours. T6 was found out to be the most preferred treatment with 163.3 percent preference level whereas T2 was the most disliked treatment which was avoided by 66.7 percent of the Eisenia foetida. This experiment thus helps to conclude that the humic acid level on soil has a significant effect on Eisenia foetida.

Key words: Humic Acid, *Eisenia foetida*, Earthworm Avoidance test, Persistence

INTRODUCTION

Humic acids are the group of complex organic molecules derived from humus. It is soluble to alkali but not to acid. From an agricultural point of view, humic acid can play a big role in the improvement of production and productivity of soil. It has various physical, chemical and biological benefits. Physically, it improves soil structure, aeration and water holding capacity making it physically fit for crop growth. It helps in neutralization of various soil reactions. It acts as a natural chelator for various metal ions and also help in the conversion of various nutrient elements into forms that can be easily use by plants for various metabolic purposes. In addition to that, it is also known to stimulate the biosphere by stimulating the activities of soil flora and fauna leading into production of various enzymes and hormones (Vista, 2015). Though it is not a fertilizer in itself, it acts as a mediator which lets soil to access its bound prospects (Khaled and Fawy, 2011).

Not many soil organisms have been found to be beneficial in organism more than earthworm. It is considered as engineer of soil system because of their effects on soil properties and their influence on the availability of resources for other organisms, including microorganisms and plants (Hale et al., 2005). It is also known to be a best indicator of soil health as its presence indicates higher soil organic matter and microbes and ultimately better plant growth (Doube and Schmidt, 1997). In recent years, the use of earthworm as bio indicator to evaluate ecotoxocity has been very popular. Various levels of pollutants and contaminations in soil due to pesticides could also be determined sensitivity tests using earthworms (Kula, 1995; Fitzgerald *et al*., 1996).

Though humic acid has been knows to improve physio-chemical vis-à-vis biological and ecological characteristics of soil, literatures regarding the findings for it appropriate amount has been barely studied in context of Nepal. In the other hand, its relation with soil organisms is unknown. Thus, this experiment was conducted in order to determine effect of various level of humic acid on preference by earthworm (*Eisenia foetida).*

MATERIALS AND METHODS

The research was carried out during 25th of January to 19th of March 2017 at Khumaltar Lalitpur in a laboratory condition. The experimental scheme was mostly divided into three parts i.e. preparation of humic acid, setting of earthworm avoidance test and post earthworm avoidance test.

Preparation of humic acid

Based on the basic principles of solubility of humic substances, humic acid was prepared in Khumaltar by rapid method. For this, a highly fertile soil was collected which was then freed from clods, roots and other foreign particles. The collected soil was placed on a plastic washing tub with net below the soil. About the same amount of water was added and the soil solution was stirred thoroughly. Sodium hydroxide was then added and stirred to increase the pH of the soil solution to 13 which was measured using pH paper. Then the soil solution was stirred for 45 minute after which supernatant and residue was separated using the net. The residual part is humin whereas the supernatant is the mixture if humic acid and fulvic acid. Residue was discarded. In the remaining supernatant solution, hydrochloric acid was added to lower the pH of soil solution to 1. The solution was left for at least 6-7 hours in order to collect the solidified humic acid by discarding the supernatant solution of Fulvic acid. Thus prepared humic acid was left to dry for a few days and used for later stages of the experiment. Humic acid was prepared from 25th January to 5th of February.

For the experiments, soil was collected from nearby field. Both HA and soil was taken for a lab test at soil laboratory of HICAST, Kalanki. The relevant properties of the humic acid and soil are shown in the table number 1.

Table 1*:* Some relevant characteristics of Soil and prepared HA

Parameters	Humic Acid	Soil	Methods adopted
pH	2.3	5	pH meter
Organic Carbon (%)	5.68	3.19	Walkley and Black Method

Setting of earthworm avoidance test

Earthworm avoidance test was carried out in order to analyze the persistivity of earthworm to various proportions of soil and humic acid. Multiple treatments were used in a completely randomized design with 7 treatments and 3 replications. Those treatments were based on different proportion of humic acid in 3 kg of soil for each treatment which are divided into 3 parts for each replication. Thus approximately 1 kg of each treatment was made for each replication. Treatments used during the experiments are:

T1: No application of humic acid (Control)
T2: Ratio of humic acid and soil at 1: 10 (300g HA in 3 kg soil)
T3: Ratio of humic acid and soil at 1: 20 (150g HA in 3kg soil)
T4: Ratio of humic acid and soil at 1: 30 (100g HA in 3kg soil)
T5: Ratio of humic acid and soil at 1: 40 (75g HA in 3kg soil)
T6: Ratio of humic acid and soil at 1: 50 (60g HA in 3kg soil)
T7: Ratio of humic acid and soil at 1: 100 (30g HA in 3kg soil)

For this experiment, 7 trays were used. In each tray three different treatments were placed. Treatments were moistened to maintain the soil moisture around 60 percent and it was kept by covering in order to ensure the moisture to remain constant during the time of experiment. Treatments were placed in such way by which all treatments were compared making a total of 21 replication units. For this experiment each treatment was provided with 10 Earthworms (*Eisenia foetida)* and their avoidance or movement were studied for 72 hours. The experiment was setup on 7th February and earthworms were left on 9th of February.

Analysis Post 72 hours

After 72 hours i.e. 12th of February, earthworms were counted in all the treatments. The collected data was subjected to analysis of variance (ANOVA) using Genstat version 10.3.0.0. P- Value, F-value, grand mean, least significant difference, percent covariance, standard error of mean were carried out for significance test at 5% level of significance using *Duncan's* new multiple range *test to compare the data.*

RESULTS AND DISCUSSION

After leaving earthworms in 7 trays filled with 7 treatments in 21 replication units for 72 hours, it showed a significant level of preference or avoidance to those treatments. The P-value <0.05 showed that humic acid had played positive role in creating suitable

condition for earthworms. Table 2 shows various statistically analyzed data of earthworm avoidance test.

Table 2*:* Effect of different level of humic acid on preference of earthworm

Treatments	Mean	Rank	Preference	Avoidance
T1: (Control)	$11^{(ABC)}$	3rd	110%	---------
T2 : 300g HA in 3kg soil	$3^{(BC)}$	7th	----------	66.7%
T3: 150g HA in 3kg soil	$7^{(BC)}$	5th	----------	30%
T4: 100g HA in 3kg soil	$10^{(ABC)}$	4th	100%	----------
T5: 75g HA in 3kg soil	$7^{(BC)}$	5th	----------	30%
T6: 60g HA in 3kg soil	$16^{(A)}$	1st	163.3%	----------
T7: 30g HA in 3kg soil	$14^{(AB)}$	2nd	140%	----------
P-value	0.032			
F-value	3.27			
Grand Mean	10			
LSD	7.479			
CV %	43.5%			
SEM	2.466			

Among seven treatments used during the experiment, 6th treatment (60g humic acid in 3000g soil) was found to have the highest number of earthworms at the end of 72 hours i.e. on average 16 earthworms were present on each replications which was 66.46 percent higher than the grand mean which in other words can be said as the most preferred treatment. Whereas, the 2nd treatment (300g humic acid in 3000g soil) was found to have lowest number of earthworms at the end of the experiment i.e. an average of 3 earthworms in each replications which was 66.05 percent lower than the grand mean which was the most avoided treatment. At the end of the experiment, there was approximately 4 times more earthworm present in units of 6th treatment than in the 2nd treatment.

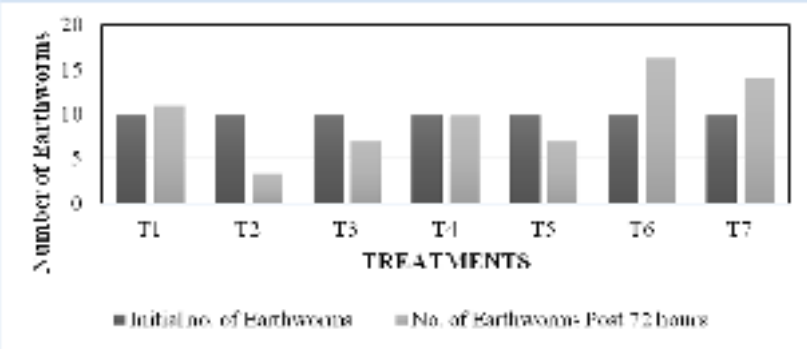

Figure 2*:* Effect of application of different level of HA on Earthworm pre and post 72 hours

The mean number of earthworms at 72 hour on 7th (30 g HA), 1st (Control), and 4th (100 g HA) were at par with the 6th treatment with an average of 14, 11 and 10 earthworms respectively. Treatment number 3(150g HA), 5(75g HA) and 2(300g HA) had significantly lower number of earthworms than 6th treatment. Treatment number 7, 1, 4, 3 and 5 were found similar as compared to each other whereas 2nd treatment was significantly lower than that of 7th treatment. Figure 1 clearly shows the difference in mean number of earthworm in 72 hours.

CONCLUSION

In recent years, the importance of earthworm in agriculture has been realized and has been relied upon. It is not just used as medium to produce vermicomposts but also to build the biosphere. Other than that, it is a clear indicator of soil organisms and ultimately of soil health. Thus, this experiment not only was able to find the prefered proportion of humic acid and soil that can be persisted by earthworms but also by the other soil organisms that are an integral part of soil health.

REFERENCES

Doube, B.M. & Schmidt O. (1997) Can the abundance or activity of soil macro fauna be used to indicate the biological health of soils. In: Pankhurst, C.E., Doube, B.M., and Gupta (Eds) *Biological Indicators of Soil Health*. USSR, CAB International, Wallingford, Oxford, UK, 265-296.

Fitzgerald, D. G., Warner, K. A., Lanno, R. P. & Dixon, D. G. (1996) Assessing the effects of modifying factors on pentachlorophenol toxicity to earthworms: applications of body residues. *Environmental Toxicology and Chemistry*. 15(12), 2299–2304.

Hale C.M., Frelich, L.E., Reich, P.B. & Pastor, J. (2005) Effects of European earthworm invasion on soil characteristics in northern hardwood forest of Minnesota, USA. *Ecosystem.* 8, 911-927. DOI: 10.1007/s10021-0050066-x.

Khaled, H. & Fawy, H. (2011) Effect of Different Levels of Humic Acids on the Nutrient Content, Plant Growth, and Soil Properties under Conditions of Salinity. *Soil and water.*

Kula, H.G. (1995) Comparison of laboratory and field testing for the assessment of pesticide side effects on earthworms. *Acta Zoologica Fennica*, vol. 196, 338-341.

Vista, S.P. (2015) Use of Humic Acid in Agriculture. *A Handbook of Soil Science.* BH Adhikary (Ed,), Soil Science Division (SSD), NARC, Khumaltar, Lalitpur, 6-10

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Evaluation of carbon sources for anaerobic soil disinfestation in tomato production in Lalitpur district

A. Bhandari[2], L. P. Sah[1], Y. Dhoj G.C[3], M. Devkota[1], L. A. Colavito[1], B.P. Rajbhandari[2], G. Norton[4], S. Miller[5] and R. Muniappan[4]

[1]Feed the Future Asian Vegetable and Mango-Integrated Pest Management Innovation Lab, International Development Enterprises (iDE Nepal). PO Box: 2674, Kathmandu
[2]Himalayan College of Agricultural Sciences and Technology (HICAST), Kathmandu
[3]Ministry of Agriculture, Land Management and Cooperative, Kathmandu, Nepal
[4]Feed the Future Integrated Pest Management Innovation Lab, Virginia Tech | OIRED, VA 24061
[5]Department of Pathology, The Ohio State University, 221 Selby Hall, 1680 Madison Ave., Wooster, OH 44691
lpsah@ideglobal.org

ABSTRACT

The study was conducted in Lele of Lalitpur district during July to December 2017 to evaluate the carbon sources of Anaerobic Soil Disinfestations (ASD) in tomato. A research experiment in the field was conducted using different treatments against soil borne diseases and weeds in the field of tomato in Lele of Lalitpur district. There were six treatments which comprises Molasses (T1), Molasses and Rice bran (T2), Mustard cake (T3), Undecomposed cattle manure (T4), Chopped green leaves(T5) and Control (Soil Solarization only)(T6). Parameters like plant growth, number of weeds, soil temperature, late blight infestation and yield were recorded. Maximum temperature of soil (37.8 ℃) was observed in Mustard cake treatment followed by molasses (35.3 ℃) Higher plant height was observed in mustard cake treatment with the mean height of 121.7cm on 60 Days after transplanting which was in increasing trend with different treatments. In the duration of 75 days after transplantation the growth of weed in the tomato cultivated area using mustard cake was found to be the lowest. Similarly the lowest leaf damage due to late blight was found in mustard cake treatment (13%) as compared to other treatments. The plants subjected to mustard cake treatment showed early flowering (average 27 DAT) and fruiting (35 DAT). In mustard cake treatment yield was found to be higher (97.58 ton/ha) as compared to control and other treatments. Therefore in comparison to other treatment mustard cake treatment was more effective in soil borne disease and weed management with better growth and development of plant.

Key words: *Anaerobic Soil Disinfestations (ASD), Molasses, Rice Bran, Mustard Cake, Undecomposed cattle manure, chopped green leaves, Soil Solarization, Tomato*

INTRODUCTION

Agriculture is the backbone of the national economy, a means of livelihood for a majority of the population, a main source of gross domestic product (GDP), incomes and employment opportunities for Nepal. About 65.7% of the population in Nepal is directly engaged in agriculture. This agriculture sector constitutes about 33.1% to the gross domestic product (MoAD, 2015). Tomato (*Lycopersicon esculentum*) belongs to the family Solanaceae which is one of the most universally known, widely consumable nutritious and widely grown vegetable in the world. Tomato is one of the major commercial vegetable crops in Nepal (Ghimire et al. 2000/ 2001). They grow best in terai, low and mid hills, and its demand is increasing in mid hills for cash generation (Pandey & Chaudhary, 2004). Total area and production of this crop in Nepal in 2013/14 is 254,932 ha and 3,421,035 ton respectively with an average productivity of 13.4t/ ha (Source: monitoring, evaluation and statistics division, 2016), which is very low as compared to the experimental yield of tomato in the country. Agricultural pest are the foes of man. Crop losses from pests and diseases are considered one of the major constraints to increase agricultural production and value addition in the farm produce. Tomatoes are subjected to attack by a large number of insect pests and diseases from the time plants first emerge in the seed bed until harvest.

Soil-borne diseases can be suppressed in different manners, by means of one-target methods such as gene resistance or chemical fumigants, but also by multi-target techniques that can contribute to the general fertility/soil health and maintenance of the plant production, while avoiding the appearance of the mentioned diseases. The addition of decomposed or composted organic matter into the soil can be considered as a cultural practice that permits the control of several pathogens, as shown in many examples. The result of this addition is variable and this variability is dependent on the decomposition state of organic matter. In a recent view, Bonanomi et al. (2010) stated that extremely decomposed materials such as peats are very stable, showing slight suppressive or moderate conduciveness. On the other hand, undecomposed materials span all the possibilities between conduciveness and suppressive. The application method for the incorporation of easily-decomposable organic materials into the soil, as well as the features of these materials, is key factors in order to achieve success in the suppression of a soil-borne disease. In this regard, promising results have been achieved when organic matter is used as a disinfectant prior to plantation. Anaerobic soil disinfestations (ASD) is also termed “biological soil disinfestation” (Blok et al., 2000), “soil reductive sterilization” and “reductive soil disinfestations” (Shinmura et al., 1999), the term ASD is used to emphasize the anaerobic soil condition and to appropriately identify the soil as a soil disinfestations. The principle of the technique is to create a temporary anaerobic soil environment to stimulates the growth of facultative and obligate anaerobic microorganisms, that under anaerobic conditions, decompose the available carbon (C) source, producing organic acids, aldehydes, alcohols, ammonia, metal ions, and volatile organic compounds, that are suppressive or toxic for several soil-borne pests and pathogens.

MATERIALS AND METHODS

Godwari Municipality-6, Lele village of Lalitpur district was selected for this study. The experiment was conducted in 3 farmers as replication with Randomized Complete Block Design. There were altogether 6 treatment plots of $4m^2$. There were 6 plants in a plot with the spacing of 60cm*60cm.The details of the treatments were presented in table 1.

Table 1: Treatments and their amounts

Code	Treatments	Amounts
T1	Molasses	2kg per m²
T2	Molasses+ Rice Bran	1kg per m² + 1kg per m²
T3	Mustard cake	1.5 kg per m²
T4	Un-decomposed Cattle Manure	3kg per m²
T5	Chopped Green Leaves	3kg per m²
T6	Control (Soil Solarization only)	—

The field was prepared by ploughing to make soil fine tilled. The individual plots were divided by raised bund so as to check the leakage of C-sources. The C-sources were incorporated in soil and the field was irrigated up to field capacity and then individual plots were covered up to 21 days by black plastic sheet. The margin of the plastic sheet was sealed with soil so as to maintain air tight condition inside the soil. In this study tomato crop and hybrid variety Srijana was used. Tomato seeds were sown on June 8, 2017 in a plastic tray 27 days prior to transplanting using (1:1) coco peat and Tricho-vermicompost as a growing media. After 21 days plastic sheets were removed. Then again the field was tilled and seedlings were transplanted on July 4, 2017 at proper spacing. The observation and measurement in respect to temperature of soil at different depth, plant height(cm), Weed density, late blight infestation, Days of 50% flowering, Days of 50% fruiting and yield were recorded in the field. The data collected from the field were coded first and entered into the computer. All the recorded data were analyzed by Microsoft office excel SPSS and other statistical analysis software's as required. Analyzed data were then presented in the form of tables and figures.

RESULTS AND DISCUSSION

Temperature of soil at different depth in each treatment

The average temperature of soil in T3 was higher (37.8°C) followed by T1 (35.3°C), T5 (34°C), T2 (33.3°C) and T4(31.5°C) and least temperature of soil was observed in T6 (30.3°C). Mustard cake addition increases the rate of decomposition in soil and thereby the rate of heat generation during decomposition; it also increases the heat carrying

capacity of soil. When this organic matter is heated during the process of soil-solarization soil borne pathogens are killed. So mustard oil cake was more effective. (Ben Yephet Nelson, 1999)

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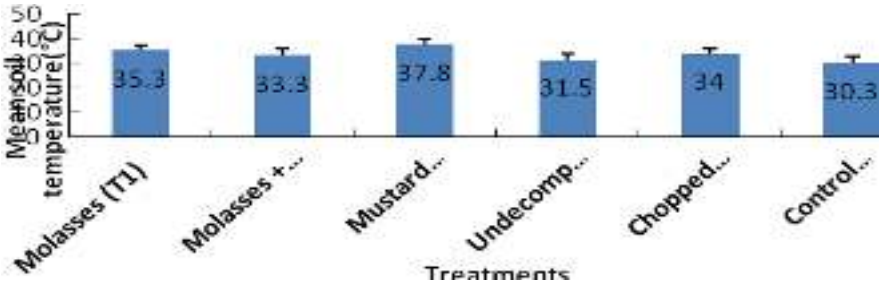

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Figure 1: Temperature of soil at different depth in each treatments

Plant Height

The average height of tomato plant was higher in the mustard cake treatment as compared to other treatments. It should be noted that tomato plant was found to be the tallest with increasing time while using T3 followed by T5, T4, T2, T1 and shortest with increasing time using T6. According to data mustard cake significantly improved the plant height as compared to other treatments. Similar results were reported by (BARC 1997).

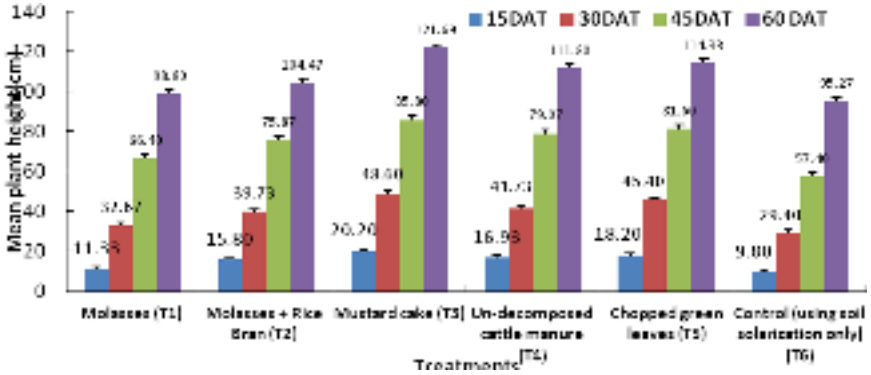

Figure 2: Dynamics of tomato plant height (cm) in each treatment

Weed density

Under different treatments, the growth of weed varied with variation of time. The average growth of weed in the tomato cultivated area using mustard cake T3 was found to be the lowest followed by T1, T2, T4, and T5 while that in the area using control (soil

solarization only) method (T6) had highest number of weeds i.e.30. This is because incorporation of mustard cake, control weeds in the crop due to the release of bio-toxic volatiles like iso-thiocyanates (Brown and Morra, 1995).

Table 2: Average number of weeds per square feet in each treatment

Treatments	**Mean±SE**
Molasses(T1)	16 ±1.2
Molasses + Rice Bran (T2)	17± 0.6
Mustard Cake (T3)	14 ± 0.9
Undecomposed cattle manure(T4)	20 ± 2
Chopped Green Leaves(T5)	22 ± 2.2
Control (soil solarization only)	30 ± 0.9

Late blight Infestation

Leaf infestation of tomato plant was found significantly different in mustard cake treatment as compared to control (using soil solarization only). Average leaf infestation of tomato plant in mustard cake treatment was 12.98% whereas in control 22.01% leaves become infected due to the late blight disease. Similar results were reported by (Ramirez-Villapudua and Munnecke, 1988).

Table 3: Average percentage of leaves damaged by Late Blight

Treatments	**Mean±SE**
Molasses(T1)	14± 2.1
Molasses + Rice Bran (T2)	16 ±2.3
Mustard Cake (T3)	13± 1.8
Undecomposed cattle manure(T4)	20 ± 3.1
Chopped Green Leaves(T5)	18 ± 2.2
Control (soil solarization only)	22 ± 2.1

Phenology

Phenological phases (flowering and fruiting) were relatively late using control (soil solarization only) (T6) followed by T5, T2, T4, T1. Similarly days to 50% flowering and fruiting was earlier in mustard cake treatment (T3). All of these treatments had significant differences in flowering and fruiting with the passage of time which may be due to the available of higher percentage of nutrients necessary for plant growth and yield in readily form in mustard cake treatment (Siddiqui and Khan, 1976).

Table 4: Phenology of tomato in different treatments

Treatments	50% Flowering (Mean±SE)	50% Fruiting (Mean±SE)
Molasses(T1)	30 ± 0.72	38 ± 1.19
Molasses + Rice Bran (T2)	31 ± 0.72	39 ± 0.72
Mustard Cake (T3)	27 ± 0.98	35 ± 1.25
Undecomposed cattle manure(T4)	30 ± 1.25	39 ± 0.94
Chopped Green Leaves(T5)	31 ± 1.19	40 ± 1.36
Control (soil solarization only)	36 ± 0.82	46 ± 0.72

Yield

Yield formation in crop plants is a complex phenomenon determined by genotype, environment and their interactions (Rajbhandari, 1998). Impact of these interactions and factors is reflected in the yield attributing traits. The average productivity of tomato in mustard cake treatment (T3) was 97.58 ton/ha Followed by T2, T1, T5, T4 whereas in control (using soil solarization only) (T6) was 43.33 ton/ha. The result showed that highest productivity of tomato in mustard cake treatment may be due to large number of flowers, fertility percent and early flowering. Other reasons may be the effect of good growing condition of soil, essential amount of micronutrient in mustard cake and lesser competition with soil borne disease and weeds.

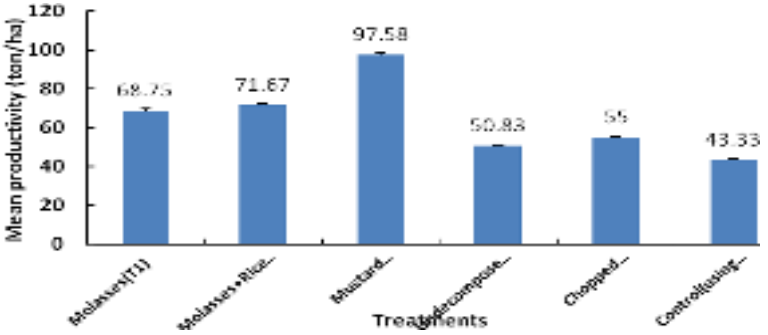

Figure 3: Yield of tomato in different treatments

CONCLUSION

Anaerobic Soil Disinfestations (ASD) is a non-chemical pest management strategy that promotes depleted soil oxygen conditions by combining irrigation, incorporation of organic amendments, and covered by a plastic sheet as a means of controlling soil-borne pests. Application of decomposable organic matter like oil cake to soil is recognized as most efficient method of maintaining a good soil structure and rhizosphere environment.

Oil cakes are good source of organic nitrogen and excellent for crop. Therefore it is gaining popularity among farmers. The study revealed that mustard cake treatment was found to be effective with respect to soil temperature, plant height, and growth of weed, late blight infestation, phonology and yield.

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REFERENCES

BARC (Bangladesh Agricultural Research Council) (l997) *Fertilizer Recommendation Guide*-1997. BARC Soils pub., No- 4l, Bangladesh Agril. Res. Coun., Dhaka-1215, 25: 180.

Ben-Yephet, Y. and Nelson, E.B (1999) Differential suppression of damping-off caused by Pythiumaphanidermatum, P. irregulare, and P. myriotylum in composts at different temperatures. *Plant Disease*, *83*(4), 356-360.

Bonanomi, G., Antignani, V., Capodilupo, M. and Scala, F (2010) Identifying the characteristics of organic soil amendments that suppress soilborne plant diseases. *Soil Biology and Biochemistry*, *42*(2), 136-144

Blok, W.J., Lamers, J.G., Termorshuizen, A.J. and Bollen, G.J (2000) Control of soilborne plant pathogens by incorporating fresh organic amendments followed by tarping. *Phytopathology, 90(3),.*253-259

Ghimire S R, Subedi P P and Sylvia, P G. (2000/2001) Status of tomato yellow leaf curl virus in tomato in the western hills of Nepal. *Nepal Agriculture Research Journal*, 4, 1-4.

Pandey, Y.R. and Chaudhary, B.N(2004) March. Evaluation of tomato varieties and their planting dates for commercial production under Jumla agro-ecological condition. In Proceedings of the Fourth National Horticultural Research Workshop, 380-385. Horticulture Research Division-NARC, Khumaltar.

Rajbhandari, B. P. (1988) Grain legume of Nepal. Kumar Chhapakhana, Chitwan, Nepal.

Ramirez-Villapudua, J. and Munnecke, D.E (1988). Effect of solar heating and soil amendments of cruciferous residues on Fusarium oxysporum f. sp. conglutinans and other organisms. Phytopathology (USA).

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Major diseases of banana and their management practices adopted by the farmers in Chitwan district

K. Shah [1]and B. P. Yadav[2]
[1] Himalayan College of Agriculture Science and Technology (HICAST), Kalanki, Kathmandu, Nepal
[2]Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur, Nepal

ABSTRACT

The study was conducted from November 2016 to January 2017 in Chitwan. There were around 625 banana farmers cultivating in around 1666.67 ha (2500 Bigha) of land. The survey revealed that majority of them were males (65%) followed by 57.5% of the respondents between the age's group 35 and 50 years having landholding of 2.05 ha/family as well as over three-fourth of land with irrigation facility. The farmers had multiple problems like lack of proper field sanitation, lack of improved saplings, and lack of proper irrigation facilities, insect pests and diseases. In the field studies, plant disease was assessed on visual observations based on disease score and disease severity. Among the diseases, major economic loss account for Sigatoka leaf spot, banana bunchy top, panama wilt and bacterial wilt respectively. The incidence of leaf spot disease was around 62% with 13% severity incidence. The insect pests like pseudo stem weevil and rhizome weevil are much important due to 95 percentages of the respondents mentioned it. Insect pest and disease management practices are highly chemical intensive (Diathane M-45, Nuvan and Plantomycin) followed by few cultural practices. The recommendation on the time and dose of agro-chemicals are mainly provided by the technicians and Agro-vets. Besides pest and diseases, the soar in the land price in Chitwan has led to the destruction of farming land into housing plots that can possibly lead to reduced banana farming in the near future.

Key words: panama wilt, bacterial wilt, Sigatoka leaf spot

INTRODUCTION

Banana farming is flourishing mostly in eastern Chitwan. The living standard of farmers in these areas has also improved due to banana farming. Banana farming, which was started on 5.34 ha of land in eastern Chitwan in 2002, has now spread over 1666.67ha. Banana is a high-value agricultural product and one of the major fruits in Nepal in terms of the potential growing area, production, and domestic consumption. The total productive area of banana plantations is 11,864 ha, with a total production of about 182,005 tons (ICIMOD, 2015). According to the Ministry of Agriculture, the current average productivity is 13.2 tons per hectare, with maximum yields reaching up to 20 tons per hectare. Currently, we can see the demand for bananas in Nepal In the budget

speech for Fiscal Year 2015/16, the government announced it would make the country self-reliant in banana farming in the next four years.

The cultivars Dwarf Cavendish and Grand Nain (Chiquita Banana) gained popularity in the 1950s after the previous mass-produced cultivar, Gross Michel (also an AAA group cultivar), became commercially unviable due to Panama disease, caused by the fungus *Fusarium oxysporum* which attacks the roots of the banana plant. Cavendish cultivars are resistant to the Panama Disease (Ploetz, 2005). Although the Cavendish was then thought to be immune, it was immune only to the strain of the fungus that destroyed the Gros Michel. It killed and spread faster, inspiring more panic than its earlier counterpart in Panama. The newly discovered strain of *F. oxysporum* was named tropical race 4(TR4) (Stover, 1962). Also in 2013, there were fears that the Black Sigatoka fungus would in turn make Cavendish bananas unviable. Black sigatoka is a leaf-spot disease of banana plants caused by the fungus *Mycosphaerella fijiensi.* Sigatoka disease complex is a cluster of three closely related fungi-yellow sigatoka (*Pseudocercospora musae*), eumusae leaf spot (Ps. *eumusae*), and black sigatoka (Ps. *fijiensis*) (Jones, 2000).. Out of which the most common diseases are Panama disease also called Fusarium wilt (casual organism-*Fusarium oxysporumf.sp. cubense*Tropical Race 4(TR4) and Subtropical Race 4), Anthracnose (casual organism- *Colletotrichum musae*), Leaf spot or Sigatoka disease (casual organism- *Pseudocercospora fijiensis*), Bacterial wilt (casual organism- *Pseudomonas solanacearum* (race 1)) or Moko disease (casual organism- Pseudomonas solanacearum (race 2)), Bunchy top(casual organism- BBTV), etc. (Jeger et al., 1995).

One factor for the rise in present situation can be the old plants along with improper use of chemicals. Also, the disease is not the only problem, though (Poudel, 2006). Just as the Cavendish is under attack from pathogen, local varieties are under attack from the Cavendish over the past two decades. The Cavendish has pushed out and replaced many of those local varieties.

MATERIALS AND METHODS

The study was conducted from November 2016 to January 2017.A simple random sampling method was used to select the households of 50 respondents from Ratnanagar municipality (Padampur, Bachhauli, Pithuwa, Chainpur, Kumroj, Jutpani) and 30 respondents from Meghauli, Prembasti, Mangalpur, Patihani, Parbatipur and Jagatpur. The total sample size was 80. The necessary data were collected primarily through the field observations, informal interviews, schedules, questionnaires and secondarily through various sources such as reports, books, journals related to the subject matter of investigation.

Disease severity and position of each leaf on the plant were recorded based on Stover's international scale method; this scale corresponds to grades of 0 (fewer than 10 spots on an individual leaf), 1 (less than 5% of leaf area spotted), 2 (5-15%), 3 (16-33%), and 4

(more than 33%). To calculate the amount of leaf area spotted (disease severity, s), the Stover and Dickson scale was modified by using the upper limit of leaf spotted area for disease grades 1, 2, and the equation is:

$$S = \frac{(0.05x + 0.15y + 0.35z + 0.5w)}{n}$$

In which, x, *y, z,* and w represent the number of leaves with disease grade 1, 2, 3, and 4, respectively; n is the total number of leaves. The proportion of leaves diseased (disease incidence, *I)* was calculated as the number of diseased leaves divided by the total number of leaves on the plant. After preliminary analysis on each assessment date, the mean disease incidence and severity were calculated for each assessment date at each site as a sampling unit (Stover, 1971).

The raw data collected primarily and from secondary data sources were edited and coded in appropriate format. The gathered information through questionnaire was entered and analyzed by using Microsoft Excel and results were finalized with apposite tables, bar diagram and pie charts.

RESULTS AND DISCUSSION

Insect pest and diseases

The most common pests reported to cause heavy loss were Banana stem weevil and banana rhizome weevil including some aphids and scarring beetles (Figure 1). According to the respondents, the most damaging insect 'the banana pseudo-stem weevil' feeds and tunnel inside the corm that makes the corm look riddled and rots into a blackened mass. This makes the leaf turn yellow, wither and the whole plant dies

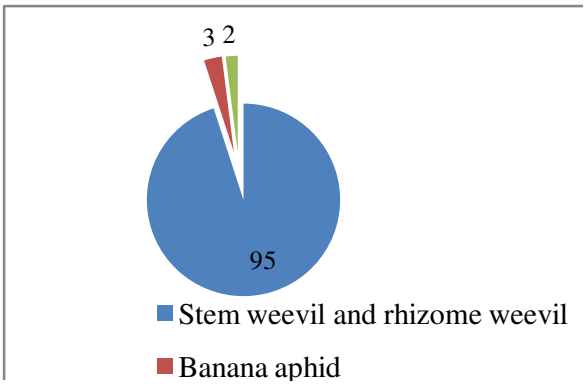

Figure 1: Percentage of different insect pests reported by growers in banana

Almost 95% of the banana growers enunciated about having stem weevil and rhizome weevil in their field. To certain extent the damage of, banana aphid and scarring beetle was also not negligible (fig. 9). Respondents reported that the major causes of severity of pest were due to source of sucker followed by poor crop management practices, and improved varieties, respectively. They also expressed their opinions that uses of chemicals including environmental factors were the other reasons of weevil infestation in the banana growing areas.

Four major diseases were evident in the study area viz. Panama wilt, Sigatoka disease, bacterial wilt or the 'moko disease' and banana bunchy top (Table 1). They were ranked based on their occurrence and intensity as per the farmer's discernment and the view of agricultural technician of Chitwan banana production cooperative union (Table 1). The symptoms explained by the farmers matched the disease symptoms. Though, Panama wilt and Moko disease are not yet reported by PPD, NARC, and Khumaltar.

Table 1: Diseases and rank

S. N	Name of the major diseases	Ranks
1.	Sigatoka disease	I
2.	Bunchy top virus	II
3.	Panama wilt or *Fusarium* wilt	III
4.	Bacterial wilt or Moko disease	IV

Insect pest and disease management practices adopted by the farmers

Banana farming in Chitwan mainly relied on use of chemical pesticides (Table 2) and various other cultural practices like; Pruning of the side suckers, balanced fertilizer application, Mulching with sugarcane trash, dried banana leaves and sheaths and some farmers were found to be intercropping banana with legumes such as soybean and beans.

Table 2: Chemical pesticides used by the respondents

S. N	Technical Name	Trade Name	Dosage (average)
1.	Mancozeb	Diathane M-45	2ml/lit of water
2.	Streptomycin Sulfate	Plantomycin	6g/60lit of water
3.	Carbendazim	Bavistin/ Carbendazole	2ml/lit of water
4.	Dicopper chloride trihydroxide	Blitox	2ml/lit of water
5.	Methyl parathion	Metacid	2ml/lit of water
6.	Dichlorovos	Nuvan	2ml/lit of water
7.	Bordeaux mixture	Bordo mix	5ml/lit of water

Fungicides were routinely used in commercial plantations to control sigatoka leaf spot, as well as post-harvest diseases. However, not all diseases caused by fungi could be controlled by fungicides. *Fusarium* wilt, for example, cannot be controlled by fungicides. Similarly, Plantomycin (bactericide) was used from time to time.

Most of the farmers (around 50 of them that are linked with cooperative) concern with their technician JTA Mr. Ramlal Shrestha about the pesticide usage and dosage. Out of the remaining 30 respondents, 70% of them concern with agro-vet, 20% concern with their progressive neighbor, governmental and non-governmental agency and the rest 10% use the pesticides from their own self experience.

Safety measures

Of the total respondents, only few (8%) of them used full safety measures during spraying of pesticides. 28% used gloves in their hands during spraying. 22 percent of the respondents used plastics just below the knapsack in their back to prevent their body from agrochemicals. 17 % of the respondents used aprons and the remaining 25% didn't used any safety measures (fig.10).

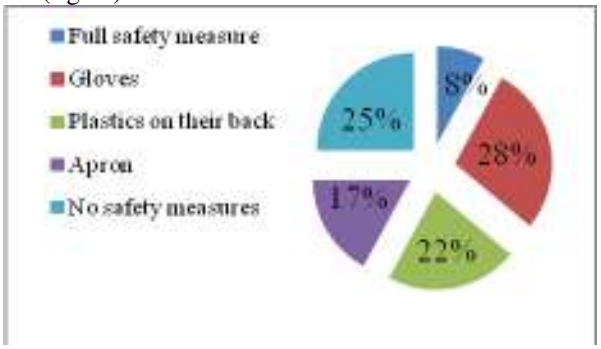

Figure 10: Safety measures used by respondents

Field Observation

Table 5: Disease grading of the leaves

No of leaves	Grade
194	0
119	1
75	2
72	3
40	4

From the above table, amount of leaf area spotted (disease severity *s*) = 0.1248*100=12.48%; The proportion of diseased leaves (disease incidence, *I)* = 306/500*100= 61.2%

CONCLUSION

The diseases like Panama wilt, Bacterial wilt and Sigatoka leaf spot including insect-pests like pseudo stem weevil and rhizome weevil are mainly responsible for banana yield loss. For controlling these pest and diseases farmers mostly used agro chemicals like Dithane M-45, Plantomycin, Bavistin/ Carbendazole, Copperoxychloride, Metacid, Nuvan and Bordo mix. The severity and incidence of banana disease and pests in Chitwan is increasing every year, mainly due to the lack of proper sanitary activities Almost all the farmers use agro chemicals as the common pest management option.Almost all the farmers used chemical pesticides as the common pest management option. Some of them were not much conscious towards the related parameters like use of safety wares, dosage and intervals, label of the product and so on.

REFERENCES

ICIMOD (2015) Expanding commercial banana production in Nepal, Available on: *http://www.icimod.org/?q=19770. Accessed on*: (2nd Jan 2017).

Jeger, M.J., Eden-Green, S., Tresh, J.M., Johanson, A., Waller, J.M. & Brown, A.E. (1995) Banana diseases. In: *Bananas and Plantains.*S. Gowen. Chapman and Hall, London.

Jones, D.R. (2000) Sigatoka leaf spot diseases. In: D.R. Jones (ed.), *Diseases of Banana, Abacá and Enset.* CABI Publishing, Wallingford. pp.79–92

Koeppel, D. (2008) *BANANA*: *The fruit that changed the world,* 1st edition, penguin books limited, England.

Koppel, D. (2008). *Yes, We Will Have No Bananas*. New York Times. June 18, Available on: *http://www.nytimes.com/2008/06/18/opinion/18koeppel.html.* Accessed on: (2nd Jan 2017).

Ploetz, R.C. (2005a) Panama Disease: An old nemesis rears its ugly head. Part 1: *The Cavendish era and beyond*. APSnet Feature.

Ploetz, R.C. (2005b). Panama Disease: An old nemesis rears its ugly head. Part 2: *The Cavendish era and beyond*. APSnet Feature.

Ploetz, R., Sauco., V.G. (1998). Banana diseases in the subtropics: A review of their importance, distribution and management. *Acta. Hortic.* 263-276.

Poudel, C. (2006) Banana farming flourishes in Chitwan. *The Himalayan Times.*

Stover, R.H. (1962) *Fusarial wilt (Panama Disease) of bananas and other Musa species*. CAB International, Great Britain.

Stover, R.H. (1971) a proposed international scale for estimating intensity of banana leaf spot. *Tropical Agriculture,* 48(3), 185-196.

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Evaluation of pest exclusion net to major insect pest of tomato in Kavre and Lalitpur

A. Singh[2], L. P. Sah[1], Y. Dhoj G.C.[3], M. Devkota[1], L. A. Colavito[1], B. P. Rajbhandari[2], G. Norton[4], E. G. Rajotte[5], and R. Muniappan[4]

[1]Feed the Future Asian Vegetable and Mango-IPM Innovation Lab, International Development Enterprises (iDE Nepal). PO Box: 2674, Kathmandu, Nepal
[2]Himalayan College of Agricultural Sciences and Technology (HICAST), Kalanki,
[3]Ministry of Agriculture, Land Management and Cooperative, Government of Nepal,
[4]Feed the Future Integrated Pest Management Innovation Lab, Virginia Tech | OIRED,
[5]Department of Entomology, Pennsylvania State University, 501 ASI Bldg, USA
lpsah@ideglobal.org

ABSTRACT

Vegetable farming has become a profitable business in terai, mid-hills and other subtropical belts of Nepal. Lele, VDC of Lalitpur district and Kushadevi, VDC of kavre district are one of the commercial vegetable pockets in the Bagmati zone of central Nepal. A study was carried out from July to December, 2017 in order to collect the information regarding evaluation of pest exclusion net in blocking the movement of major insect pests of Tomato in Kavre and Lalitpur. There were three replications with two treatments i.e Pest Exclusion Net (PEN) and Open poly-house. Two replications were located in lele, lalitpur and third replication in Kushadevi, Kavre. As a major activity, evaluation of insect pest activity was conducted through monitoring of plant height, percentage leaf damage, fruit damage, days of 50% flowering and fruiting, yield was recorded. Study revealed insect pest's movement by the use of PEN consequently reduces the pest population. Similarly, there was significant reduction of the damage of the leaf and fruit. Very interestingly it was less in the treatments with PEN compared to open poly-house. PEN has the highest plant height. Also, days of 50% flowering and fruiting were faster in PEN. i.e 24 days after transplanting and 31days after transplantin,g respectively. The yield was found maximum in PEN (93.7ton/ha) compared to open poly-house (71.2 ton/ha). Based on the study conducted within a season, it was found that Pest Exclusion Net is most effective for blocking the movement of major and minor insect pest which reduces quality and yield. It is clear that early population build up can be reduced substantially and economically by using these physical barriers.

Key words: PEN, Tomato, *Tuta absoluta, Spodoptera litura, Helicoverpa armigera, Bemisia tabaci*

INTRODUCTION

Nepal is small landlocked and extremely diverse country which is located in the Himalayas and in between India and China. According to the International Labor Organization, 68% of Nepal's population is employed in agriculture and forestry sector. By land mass, Nepal is known as a multi-ethnic and multilingual country. Nepal is divided into different regions or states, the Himalaya to the North, the middle hills where the Mahabharat range and the Churia Hills exist, and the Terai to the south. It has unique geographic, zoological and ethnic diversity. Nepal has suitable climate and land topography for the production of various types of agricultural products. Agriculture is the main source of food, income and employment for the great majority of the population. It has provided employment opportunities. In Nepal, 65.5% populations are engaged in agriculture (MoAD, 2015). As compared to cereals and other agricultural commodities, vegetable cultivation is considered as profitable. There is a great potentiality of growing large number of vegetable crops. There is availability of a wide range of agro-climatic and topographical conditions from subtropical, temperate to cold climate which favor the successful cultivation of vegetable. The area of vegetable crops is 266937ha, production 3580085 MT and productivity of 13.41 MT/ha (MoAD, 2014/15). Out of commercially grown vegetables, tomato is considered as one of the important crop cultivated in spring and summer rainy seasons in normal conditions. Tomato is one of the important cash generating crops which has been widely grown in Nepal. In Nepal, the area under tomato cultivation is around 20,046 ha with total production 484,036.8 MT (MESD 20015/16). Nepal has very high potential in agriculture production but it has not been able to progress much more in agriculture sector. Insect pests and plant diseases have been associated with agriculture since its beginning many thousands of years ago. Pests are getting resistant against insecticides and have reduced population of beneficial insects with toxic field effects and health hazard which has emerged as serious side effects of intensification of agricultural production system. Tomato is highly popularized and preferred vegetable crop among farmers, traders and consumer. Despite of its greater economic significances, its potential production has not been achieved due to considerable losses of insect pests. With the rising demand of locally produce tomato, it is important to protect crop from insect pest. There are many destructive pests on tomato which have destructive effects on the yield of tomato. Among many insect pest of tomato *Tuta absoluta*, *Bemisia tabaci* and *Helicoverpa armygera, Spodoptera litura* are the most important pest damaging the plant. *Tuta absoluta* (Meyrick, 1997) is a serious economically important pest of tomato (Bajracharya et al., 2016). It may cause loss upto 80-100%. *Bemisia tabaci* is also most important pest damaging the plants (Byrne *et al.* 1990). They reduce crop yield and act as vectors of viral pathogens (Kajita and Alam 1996). Paneru and Aryal (2004) reported that *Helicoverpa armigera* is also one of the major problematic insect pests of tomato in Nepal. In severe cases of infestation, more than 80% fruits get damaged. Farmers have been practicing various methods to control these pests like Biological control, Cultural control; Chemical control etc. Farmers have been using many chemical insecticides to control the insect pest. Due to continuous use

of insecticides insect pest are getting resistant to insecticides and number of pest are increasing day by day. Similarly, non-targeted insects which are beneficial are also being affected. Farmers are still unaware about PEN (Pest Exclusion Net) which is one of the effective management practices to control the pest population. It has been used in agriculture commonly since the 1990s, when they became as one of the protection tool. It helps in higher yield and produce improved quality vegetables since the middle of 20th century (Scarascia-Mugnozza et al., 2012; Merill, 1967).

The objectives of the study were to collect the information regarding evaluation of pest exclusion net in blocking the movement of major insect pests of Tomato in Kavre and Lalitpur districts of Nepal.

MATERIALS AND METHODS

Experimental site:
Field experiment was carried out in Lalitpur and Kavre district. Three trials were conducted at Lalitpur and Kavre. Lele of Lalitpur and Kushadevi of Kavre where tomato cultivation is predominant were chosen for this research.

Experimental Design and Treatments
The was laid in a randomized complete block design (RCBD) with three replications and two treatments. Two replications were situated in lele, Lalitpur and 3rd replication was situated in Kushadevi, Kavre. The 2 treatments are inside Pest Exclusion Net (PEN) and open poly-house.

Land Preparation
Seedling of Srijana variety was raised inside tunnel covered with 1mm mesh size nylon net in a plastic tray with coco peat and *Tricoderma.* 25 days old seedlings were transplanted in poly houses after covering the poly house by pest exclusion net (PEN) 1week earlier. The size of poly house was 60meter square (5m x 12m). A total of 19 plants per plot, plant spacing of 55cm plant to plant and 75cm row to row was maintained. Altogether there were 6 poly houses with pest exclusion net (PEN) and control plots. In every treatment pheromone traps were used for the *Tuta absoluta, Helicoverpa armigera*, and other major pests of Tomato. Drip irrigation system was installed in each poly house for irrigation.

Parameters: For evaluation of Pest Exclusion Net in blocking the movement of insect pests in tomato different parameters was taken such as monitoring of major insect pest to quantify the difference in pest pressure inside PEN and open poly-house. It also helps in providing valuable information regarding effectiveness of PEN in blocking the movement of insect pests. And, other parameters like plant height, leaf damage percent due to insect pests, days of 50% flowering and 50% fruiting; fruit damage percentage and yield

parameters were recorded in weekly interval in 10 randomly selected plants in each treatment.

Data analysis: Data obtained from the field experiment was entered and analyzed by using computer software package, Microsoft excel and SPSS. Analysis of variance (ANOVA) was carried out to test the treatment differences; α level was set at 0.05; means were compared using LSD. Analyzed data were presented in the form of tables and charts.

RESULTS AND DISCUSSION

There was no significance difference between the treatments statistically although variations in plant height were noted. The maximum height was observed in poly house inside Pest Exclusion Net compared to open poly-house. The reason behind it may be due to minimum damage by insect pests during the growing period.

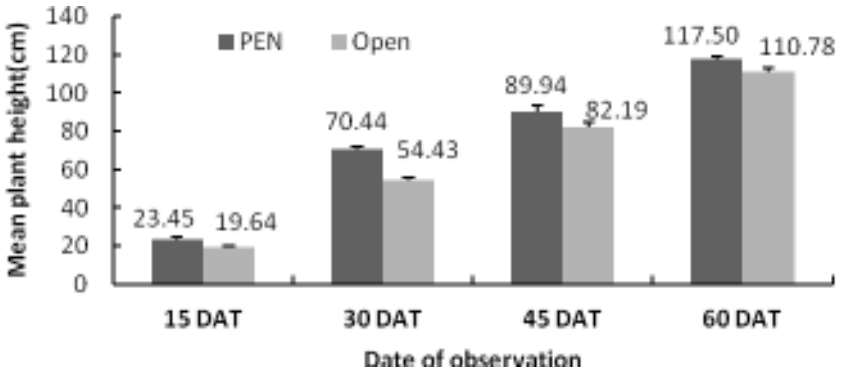

Figure 1: Measurement of plant height in different treatment

Leaf damage percent**:** Pest exclusion net was found to be effective in reducing leaf damage percent. It was found that there was a significance difference between the treatments. The damage percentage is higher in open field compared to the PEN house. From the study we found 1.61 % of leaves were damaged by *Tuta absoluta* and 0.5 percent by *Spodoptera litura* in the PEN. Similarly, in open on an average 9.34 percent of leaves were damaged by *Tuta absoluta* and 1.45 percent by *Spodoptera litura* which is higher than the damage in PEN. The numbers of insect pest were reduced in treatment first due to use of Pest exclusion Net. Therefore, the infestation on leaves was significantly lower in the Pest exclusion net poly house. And, the highest percent of damage was recorded in the open poly house. (Farmer's practice).

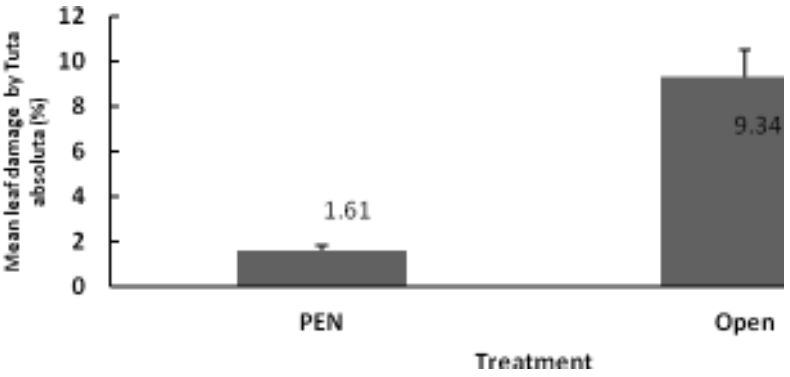

Figure 2: Leaf damage percent by *Tuta absoluta* in different treatment

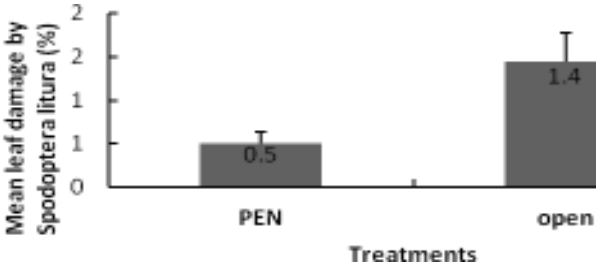

Figure 3: Leaf damage percent by tobacco caterpillar (*Spodoptera litura*)

Number of *Tuta absoluta*: The number of adult moth in both treatments in tomato field has been reported in figure 4. From the result, it was found that there was significance difference between two treatments. The p-value was found to be 0.000 (<0.05). Similar result was reported by Gogo et al. (2014).

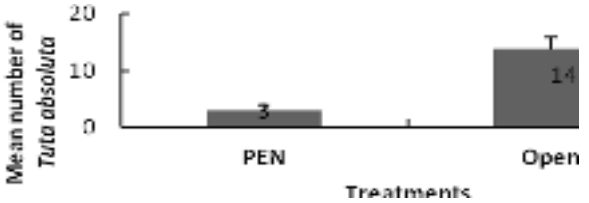

Figure 4: Number of *Tuta absoluta*

Number of whitefly (*Bemisia tabaci*): The number of *Bemisia tabaci* in both treatments in tomato field has been reported in figure 5. According to data, there was significant difference between both treatments. The treatment with PEN has few number of whitefly. The use of PEN reduces the movement of *Bemisia tabaci* in the tomato field. According to data, the PEN was found effective in blocking the movement of *Bemisia tabaci*. Similar result was reported by Feng-cheng et al. (2010).

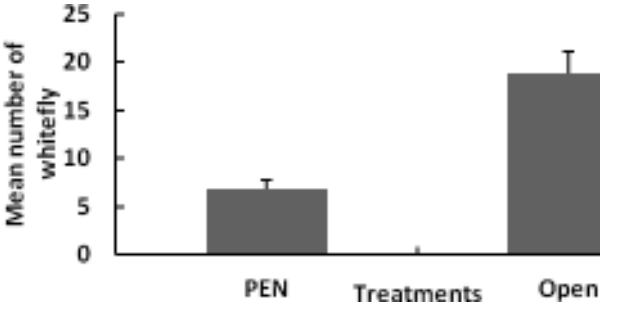

Figure 5: Number of whitefly

Number of Tobacco caterpillar (*Spodoptera litura*): The treatment with PEN has relatively few number of *Spodoptera litura* compared to open poly-house. The number of adult moth of *Spodoptera litura* in both treatments in tomato field has been tabulated in figure 6. There was significant difference among the treatments in number of *Spodoptera litura*. From the research we find that, Pest Exclusion Net is very much effective in controlling insect pest like *Spodoptera litura* too.

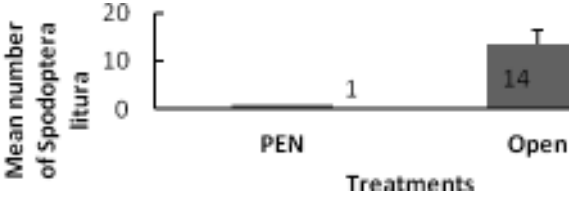

Figure 6: Number of Tobacco caterpillar (*Spodoptera litura*)

Number of tomato fruitworm (*Helicoverpa armigera*): Figure 7 present results of number of *Helicoverpa armigera* in both treatments (PEN and open). And the results of the study show that there was significant difference between the treatments indicating

that PEN was effective in blocking the movement of *Helicoverpa armigera.* The number of *Helicoverpa armigera* is reduced in first treatment due to use of Pest Exclusion Net. The result has also been supported by Saidi et al, 2014.

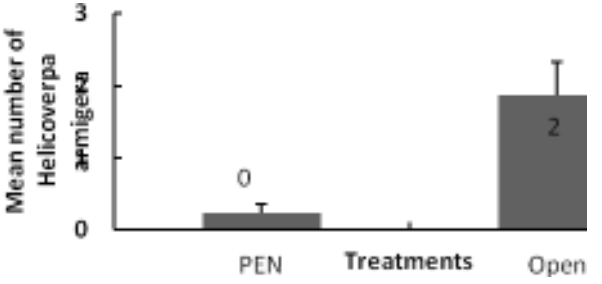

Figure 7: Number of *Helicoverpa armigera*

Days to 50% flowering and fruiting: Flowering and fruiting date of 50 percent plant from both the treatments was noted. And, the result showed that in treatment using PEN the flowering of 50% plant occur first i.e 24 days after transplanting and in open poly house the 50% flowering occurs after 31days of transplanting. The flowering duration was shorter inside PEN. Similarly, fruiting of 50 percent plant was earlier in PEN (31 days after transplanting) than open poly-house (45 days after transplanting). The reason may be due to less attack of insect pest in PEN.

Table 1: Days to 50 % flowering and fruiting

Days to 50% flowering			Days to 50% fruiting	
Replication	PEN (T1)	Open (T2)	PEN (T1)	Open (T2)
R1	27	34	35	50
R2	25	29	29	42
R3	21	31	30	44
Average	24	31	31	45
SD	3.06	2.52	3.21	4.16
SE	1.76	1.45	1.86	2.40

Fruit damage percentage: The result of the study shows that there was significance difference on fruit damage caused by insect pest between two treatments. It shows that

the percentage of fruit damage is high in open poly house compared to PEN poly house. The damage of fruit can also be controlled by use of PEN.

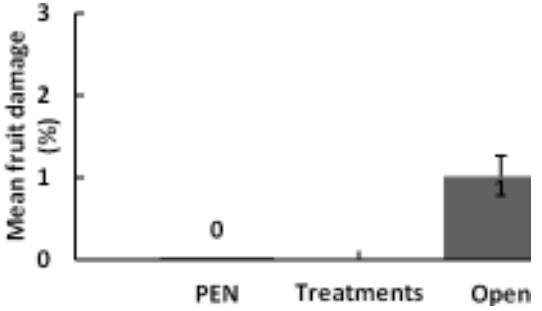

Figure 8: Fruit damage percentage

Yield: The result shows that there was significance difference between two treatments indicating that the yield was high in PEN compared to open poly-house. The reduction of insect pest infestation was the major reason behind the increase in yield. As shown in figure 9, the average yield of tomato in the PEN is 93.7 ton/ha and in open poly-house is 71.2ton/ha. This result was also supported by Scarascia-Mugnozza et al., 2012. According to Scarascia-Mugnozza et al., 2012, PEN helps in higher yield and produce improved quality vegetables.

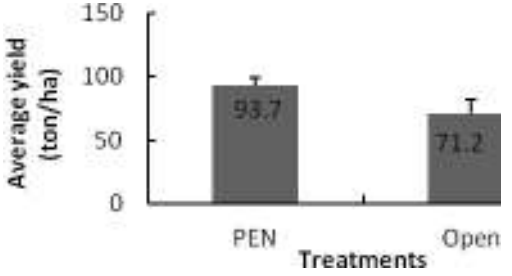

Figure 9: Yield

CONCLUSION

First time, the use of PEN was conducted and which was found effective to manage the major insect pests in the field. As compared to other methods, it was realized cheaper and easier to establish since majority of the farmers preferred it. After the occurrence of insect pests, it was found very useful to check the movement of insect pests inside the poly house and reduces loss caused by insect pest. Insect-proof screens constitute

efficient physical means of protecting horticultural crops against different insect pests and their use has becoming widespread throughout country in Nepal.

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REFERENCES

Bajracharya, A. S. R., R. P. Mainali, B. Bhat, S. Bista, P. R. Shashank, and N. M. Meshram. (2016). The first record of South American tomato leaf miner, Tuta absoluta (Meyrick 1917) (Lepidoptera: Gelechiidae) in Nepal. *Journal of Entomology and Zoology Studies* 4(4):1359-1363. Last accessed September 1, 2016, from http://www.entomoljournal.com/archives/2016/vol4issue4/PartO/ 4-4-95-749.pdf

Byrne DN, Bellows TS, Parrella MP (1990) Whiteflies in agricultural systems. In: Gerling D (ed.) *Whiteflies: their bionomics, pest status and management. Intercept, Andover*

Feng-cheng, X.U., L. Hui, L. Li-min, L.L. Fang-fang, C. Wen-hua, and L. Ding-peng. (2010). Initial report about prevention and controlling of tomato leaf curl virus with 50-mesh insect nets throughout the whole growing season. China Vegetables. 8: 61-64.

Gogo,E.O.; Saidi, M.; Itulya, F.M.; Martin, T.; Ngouajio, M. (2012) Microclimate modification using eco-friendly nets for high quality tomato transplant production by small-scale farmers in East Africa. HortTechnology (2012), 22, 292–298.

Kajita, H. and Alam, M.Z. (1996). Whitefliess on Guava and Vegetables in Bangladesh and their Aphelinid parasitoids. Appl. Entomol. Zool. 31(1):159-162.

Merrill, (1967) H.A. Merrill Control of nuisance pests in suburbia Proceedings of the 3rd Vertebrate Pest Conference, March 1967, San Francisco, California, USA (1967), pp. 7-9

MESD. (2015) *Statistical information on Nepalese agriculture*. Monitoring, evaluation and statistics division, Ministry of agriculture development, Singha Durbar, Kathmandu, Nepal

MOAD. (2015). *Statistical information on Nepalese Agriculture.* Ministry of Agriculture and Development, Singha Durbar, Kathmandu.

Paneru, R. B., Bhurtyal, P.R. & Aryal, S. (2004) 'Evaluation of biopesticides against tomato fruit worm Helicoverpa armygera Hubner, on tomato at Khumaltar'. In: *Proceedings of fourth National Workshop on Horticulture*, 2-4 March, Horticulture Research Division, Khumaltar, Lalitpur, Nepal. pp. 391-395.

Saidi, M., Gogo, E.O., Itulya, F.M., Martin, T. and Ngouajio, M., (2013) Microclimate modification using eco-friendly nets and floating row covers improves tomato (Lycopersicon esculentum) yield and quality for small holder farmers in East Africa. *Agricultural Sciences*, *4*(11), pp.577-584.

Scarascia-Mugnozza et al., (2012) G. Scarascia-Mugnozza, C. Sica, G. Russo Plastic materials in European agriculture: actual use and perspectives J. Agric. Eng. Res., 42 (2012), pp. 15-28 CrossRef

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Production and marketing of rice in Naghlebhare Rice Block, Kathmandu: an economic analysis

B.K. Sapkota[1], J.P. Dutta[1], T.R. Chaulagain[2] & S. Subedi[3]
[1]University of Agriculture and Forestry, Nepal
[2] Prime Minister Agriculture Modernization Project, Ministry of Agricultural Development, Nepal
[3]Nepal Agricultural Research Council, Nepal
sapkota.bidya@gmail.com

ABSTRACT

Research was conducted from May to August, 2017 to assess the economics of production and marketing of rice in Naghlebhare rice block, Kathmandu. Pre-tested interview schedule, Focal Group Discussion (FGD) and Key Informant Survey (KIS) were used to collect the primary information from the respondents, while secondary information were collected by reviewing different relevant publications. Respondents were of two categories; namely, farmers and traders. Altogether, 60 samples were taken by simple random sampling for the purpose of the study. The statistical tools, MS- excel and SPSS were used for data analysis. Majority (55%) of the respondents reported agriculture as their major occupation. The average land holding of the farmers was 13 ropani; the average rice cultivated land was 6.6 ropani. Nearly 90% of the farmers buy inputs (seed and fertilizers) from cooperatives. The average gross margin per ropani from rice production was calculated Rs.3911; benefit cost ratio was estimated 1.89. In addition, four marketing channels were identified; price spread and producer's share were found to be ranging from 0 to Rs.5.4 and 89 % to 100% respectively. Furthermore, indexing identified- lack of availability of fertilizers in required quantity and time (I = 0.88) and lack of proper coordination between producers, market players and government agencies (I = 0.86) as the major problems associated with the production and marketing of rice in Naghlebhare respectively. This research explored the economic feasibility of rice production, efficiency of marketing channels and major problems in rice production and marketing in Naghlebhare rice block, Kathmandu.

Key words: Benefit cost ratio, indexing, producer's share, rice block

INTRODUCITON

In Nepal, agriculture and forestry sector contributes 31.13 % share in national Gross Domestic Product (GDP) (MOAD, 2017). Rice is the major staple food in the Nepalese context. Rice ranks the first among cereal crops in terms of area, production, and livelihood of the people. However, Nepal has lagged behind in increasing productivity to fulfill the rice demand of the increasing population. The total area, production and yield

of the rice in Nepal are 1,362,908 ha, 4,299,079 metric ton (mt) and 3154kg/ha respectively (MOAD, 2017). Ministry of Agricultural Development (MOAD) has launched the 10 years Prime-Minister Agriculture Modernization Project (PM-AMP). The MOAD has envisaged pockets, blocks, zones and super zones for agriculture products to address the fragmentation of arable land, which is considered to be a major barrier for agriculture commercialization and mechanization in the country. As per the MOAD, at least 10 hectares of land is needed to identify it as 'pocket area'; 100 hectares to be considered a 'block'; 500 hectares to be termed as 'zone', while a 'super zone' would make up of 1,000 hectares of land mass. Kathmandu is one of the potential districts for rice production; PM-AMP has selected Naghlebhare as the rice block in Kathmandu district (MOAD, 2016). Though infrastructure is not the major constraint for rice production in Kathmandu, there are some problems associated with the production and marketing of rice which are hindering yield and benefits. Inadequate and untimely supply of quality seeds and fertilizers, land fragmentation, incidence of disease-pests, inefficient marketing and pricing system are the major constraints of rice production and marketing. In addition, marketing problems such as lack of marketing knowledge, market information, lack of proper transportation and storage, proper coordination between market players are also hindering the benefits from rice cultivation. Agribusiness being crucial lever of rural development and income improvement in Nepal, it is important to conduct local research to generate knowledge on economics of production and marketing of rice. In addition, identification of the major constraints associated with rice production and marketing in this potential block is still lacking. In this context, this research aims to address these research gaps. Furthermore, this study facilitates documentation of costs and benefits in rice production, market information and associated problems in production and marketing; it would help the policy maker and researchers in identification of potential area for intervention as well.

MATERIALS AND METHODS

Study area, sample size and data collection technique

Naghlebhare was selected for the purpose of the study as it has been identified as the rice block of Kathmandu under PM-AMP. Respondents were of two categories; namely, farmers and traders. Altogether, 60 samples were taken by simple random sampling for the purpose of the study. 40 farmers and 20 traders were selected; among the 20 traders, 5 were local level collector/middle man, 5 were wholesalers, 5 were mills and remaining 5 were consumers. Pre-tested interview schedule, Focal Group Discussion (FGD) and Key Informant Survey (KIS) were used to collect the primary information from the respondents, while secondary information were collected by reviewing different relevant publications.

Methods and techniques of data analysis

The information collected from the field was first coded and entered into the computer. Data entry and analysis was done by using computer software packages like the

Statistical Package for Social Science (SPSS) and Microsoft Excel. Simple descriptive statistics such as average, standard deviation, and percentage were used for the analysis. The following analyses were performed.

Gross margin

Gross margin is the value of output by producer, which is computed at the farm gate price minus the total variable cost.

Gross margin = Gross return - Total variable cost

Where, Gross return = Price x total quantity marketed

Total variable cost = Summation of cost incurred in all the variable items

Benefit cost analysis

Benefit cost analysis was done after calculating the total cost and gross return from the rice cultivation. Cost of production was calculated by summing the variable cost items in the production process. For calculating gross return, income from product sale was accounted. Therefore, the benefit cost analysis was carried out by using formula:

$$B/C\ ratio = \frac{Gross\ return}{Total\ cost}$$

Price spread and producer's share

Price spread is the difference between the price paid by the consumers and the price received by the farmers. In addition, price spread is the sum total of the marketing margins in different stages of the marketing channel.

Price spread = Price paid by consumer – Price received by producer (Farm gate price)

Similarly, Producers' share (P_S) is the price received by the farmer expressed as a percentage of the retail price, that is, the price paid by the consumers. It was calculated by the following formula.

$$P_S = (P_f/P_r) \times 100$$

Where,

P_f = Producer's price (farm gate price)

P_r = Retailer's price

P_s = Producer's share

Problems in production and marketing

Qualitative data were taken into account to prepare the index. On the basis of responded frequencies, weighted indexes were calculated for the analysis of farmer's perception on the extent of production and marketing problems. Scaling techniques provide the direction and extremity attitude of the respondents towards any proposition (Miah, 1993). Farmer's perception to the different production and marketing problems were ranked by using five point scales. Then the priority index was calculated by estimating weight age average mean. The index of importance was computed by using the formula,

$$I_{imp} = \sum \frac{Sifi}{N}$$

where, I_{imp} = index of importance

$\sum$ = summation

S_i = I^{th} scale value

F_i = frequency of i^{th} importance given by the respondents

N = total number of respondents

RESULTS AND DISCUSSION

Total land holding

Land, labor and capital are the major factors for the cost of production. Table 1 shows that more than two third of the respondents (75%) had total land in between 6 to 20 ropani, (17.5%) had total land greater than 20 ropani and (7.5%) had less than 6 ropani. The average land holding of the respondents was 13 ropani while standard deviation was calculated 7 ropani.

Table 1: Land holding status

Total land holding in ropani*	Naghlebhare
<6 ropani	3 (7.5)
6-20	30 (75)
>20	7 (17.5)

Note: Figures in parentheses indicate percentage, *mean 13 and s.d.7
Source: Field survey, 2017

Rice cultivated land

The study revealed that (82.5%) of the respondents grow rice in the area between 3-10 ropani, (12.5%) grow in the area less than 10 ropani and (5%) grow rice in the area less than 3 ropani (Table 3). The average rice cultivated land was 6.6 ropani, standard deviation was calculated 3.6 ropani.

Table 2: Rice cultivated land

Rice cultivated land in ropani*	Naghlebhare
<3	2 (5)
3-10	33 (82.5)
>10	5 (12.5)

Note: Figures in parentheses indicate percentage, *mean 6.6 and s.d. 3.6
Source: Field survey, 2017

Table 3 and Table 4 revealed that the major portion of the total cultivated land (51%) is being used for rice cultivation in the study area.

Cost of production of rice

The cost of production is the major factor that influenced the profitability of the enterprise and also shows the efficiency of the inputs used by the farmers. In the study area, human labor was one of the major attributing items among all variable items and was computed in term of man per day. Human labor was required for performing different operations such as nursery bed preparation, land preparation, fertilizer application, pesticides application, irrigation, weeding, harvesting and storage. Labour cost occupied the major portion (77.68%) of the cost of production followed by the fertilizer cost (5.92%), FYM cost (5.92%), seed cost (4.64%), micronutrient (3.38%) and pesticides (2.43%). Only 4.64% and 5.92% of the total cost of production was incurred by the seeds and fertilizers respectively, this may be due to the subsidy on seeds and fertilizers provided by the government.

The total variable cost for rice production in one ropani land was calculated Rs.4386.220. The average cost of seed per ropani was calculated Rs.203.62 whereas the cost of farmyard manure and fertilizers were estimated Rs. 259.75 and Rs. 259.82 respectively. Similarly, the average cost of labour per ropani was calculated Rs.3407.61 and cost of pesticides and micronutrients were estimated Rs.106.75 and Rs.148.67 respectively. This showed major cost attributing item was labour in the rice production. The details of the average cost of rice production are shown in the Table 3.

Table 3: Average cost of rice production per ropani

Materials	Average cost
Seed	203.62
Farmyard manure	259.75
Fertilizers (Urea, DAP and MOP)	259.82
Labour cost (Ploughing, transplanting nursery preparation, cutting weeding, bitting)	3407.61
Pesticides	106.75
Micronutrient	148.67
Total variable cost	4386.220

Source: Field survey, 2017

Gross return

The return was obtained from two products, grains and straw. The total return from grains in one season in one ropani was calculated Rs.6231.758 and Rs. 2065 from the straw. The gross return obtained was calculated Rs. 8296.758. The average price of the grain was calculated Rs.44.2 per kg and that of straw Rs.10 per bundle.

Gross margin

Gross margin = Gross returns –Total variable cost
= 8296.758-4386.220
= NRs. 3910.53 per ropani

Benefit Cost Ratio

Benefit Cost Ratio (BCR) = Gross returns/ Total cost
= 8296.758/4386.220
= 1.892

Gross margin is positive which showed that the rice production is economically viable. The estimation of gross margin is essential to obtain economic optimization (Upton, 1996). BCR is greater than one. This implies, if we invest one rupee, we can get the returns of Rs 1.892, which indicates that the investment is financially viable (Table 4). The BCR of rice in the central development region was 2.83, which was highest among the five development region (Joshi, 2004).

Table 4: Economic indicators of the rice production.

Cost items	Amount (Rs.)
Total variable cost (Rs./ha)	4386.220
Return from Grain	6231.758
Return from Straw	2065
Average price of grain (Rs./kg)	44.2
Average price of straw(Rs./bundle)	10
Gross returns (Rs.)	8296.758
Gross margin (Rs.)	3910.53
Benefit-cost ratio (B:C)	1.892

Source: Field survey, 2017

Marketing channels

Marketing channel is the route through which the product reached from the producer field to consumer hands. Acharya and Agrawal (1999) defined agricultural marketing as comprising of all activities involved in supply of farm input to the farmers and movement of agricultural products from the farmers to the consumers. Four marketing channel were identified from the FGD, KIS and field survey in the study area. Survey results showed that 12.5% of the producer sold rice grains directly to the consumer and rest of the producers (87.5%) sold to local level collector. From the local level collector, product reached to the consumer passing through wholesaler and mills.

Furthermore, marketing channel - (Producer – Collector – Mills - Consumer) was identified as major marketing channel from where 43.75% of the total produce reached to consumer. While, 26.75%, 17.5% and 12.5% of the total produce reached to consumer

through marketing channels - (Producer – Collector - Consumer), (Producer-Collector-Wholesaler -Mills-Consumer) and (Producer-Consumer) respectively.

Price spread and producers' share

Price spread is the sum total of the marketing margins in different stages of the marketing channel. Producers' share (P_S) is the price received by the farmer expressed as a percentage of the retail price, that is, the price paid by the consumers. The four marketing channels are described below.

Channel 1st

Producer (NRs. 44.8) → Consumer (NRs. 44.8)

Channel 2nd

Producer (NRs. 44.2) → local level collector (NRs. 47.6) → Consumer (NRs. 47.6)

Channel 3rd

Producer (NRs. 44.2) → local level collector (NRs. 46.8) → Mills (NRs. 49.6) → Consumer (NRs. 49.6)

Channel 4th

Producer (NRs. 44.2) → local level collector (NRs. 46) → Wholesaler Rs. 48) ⟶ Mills (NRs. 49.6) ⟶ Consumer (NRs. 49.6)

Source: Field survey, 2017

Price spread = Price paid by consumer – Price received by producer

Price spread was observed as NRs 0, 3.4, 5.4 and 5.4 in channel 1st, 2nd, 3rd, and 4th respectively. Study showed that price spread is directly proportional to the length of the marketing channel. With the increased in the length of the marketing channel, price spread increased. Mishra et. al. (1995) reported that the farmers' share can be as high as 87% in onion, 68% in cabbage, and 62% in cauliflower, when they sell their output direct to consumers; however, the share can fall below 50% as more agents are involved in marketing. Though the price spread in 3rd and 4th marketing channel are equal but the marketing margin among market players varies in different stages. Marketing margin in the first marketing channel is zero which is least among the four marketing channel. Marketing margin from producer to the local level collector in the second marketing channel was calculated 3.4. Similarly, the marketing margin in the third marketing channel was 2.6 from producer to the local level collector, 2.8 from local level collector to the mill. In the fourth marketing channel, marketing margin was computed 1.8, 2, and 1.6 from producer to local level collector, local level collector to wholesaler and wholesaler to mill respectively.

Producers' share in consumers' price = (price received by the farmers /price paid by the consumer) × 100%

Producers' share in consumers' price was observed as 100%, 92.86%, 89.11% and 89.11% in channel 1st, 2nd, 3rd and 4th respectively. Study showed that producers' share is inversely proportional to the length of the marketing channel i.e. producer's share decreased with the increase in the length of the channel. However, producer's share in the third and fourth marketing channel remains the same irrespective of the length of the channel. It is due to the fact that in the both the marketing channels, consumer are receiving the product from the mills at the same price and the price received by the producer is also same. Consequently, the producer's share in the both the marketing channel was found to be same. It has been reported that the farmers who sold their produce directly to consumers received higher share of the consumer's price than did those who sold their produce through agents (Vasish et. al., 1995). The producer's share of different marketing channels is better illustrated in figure 1.

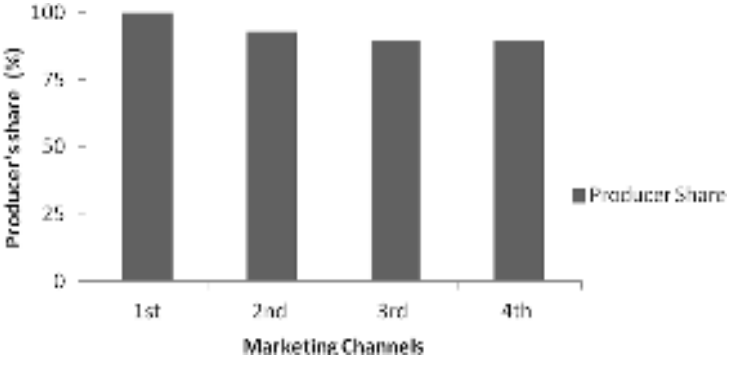

Figure 1: Producer's share of different marketing channels

Problems associated with the rice production

In the study area, farmers were facing several problems related to the production. Based on the farmers' perception, scaling technique was applied to rank the problems. The study revealed that, among the production problems, lack of availability of fertilizers in required quantity and time (I= 0.875) appeared as the most important problem followed by lack of availability of quality seed (I= 0.79), land fragmentation and lack of mechanization (I= 0.575), incidence of disease and insect/pest (I= 0.445) and lack of proper irrigation and drainage (I= 0.305) (Table 5). These problems might be prevailing because of lacking of appropriate policies due to instability of government; also, due to lack of proper action plans for providing the effective extension services. Paudyal (2001); Shrestha and Timsina (2011) also stated that the yield is significantly affected by seed quality, infestation of disease and pest and availability of irrigation. In addition, it has been reported that the low use of quality seeds of high yielding crop varieties along with other inputs (e.g. fertilizer, farm machinery) lead into low productivity (Gauchan, 2015).

Table 5. Problems in rice production

Production problems	Index	Rank
Lack of availability of fertilizers in required quantity and time	0.875	I
Lack of availability of quality seed	0.79	II
Land fragmentation and lacking of mechanization	0.575	III
Incidence of disease and insects/pest	0.445	IV
Lack of proper irrigation and drainage	0.305	V

Source: Field survey, 2017

Problems associated with the rice marketing

Indexing/ Scaling technique was again used to rank the marketing problems. The study revealed that lack of proper coordination between producers, market players, and government agencies (I= 0.855) was the first major marketing problem followed by lack of proper knowledge of marketing techniques (I= 0.74), distant market (I= 0.57), lack of proper transportation facilities (I= 0.49) and lack of storage facilities (I= 0.345). No doubt, these problems have contributed to a greater extent for the increased price spread and decreased producer's share. The index value and ranking of the marketing problems are shown below in the table 6. A study was done on constraints related to the agricultural marketing in Nepal at various levels from producers to consumers and the finding identified poor institutional, legal and marketing infrastructure as the major constraints of agricultural marketing in Nepal (Thapa et al., 1995). Also, Bhattarai (1992) explained the lack of transportation facilities as major marketing problems for vegetables.

Table 6. Problems in rice marketing

Marketing problems	Index	Rank
Lack of proper coordination between producers, market players and government agencies	0.855	I
Lack of proper knowledge for marketing techniques	0.74	II
Distant market, no nearby access to market	0.57	III
Lack of proper transportation facilities	0.49	IV
Lack of proper storage facilities	0.345	V

Source: Field survey, 2017

CONCLUSIONS

The gross margin is positive and benefit cost ratio, greater than 1 (1.89), which indicated the economic feasibility of the rice farming in the study area, Naghlebhare. However, labour cost has occupied the major portion of cost of production; emphasizing mechanization in agriculture could minimize the cost of production. Seeking the producer's share of four marketing channels, marketing channel- first (Producer – Consumer) was identified the most efficient with the highest producer's share (100%). In addition, price spread was lowest (0) in the first marketing channel; marketing channel

with the lower price spread is more efficient. Furthermore, third marketing channel was identified as the major marketing channel from where 43.75% of the total produce reaches to consumer. It would be better to shorten the intermediaries in the marketing channel, conducting marketing through cooperative system. Lack of availability of fertilizers in required quantity and time (I=0.88) was identified as the major problem associated with rice production in the study area. Proper supervision of subsidies in fertilizers and their timely availability is still lacking. Similarly, regarding marketing, lack of proper coordination between producers, market players and government agencies (I= 0.86) was identified as the major problem. There is an immense need of proper coordination between producers, market players, and government agencies.

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REFERENCES

Acharya, S. S. and Agarwal, N. L. (1999) *Agricultural Marketing in India*, 3rd Ed. Oxford and IBH Publishing Co. Pvt.Ltd, New Delhi, India. 402 p.

Bhattarai, M., (1992) *A study on Marketing of Tomato in Sarlahi District: Problems and Prospects*. Report Submitted By No-Frills Consultant to Winrock International, Kathmandu, Nepal. 39-73.

ADB (2017) *Poverty line in Nepal*. Share of population below the national poverty line. Available at: http://www.adb.org/countries/nepal/poverty (Retrieved on: June 10th 2017).

ADS (2015) *Agriculture Development Strategy (2015 to 2035).* Singh Durbar, Kathmandu, Nepal: Ministry of Agriculture Development (MOAD), Government of Nepal.

CBS (2015) Statistical Year Book Nepal, (2015) *Central Bureau of Statistics (CBS),* National Planning Commission Secretariat, Government of Nepal.

DADO (2015) *District agriculture statistics data book 2015/16*. Kathmandu: District Agriculture Development Office, Kathmandu.

Dhital, K. (2011) *Study on System of Rice Intensification in Transplanted and Direct seeded Versions Compared with Standard Farmers Practice in Chitwan*. Thesis. M.Sc.Ag., IAAS, Department of Agronomy, Rampur, Chitwan, Nepal.

Dwett, K. K. and Verma, J.D. (1980) *Elementary economic theory*. New Delhi: S. Chanda and Company.

Gauchan, D. (2015) *Research and Support Services in Seed Production and Supply in Nepal*. Thematic Paper for Seed Submit, 2015. Retrived from: http:// sqcc.gov.np/ media/ publication/Research_ by _ Devendra. pdf.

Gujrati, D.N. (2003) *Basic Econometrics*. 4th ed. McGraw- Hill, Singapore. 112-128.

Joshi, N.P. (2004) *Production and Marketing of Rice in different development regions of Nepal.* Thesis. M.Sc.Ag., IAAS, Department of Agricultural Economics, Rampur, Chitwan, Nepal.

Kothari, C.R.(1974) *Quantitative techniques. (*3rd ed). Vikash Publishing House, New Delhi.

AICC. (2016) *Krishi Diary*. Agriculture Information and Communication Centre. Lalitpur, Nepal.

Kumar, K.Y. (2015) *Nepal Portfolio Performance Review 2015*. Ministry of Agricultural Development. Singh Durbar, Kathmandu, Nepal.

Miah, A.Q. (1993) *Applied statistics: A course handbook for human settlements planning.* Asian Institute of Technology, Division of Human Settlements Development, Bangkok, Thailand, 412 p.

Mishra, S.N.; Tripathi, S.and Prusty, B.K. (1995). Production and marketing of onion in Kalahandi district of Odisha. *Indian journal of Agricultural marketing*, 9(1): 167.

MoAD. (2014) *Statistical Information on Nepalese Agriculture.* Agri-Business Promotion and Statistics Division, Singh Durbar, Kathmandu, Nepal.

MoAD. (2015) *Statistical Information on Nepalese Agriculture, 2014/15*. Ministry of Agricultural Development. Singh Durbar, Kathmandu, Nepal.

MoAD. (2016) *Statistical Information on Nepalese Agriculture 2015/2016*. Agribusiness Promotion and Statistic Division. Hariharbhawan, Lalitpur: Ministry of Agricultural Development.

Paudyal, K.R., Ransom, J.K., Rajbhandari, N.P., Adhikari, K., Gerpacio, R.P. and Pingali, P.L. (2001) *Maize in Nepal: Production Systems, Constraints, and Priorities for Research*. Kathmandu: NARC and CIMMYT.

PMAMP. (2016) *Prime Minister Agriculture Modernization Project* Final Cabinet Document. Singhadarbar, Kathmandu, Nepal: Ministry of Agricultural Development, Government of Nepal.

Shrestha, J., & Timsina, K.P. (2011). Agronomic Performance and Economic Analysis of Maize (Zea mays L.) under Different Plant Geometry and Nitrogen Rates in Chitwan, Nepal. *Nepalese Journal of Agriculture Science*, 9, 5-13.

Singh, C. (1997). *Modern Techniques of Raising Field Crops*. Oxford and IBH Publication Co. Pvt. Ltd. New Delhi, India.

Thapa, P. K. (1998) *Economic Efficiency of Contractual Vegetable Seed Production in the Eastern Hills of Nepal*. Thesis, Ph. D. University of Philippines Los Banos. 231p.

Upton, Martin. (1996) *The Economics of Tropical Farming Systems.* Cambridge University Press, England.

Vasisht, A. K., Singh C., and Singh, I. (1995) Temporal and Spatial Change in the Price spread of Agricultural Commodities in India. *Indian Journal of Agriculture Marketing, Conference Special,* 9(1), 1-11.

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Proximate analysis of ostrich meat for its quality in chilled and frozen condition

R.P. Yadav[1] and A. Mishra[2]
[1]Himalayan College of Agricultural Sciences &Technology, Kathmandu, Nepal
[2]Food Research division Nepal Agricultural Research council

ABSTRACT

Ostrich meat is very popular due to its healthy nature so its demand is increasing globally. Therefore, one study has been made on quality of ostrich meats of different ages at chilled and frozen conditions by targeting product. Meat samples from two differently aged, 10 and 14 months' ostriches were collected and divided into three parts for each type. One part was analyzed immediately, one part was *put in chilling at 4°C for 72 hours and next part was put in deep fridge at -20°C for 30 days. Proximate analyses were carried out for moisture (73.98 to 75.22%), protein (21.08 to 22.46%), total fat (2.43 to 3.27%) and total minerals (0.83 to 1.82%). There was subsequent decrement in moisture at cold storage practices, at 72 hours chilling by 1% and one month freezing by 2.3% and there was no difference of water content within the age of bird. The amount of protein was found increasing at chilling, freezing and age, total fat significantly different within the age as well as storage practices and total ash in decreasing trend in case of chilling and freezing conditions but no difference with age.*

Keywords: Ostrich meat, proximate analysis, storage, protein, total fat, mineral

INTRODUCTION

Meat consumption in developing countries has been continuously increasing. There are economic, dietary and sensory aspects that make meat processing one of the most valuable mechanisms for adequately supplying animal protein to human populations (Heinz and Hautzinger, 2007). These circumstances coerce into the diversification of meat into variety of meat products. The total annual meat production in Nepal is 288 thousand MT in which buffalo contributes the largest supply (64.1%) followed by goat (17.46%), sheep (1.33%), pig (7.38%), and poultry (9.61%) (CBS, 2014/15). From the data of five years, it can be said that production and consumption of poultry meat is in increasing trend in Nepal.

Introduction Over the last decade there is still observed a growing interest in ostrich farming and husbandry worldwide (Cooper et al. 2008). In Nepal also ostrich farming is in increasing trend just like as livestock and livestock products especially as a source of foods leathers, feathers and eggs. Its meat has been started to retail in meat mart since 2008 in Nepal. Ostrich meat is very popular due to the low level of cholesterol, calories,

fat free, high level of iron and proteins, rich of omega 3, 6, and 9 with low saturated fat contents of 0.5% with rich of taste and easy to prepare. That's why ostrich meat is increasing rapidly and gaining popularity globally among the health conscious red meat lovers.

Protein levels are high in ostrich meat, of about 28% in average, and the most frequent amino acid is creatinine (Nitzan *et al*., 2002). Tenderness is the most appreciated ostrich meat characteristic. This is due to its low levels of saturated fat and its collagen to protein ratio, which are part of the connective tissue, and are responsible for meat texture, making it easy to digest and to chew. In addition to the low collagen level (0.44% in average), the arrangement of the muscle fibers, which are transversally oriented, may also explain its tenderness (Balog *et al.,* 2006).

The characteristic red color of ostrich meat can be explained by its high pigment content (22 mg Fe/g). Pigment content varies among different ostrich muscles, with *Flexor cruris lateralis, Iliofibularis*, and *Iliotibialis cranialis* presenting more intense color. Meat color is also influenced by water holding capacity, as higher water content results in higher absorption of radiation and lower reflection, making the meat darker (Balog and Almeida, 2007). This study was carried out to assess the quality of ostrich meats produced in Nepal which were of different ages and stored in chilled and frozen conditions

MATERIALS AND METHODS

Meat sample collection and processing

Meat samples from two differently aged, 10 and 14 months' ostriches were collected from outlet of Gangoliya Rupandehi by maintaining cold chain. Ice box and ice packs were used for cold chain maintenance and the temperature was in the range of 2-3°C. Collected samples were divided into three parts for each type. One part was analyzed immediately. Among the remaining two parts, samples were divided equally, packed in polyethylene pouches (thickness 40 microns) and sealed. Thereafter, one part was put in chilling at 4°C for 72 hours and next part was put in deep fridge at -20°C for 30 days prior to analyses. Proximate analysis Moisture, protein, fat, total ash, and crude fat as ether extract of ostrich meats of two different treatments were analyzed as per the method mentioned in Meat Science by Lawry (1998). The carbohydrate contents and crude fiber contents in ostrich meat were assumed to be zero.

RESULTS AND DISCUSSION

Proximate constituents such as moisture, protein, fat, total ash, and total fat as ether extract of ostrich meats of two different treatments were analyzed results were interpreted onTable 1. The carbohydrate contents and crude fiber contents in ostrich meat were assumed to be zero. Observations were taken at fresh meat, chilled and frozen meats after 72 hours.

Table 1. Proximate analysis of ostrich meat of different treatments

Treatments	Moisture %	Protein %	Total fat %	Total ash %
T1 (Fresh 14 months' ostrich meat)	73.98^{ae}	22.46^{a}	2.43^{a}	1.82^{a}
T2 (Chilled 14 months' ostrich meat)	72.86^{b}	22.98^{ab}	2.51^{a}	1.56^{a}
T3 (Frozen 14 months' ostrich meat)	71.67^{c}	23.35^{b}	3.03^{b}	1.24^{b}
T4 (Fresh 10 months' ostrich meat)	75.22^{d}	21.08^{c}	2.85^{c}	1.32^{b}
T5 (Chilled 10 months' ostrich meat)	74.38^{e}	21.77^{cd}	3.02^{b}	1.02^{c}
T6 (Frozen 10 months' ostrich meat)	73.54^{a}	22.18^{d}	3.27^{d}	0.83^{d}
F. Pr.	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$
LSD	0.615	0.845	0.221	0.276
SEM	0.205	0.188	0.067	0.085
CV%	1.5	0.9	4.4	7.8

Values are the means of triplicate analyses. The different superscripts on the each mean value in same column indicates significantly different.

Moisture content of older and younger ostrich fleshes were found 73.98% and 75.22% respectively at fresh condition. There was subsequent decrement in moisture at cold storage practices. At 72 hours of chilling moisture of older ostrich flesh was reduced almost one percent whereas at frozen condition for one month, moisture was reduced by 2.3%. Moisture contents of ostrich were significantly different at both conditions such as age and storage practices ($p<0.05$) (Table 1). In case of younger ostrich flesh, the moisture loss was found in similar pattern as older ostrich flesh. The noticeable loss in moisture might be due to the drip loss at chilling condition. Unlikely chilling condition, the loss in moisture at frozen conditions might be the sublimation of exudates at the time of thawing.

The results in this study were very comparable to the findings of Naseva *et. al.* (2010). In his study, ostrich meat contains 74.52 % water. He also mentioned that the values were very similar to chicken flesh 75.58 % and beef flesh 74.21 %. The protein amounts 22.62 % in the ostrich meat, 17.57 % in the chicken and 21.22 % in the beef; the fats quantity is 0.34 % in the ostrich meat, 5.2 % in the chicken and 1.9 % in the beef, and the minerals take 1.2 % of the ostrich meat, 0.9 % of the chicken and 1.1 % of the beef.

Regarding protein content, ostrich flesh was found a bit higher protein compare to other meat animal fleshes. The range of protein was 21.08 in younger bird of 10 months to 22.46% in older bird of 14 months. The amount of protein was found a bit increasing at

chilling and more at freezing conditions. However, within the same origin of flesh, there were no significant differences in protein contents at both cold storage practices ($p<0.05$) (Table 1). The condition might be due to the loss of water as drip loss at chilling condition and by sublimation at freezing condition and thereby increased solid contents.

In one of the study by Nitzan *et al*., 2002, protein level in ostrich meat was assessed about 28% in average, and the most frequent amino acid is creatine. Protein contents in this study were found lower than the abovementioned study but found similar to the results of Naseva *et. al.* (2010). The major factor might be the environmental condition where ostrich were reared or and the minor one might be the analytical errors.

Total Fat, extracted as ether extract, contents in ostrich fleshes were found significantly different within the age as well as storage practices ($P<0.05$) and ranged 2.43 to 3.27% (table 4.1). Total fat includes fat from residual adipose tissues and intramuscular fats. Fat contributes in palatability of meat and considered eating quality. In this study, difference was insignificant in fat contents between normal and chilled flesh from 14 months' ostrich but it was statistically different within the meats from younger ostrich.

Fat contents estimated in this study were found higher compare to the study made by Naseva *et. al.* (2010), which was less than 1%. The condition might be due to the error in sampling such as from different anatomical cut up parts or higher content of adipose tissue in the flesh. However, Cooper *et al.*, 2009 also mentioned that fresh ostrich meat contained 0.56 to 3.57% total fat. Similarly, Paleari *et al.,* (1998) reported that the percentage of fat is the lower for ostrich meat (1.6%) compared with turkey and bovine, with values of 3.8 and 4.5%, respectively and the results were very comparable to the current study. The fat-to-protein ratio is the key characteristic that favors ostrich meat as a healthy red meat. This ratio was low in ostrich meat (0.07) as compared with turkey and bovine, 0.18 and 0.22, respectively (Paleari *et al.,* 1998).

Total ash is the combination of all minerals available in the sample. Meat contains 1-2.5% total minerals (Subba, 2010). In this study the range of total ash was 0.83 to 1.82%. The study conducted by Naseva *et. al.* (2010) stated that there were about 1.2 % total minerals in ostrich meat which were similar to chicken flesh (0.9 %) as well as to beef (1.1 %). However value of total minerals was a bit higher in the present study. Results from the current study were statistically different to each other except fresh and chilled meats from 14 months old ostrich ($p<0.05$) (table 1). Total minerals were in decreasing trend in case of chilling and freezing conditions because of the loss of minerals in exudates during chilling or thawing process. Among the ash contents, minerals such as phosphorus, manganese, and iron are higher and sodium is lower in ostrich meat than either beef or chicken.

CONCLUSION

This study was conducted first time in nepal to study on **Proximate Analysis of ostrich meat to assess the quality in Chilled and frozen condition.** This study revealed the carbohydrate contents and crude fiber contents in ostrich meat were assumed to be zero. Observations were taken at fresh meat, chilled and frozen meats after 72 hours.

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REFERENCES

Annonymous (1992) *Meat and meat products for Human Nutrition in Developing Countrie*s. FAO Food & Nutrition Paper 53, FAO Rome.

Balog, A. and Almeida P. (2007) Ostrich (*Struthiocamellus*) carcass yield and meat quality parameters.*Rev. Bras. Cienc.Avic.* 9 (4).

Cooper, R. G, Jimenez S, Barbera T, Sendra R, Alvarez P (2006) Quality characteristics of ostrich (*Struthiocamelus*) burgers. *Meat Sci.*73,295-303.

Cooper, R. G. (1999) Ostrich meat, an important product of the ostrich industry: A Southern African perspective. *World's Poult. Sci. J.* 55, 389-402.

Hoffman, L. C., Fisher P (2001) Comparison of meat quality characteristics between young and old ostriches. *Meat Sci.* 59,335-337.

Honikel, K.O. (1987) The water binding of meat. *Fleischwirtschaft,* 67(9), 1098- 1102.

Horbañczuk, Sales J., Celeda T., Konecka A., Zieba G. & Kawka P (1998) Cholesterol content and fatty acid composition of ostrich meat as influenced by subspecies, *Meat Sci.* 50,385-388..

Sales, J. (1998) Fatty acid composition and cholesterol content of different ostrich muscles. *Meat Sci.* 49, 489-492.

Sales, J., & Hayes J. P (1996) Proximate, amino acid and mineral composition of ostrich meat, *Food Chem.,* 56,167-170

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Performance of buffalo male calves fed combination of different sources of protein

R. Kadel[1] A. K. Varma[2] & M. A. Akabar[3]
[1]Goat Research Station,Bandipur,Tanahu,NARC, [2]Department of Livestock Production Management, LLR University of Veterinary and Animal Sciences, Hisar, India,
[3]Department of Animal Nutrition, LLR University of Veterinary and Animal Sciences, Hisar, India
raju_kadel@gmail.com

ABSTRACT

The present experiment was conducted on growing Murrah buffalo male calves to determine the growth performance, feed conversion efficiency and certain hematological parameters and cost of feeding in Murrah male calves The calves were divided into four groups of six each randomly and denoted as T_1, T_2, T_3 and T_4. All the four rations were isonitrogenous and isocaloric in nature (CP 20% and TDN 73%). In treatment T_1, mustard cake was as sole protein source. In treatment T_2, concentrate mixture containing combinations of two protein sources-50% of mustard cake will be replaced with soybean meal, in treatment T_3, concentrate mixture containing combinations of two protein sources- 50% of mustard cake will be replaced with groundnut cake. In the treatment T_4 concentrate mixture containing combinations of three protein sources-33% mustard cake, 33% groundnut cake and 33% soybean meal. Although higher average daily body weight gain was observed in T_4 and T_1 those were not statistically significant among the treatments. The average daily intake of DM, CP and TDN per gain in body weight was not significantly influenced by different sources of protein. The nutrient digestibility coefficients under various treatments did not differ significantly influenced by different sources of protein. The total CP intake, DCP intake and total TDN intake under various treatments did not significantly influenced by different sources of protein. The blood profile, hemoglobin level, blood glucose level and plasma protein were found non significant in different sources of protein. The cost per kg body weight gain was slightly lower in group-fed MC (Rs 41.87) as protein source in concentrate mixture. Feeding of mustard cake as protein source for growing buffalo calves is economical as compared to soybean and groundnut cake.

Keywords: male buffalo calves, growth performance, protein sources

INTRODUCTION

Buffalo is a versatile triple-purpose animal and rightly referred as a backbone of Indian commercial dairying. Buffaloes significantly contribute to sustainable human nutrition and economy of the nation. As the demand for lean red meat has been increasing consistently worldwide, buffalo meat is expected to get consumer preference due to its

leanness, low cholesterol and lower cost. Buffalo meat production has been growing at of 5% per annum while poultry meat is fast growing at the rate of 15% in domestic market. Buffalo meat constitutes more than 98% of the total meat exported (500000MT) from India primarily to Malaysia, Philippines, Mauritius, UAE, and other gulf countries. During 2007-08 about 483.5 thousands MT of buffalo meat was exported and fetched 877.36 million US dollar while exported processed meat 1245.46 MT and earned only 3.2 million US Dollar.

Balanced nutrition and better management can enhance buffalo productivity. Many efforts have been made in the last few decades to improve nutrient supply and utilization in buffaloes. Recent research on locally available feed resources such as crop residues and industrial by-products, dietary addition of micronutrients, use of performance modifiers and use of rumen protected fat and protein sources have shown significant potential to improve growth, milk yield and reproductive performance of buffaloes. However, a number of issues, including establishment of nutrient requirements for dairy and beef, development of buffalo calf feeding systems, nutritional management of metabolic and reproductive anomalies and understanding and exploitation of the buffalo gut ecosystem, need to be addressed. Extensive coordinated research and extension efforts are required for improved buffalo nutrition in developing countries.

To have good dairy replacement stock and higher body weight gain in buffalo, an efficient calf-feeding system is crucial because it determines the future income and sustainability of a buffalo enterprise. However, buffalo calf nutrition and feeding management are the most neglected area in both buffalo husbandry and research. Wynn *et al.* (2009) reported higher mortality and morbidity losses in buffalo calves and attributed this to poor colostrum and feeding management of calves. In south Asia, although calves are generally separated from their dams at birth, however, they are allowed to suckle limited amount of milk for few weeks directly from dam's teat at each milking. Then the calves are usually milk weaned between 4 to 12 weeks of their age. Main determinants of milk weaning in buffalo calves are the price of milk, dam's milk let down behaviour and sex of the calf. Direct teat suckling is commonly used as a stimulus for milk let down under conventional farming in India. In many cases, especially in rural areas, female calves are weaned later than male calves. In contrast to this system, Mediterranean buffalo calves are separately fed limited amount of milk or milk replacer using bucket or teat for first few weeks of life before weaning. The Mediterranean buffalo calves also receive some amount of concentrate to ensure their early rumen development. Early mortality in buffalo calves in south Asia was higher than those reported in Mediterranean buffalo calves (Khan *et al*., 2007).

Scientific data regarding growth and physiological response of buffalo calves to various dietary attributes during pre-weaning and post-weaning is scarce to draw solid conclusions. Sporadic attempts have been made to examine the influence of weaning age (Palladino *et al*., 1993; Cutrignelli *et al*., 2003), dietary energy and protein level in starter

diets (Zicarelli *et al*., 2007), supplementation of yeast cultures (Kumar *et al*., 1997; Francia *et al*., 2008) on the performance of buffalo calves with contrasting conclusions. In most of the studies where growth and physiological response of buffalo calves to various dietary treatments were assessed used the term "buffalo calf" for animals having body weight ranging between 40 to 220 kg. Thus at the first instance, it is highly essential to develop and use proper scientific terminology based on the physiology, body weight and age of buffalo calves. Then the extensive coordinated research efforts are required to establish the pre-weaning and post-weaning nutritional regimens and feeding management systems for calves reared for two distinct purposes i.e. milk and meat production.

Feed is the single main item which constitutes more than 70 percent of total expenditure incurred on production and maintenance, in which concentrate constitutes major part in terms of cost of feeding. Good concentrates fed to animals include grains like maize, oats, sorghum and barley to the extent of 40-50 percent, which are rich in carbohydrates and usually have low protein content. They are used in the ration as a source of energy but this does not mean that they do not supply any protein. The proteins present in grains are highly digestible and whatever deficiency of proteins remains in grains is corrected by inclusion of protein rich concentrate ingredients. Oil cakes like soybean meal, groundnut cake, cotton seed cake, mustard cake, linseed cake and various chunnies are good source of proteins. These oil cakes usually contain 30-40 percent crude protein and use of these cakes as a source of protein in the feed has been well established for many years. However, efforts are continuously made to find out alternative sources of protein due to high cost and availability of the conventional source of proteins.

High protein containing feed ingredients like oil cakes- used as an essential component of concentrate mixture- are relatively costly. The use of oil cakes like mustard cake, groundnut cake and soybean meal in the ration of calves as conventional protein source is well established. Generally for feeding of buffalo calves only one source of protein is used. However, use of different sources of protein in the ration of livestock and poultry should give better result in terms of growth due to better assortment of amino acids but such information on feeding of male buffalo calves is scanty. Moreover, economics of feeding such combination of protein from different sources needs to be worked out for recommending practical rations. An attempt was therefore made to study the effect of feeding combination of different protein sources on growth, feed conversion efficiency and certain blood parameters.

MATERIALS AND METHODS

An experiment was conducted at the Buffalo Farm, Department of Livestock Production Management, LLR University of Veterinary and Animal Sciences, Hisar. The experiment was conducted for a period of 90 days (20^{th} January to 19^{th} April, 2012).

Animals and treatments

Twenty (24) male Murrah buffalo calves of 11 months age and 135 kg average initial body weight, were randomly divided into 4 groups of six each. The energy and protein requirement of the animals were met as per the recommendation of ICAR (Ranjhan, 1998). The concentrate mixtures (dietary treatments) containing various oil cakes or their combinations having 20 % CP and 73% TDN contents were formulated. The protein sources in the concentrate mixture of various dietary treatments were as follows:

T_1 : Wheat straw plus seasonal green fodder, and the concentrate mixture containing mustard cake as sole protein source (This treatment group will serve as control)

T_2 : Wheat straw plus seasonal green fodder and the concentrate mixture containing combinations of two protein sources- 50% of mustard cake (of control group) will be replaced with soybean meal

T_3 : Wheat straw plus seasonal green fodder and the concentrate mixture containing combinations of two protein sources – 50% of mustard cake (of control group) will be replaced with groundnut cake

T_4 : Wheat straw plus seasonal green fodder and the concentrate mixture containing combinations of three protein sources – 33% mustard cake, 33% groundnut cake and 33% soybean meal

Feeds and feeding

The animals of different treatment groups were ear tagged and allowed 15 days to adapt the experimental conditions prior to the commencement of the study. All the experimental animals were de-wormed with an anthelmintic drug and were maintained under standard farm conditions. The animals were housed in metabolism stall having group-feeding and watering arrangement. All the groups were fed concentrate mixture and green oat to meet their energy and protein requirements ICAR (Ranjhan, 1998). The amount of concentrate mixture was rescheduled as per CP requirement every fortnight according to body weight changes of the experimental animals.

Body weight

The calves were weighed at the beginning of the experiment and thereafter at fortnightly intervals .The weights were recorded in the morning before providing water and feed. These weights were used for computation of nutrients as well as to study weight changes of the calves.

Feed and nutrient intake

The calves were given weighed quantity of feed and fodder daily as per computed ration. The feed intake during experimental period was determined for two consecutive days in a fortnight on the basis of weighing feed and fodder offered and left over individually for three consecutive days in a fortnight. Representative samples of wheat straw, green oats and concentrate mixtures were taken daily for two consecutive days in each fortnight before feeding the animals and kept in hot air oven for determining the dry matter content. These samples were then analyzed for proximate composition (AOAC, 2005)

Table 1: Ingredient composition of different dietary treatments

Attribute	Treatment Groups			
	T_1	T_2	T_3	T_4
Mustard cake	35	15	16	9
Groundnut cake	0	0	15	9.9
Soybean meal	0	12.5	0	8.3
Barley	35	37	35	38
De-oiled rice polish	27	32.5	31	31.8
Mineral mixture	2	2	2	2
Common salt	1	1	1	1

The calves had free access to drinking water throughout the day and night. The water intake of individual calf was determined for two consecutive days. A measured quantity of fresh water was offered (*ad libitum)* to each calve by placing a graduated bucket full of water twice a day. The left over water was also measured to find out the actual voluntary water intake for two consecutive days coinciding with the day of feed intake. After 90 days of experimental feeding, a digestibility trial of 7 days duration was conducted. A proper record of total feed offered, refusal feed consumed and feces voided by each buffalo calf was maintained during the trial period and representative samples were analyzed for proximate principles (AOAC, 2005).

Blood parameter

Blood samples were taken at the beginning and at the end of the experiment using Sodium fluorides as an anticoagulant. Blood was drawn from jugular vein of the calves. The hematological parameter studied were, blood hemoglobin which was determined by using Shale's hemoglobin meter (Oser, 1965). The plasma total protein and glucose levels were analyzed by Biuret method and God/Pod method respectively.

Economics of feeding

To calculate the economics of feeding data on market prices of feed and fodder and the quantity of required ingredients used for this experiment were maintained during the experiment. Cost per kg of body weight gain was also calculated.

Statistical Analysis

The data were subjected to statistical analysis (CRD) to draw inferences (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Body weight changes

The average initial and final body weight of the calves during experimental period has been presented in Table 4. At the end of the experiment, the body weight gain of the

calves was 199.80±19.57, 192.00±24.29, and 189.40±29.21 and 195.00±25.15 kg in T_1, T_2, T_3 and T_4 respectively. Average daily body weight gain was recorded as 655.20±37.31, 599.60±34.80, 599.60±39.87 and 661.80±52.94 g respectively. The change in body weight of the calves during the experimental period has been depicted in Fig. 2. Statistical analysis of data revealed that there was no significant difference in body weight gain ($p<0.05$) among the treatments however average body weight gain was slightly higher in treatments T_4 and T_1as compared to T_2 and T_3.

Table 2: Average body weight gain of buffalo male calves under various treatments

Attribute	Treatments			
	T_1	T_2	T_3	T_4
Initial body weight(kg)	140.80±17.18	138.40±22.03	135.40±27.70	135.40±20.98
Final body weight (kg)	199.80±19.57	192.00±24.29	189.40±29.21	195.00±25.15
Body weight gain (kg)	59.00±3.36	54.00±3.13	54.00±3.59	59.60±4.76
Body weight gain (g/day)	655.20±37.31	599.60±34.80	599.60±39.87	661.80±52.94

Each figure is an average of 6 observations

Dry matter and water intake

The average daily dry matter intake, dry matter intake per 100 kg body weight, dry matter intake per kg metabolic size and daily water intake have been presented in Table 3. The average daily dry matter intake per animal was 4.72±0.39, 4.74±0.44, 4.61±0.36 and 4.87±0.35 kg in T_1, T_2, T_3 and T_4 groups, respectively. The average dry matter intake per 100 kg body weight was 2.37±0.06, 2.49±0.081, 2.52±0.14 and 2.56±0.15 and the corresponding values expressed per kg metabolic body size ($W^{0.75}$) were 89.14±1.77, 92.22±0.71, 92.23±2.58 and 93.27±3.84 kg in T_1, T_2, T_3 and T_4 respectively. The average water intake per animal was 11.60±0.67, 12.30±1.3, 11.50±1.34 and 13.40±0.92 in T_1, T_2, T_3 and T_4 respectively. Statistical analysis of data revealed that the average dry matter intake did not vary ($P<0.05$) among treatments and average water intake also did not vary among the treatments.

Feed conversion efficiency

The average intake of nutrients per kg gain in body weight has been presented in Table 4. The dry matter intake per kg gain in body weight for calves under T_1, T_2, T_3 and T_4 was 6.97±0.66, 6.76±0.31, 6.67±0.19 and 7.02±0.84 kg, respectively. Statistical analysis revealed that average dry matter per kg in body weight was not significant among the treatments. Crude protein intake per kg body weight gain was 0.854±0.071, 0.788±1.67, 0.754±0.074 and 0.828±0.061 kg in T_1, T_2, T_3 and T_4, respectively. The difference between the treatments in CP intake per kg gain was found to be statistically non-significant. Similar trend was observed for TDN intake per unit gain.

Table 3: Dry matter intake and water intake of calves under different treatments

Attribute	Treatments			
	T_1	T_2	T_3	T_4
DM intake (kg/d)	4.72±0.39	4.74±0.44	4.61±0.36	4.87±0.35
DM intake (kg/100 kg b.w)	2.37±0.06	2.49±0.081	2.52±0.14	2.56±0.15
DM intake ($kg/W^{0.75}$)	89.14±1.77	92.22±0.71	92.23±2.58	93.27±3.84
Water intake (l/d)	11.60±0.67	12.30±1.3	11.50±1.34	13.40±0.92

Each figure is an average of 6 observations

Table 4: Average intake of DM, CP and TDN per kg gain in body weight

Attribute	Treatments			
	T_1	T_2	T_3	T_4
DM intake (kg)	6.97±0.66	6.76±0.31	6.67±0.19	7.02±0.84
CP intake (kg)	0.854±0.071	0.788±1.67	0.754±0.074	0.828±0.061
TDN intake (kg)	4.73±0.74	4.67±0.31	4.51±0.21	4.89±0.96

Each figure is an average of 6 observations

Nutrient digestibility

The nutrient digestibility coefficients under various treatments did not differ significantly influenced by different sources of protein (Table 5). The total intake of CP, DCP and TDN under various treatments did not differ significantly influenced by different sources of protein (Table 5).

Blood biochemical parameter

The initial and final blood biochemical parameters (hemoglobin, protein and glucose level) of the experimental male buffalo calves have been presented in Table 6. There was no significant difference in blood biochemical parameters.

Table 5: Average digestibility coefficients, mean values of nutrient intake and nutritive value of different diet fed to calves

Attribute	Treatments			
	T_1	T_2	T_3	T_4
Dry matter	67.2±0.73	67.48±0.76	66.91±1.02	66.19±1.02
Organic matter	66.30±1.81	65.37±1.18	65.47±1.57	66.59±1.57
Crude protein	70.56±0.34	71.31±0.48	71.01±0.46	70.74±0.42
Ether extract	72.67±0.31	71.18±0.32	72.07±0.56	70.69±0.41
Crude fiber	56.36±0.76	58.56±0.58	57.55±1.06	56.69±0.41
Nitrogen free extract	71.44±0.67	72.40±0.22	71.75±0.70	71.41±1.66

Nutritive value				
CP (%)	11.38±0.14	10.71±0.14	10.50±0.12	10.51±0.122
DCP (%)	7.54±0.12	7.41±0.13	7.30±0.064	7.47±0.158
TDN (%)	60.51±0.13	61.54±0.13	61.50±0.11	60.46±0.165
Nutrients intake				
CPI (g/day)	521.84±0.43	491.84±0.54	472.00±0.37	498.58±0.45
DCPI (g/day)	382.50±0.60	352.36±0.60	336.50±0.45	335.78±0.84
TDN intake (kg/day)	2.63±0.075	2.88±0.032	2.81±0.063	2.94±0.034

Each figure is an average of 6 observations

Table 6: Average value of blood protein, glucose level and hemoglobin in calves under different treatments

Attribute	Treatments			
	T_1	T_2	T_3	T_4
Initial hemoglobin (g/100ml)	12.52±0.42	11.90±0.25	11.30±0.37	11.80±.0.2
Final hemoglobin (g/100ml)	12.96±0.39	12.30±0.90	11.50±0.20	11.76±0.33
Initial blood glucose (mg/dl)	38.50±1.15	37.86±1.76	34.96±0.92	36.22±2.8
Final blood glucose l(mg/dl)	38.36±0.75	38.04±1.72	35.08±.08	36.62±2.6
Initial blood protein (g/dl)	5.60±0.23	5.77±0.09	5.70±0.19	5.50±0.03
Final blood protein (g/dl)	5.34±0.16	4.99±0.03	5.22±0.17	5.07±0.22

Each figure is an average of 6 observations

Cost of feeding

The cost of feeding of buffalo calves under different dietary treatments has been depicted in Table 7. The total feed cost of raising a calf for a period of 90 days was Rs. 12353.25, Rs. 12913.5, Rs. 12779.20 and Rs. 13052.53 in T_1, T_2, T_3 and T_4, respectively. The cost per kg gain in body weight was Rs. 41.87, Rs. 47.82, Rs. 47.33 and Rs. 43.80 in T_1, T_2, T_3 and T_4, respectively.

Table 7: Feeding cost (Rs.) of buffalo calves under different dietary treatments

Cost of feeding (Rs.)	Treatments			
	T_1	T_2	T_3	T_4
Concentrate mixture	7313.25	7873.50	7739.20	8012.53
Wheat straw	2430	2430	2430	2430
Green fodder	2610	2610	2610	2610
Total cost for 90 days	12353.25	12913.50	12779.20	13052.53
Daily feeding cost/calf	27.45	28.69	28.39	29.05
Feed cost/kg gain	41.87	47.82	47.33	43.80

DISCUSSION

As the growth rate and efficiency of conversion of feed to gain continues to increase, it will be increasingly more difficult to meet specific amino acid requirements of growing cattle. A shortage of a specific amino acid may result because the mixture of amino acids delivered to the absorption sites is of inferior quantity and/or quality to meet performance capabilities. This mixture of amino acids available for absorption and ultimately for production is supplied by microbial protein synthesized in the rumen, dietary protein escaping rumen degradation and endogenous secretions. The results of data reported to date indicate that post-ruminal supplementation of amino acids does increase animal performance under certain experimental conditions when supplied to cattle. Post-ruminal supplementation of amino acids to growing cattle fed diets with urea as the sole nitrogen source and cattle fed natural protein diets has resulted in increased nitrogen retention. Estimates of the amino acid requirements of sheep have been made and the limiting amino acids of sheep fed urea as the sole nitrogen source have been identified as methionine, lysine and threonine. Studies with cattle and buffaloes have been fewer in number and results have been less conclusive. Although estimates of the amino acid requirements of growing cattle have been made, there is no comparable data showing the limiting amino acids in the microbial protein of growing cattle as has been shown in sheep. If we are to improve the amino acid status of growing cattle, it is imperative that we identify the first-limiting amino acids of the microbial protein for growth. The nitrogen balances and plasma levels of free amino acids responses to post-ruminal administration of various combinations of amino acids indicate that methionine, lysine and threonine are the first three limiting (and order of limitation) amino acids in growing steers whenever rumen synthesized microbial protein is essentially the sole source of protein (Richardson and Hatfield, 1978). Primary objective of this study was to observe whether a single source of natural protein is inferior to a combination of two or three sources of protein as the mustard is being grown widely in this region and cakes are available at comparatively cheaper rate.

The result of the study showed no significant difference in body weight gain, feed intake and feed conversion efficiencies. Comparatively higher amount of lysine and methionine is present in mustard cake than that of groundnut and soybean cake. This could perhaps offset the benefit of better assortment of amino acids when protein is supplied through two or three sources. Present observations are in agreement with those of Nour *et al.* (1990), Din *et al*. (1992), Singh *et al* (1998) and Sharma *et al.* (2007).

The average daily dry matter intake and water consumption were not significantly different in various treatment groups. This is an agreement with the observations of Gupta *et al*. (1992), Mehla *et al*. (2005), Sharma *et al*. (2007), Ravichandiran *et al.* (2008) and Kumar *et al.* (2009). On the contrary, Finn *et al.* (1985) found significant effect on DM intake in animals fed different sources of dietary protein. The nutrient digestibility coefficients under various treatments did not differ significantly influenced by

different sources of protein. This is an agreement with the observation of Akbar and Gupta (1990), Mehla (1996), Vasistha *et al.* (2000), Yadav and Paliwal (2001), Sharma *et al.* (2007) and Ravichandiran *et al.* (2008). The CP intake, DCP intake and TDN intake under various treatments also did not differ significantly influenced by different sources of protein. This is an agreement with the observations of Akbar and Gupta (1990) and Jha *et al.* (2011).

The hemoglobin (%) and total plasma protein levels were similar in all the experimental groups as reported by Malik *et al.* (1988) in male buffalo calves and by Shenu (2000) in crossbred calves. Similarly, there was no significant difference in blood glucose level in calves fed different sources of protein as has been reported by Ravichandiran *et al.* (2008) and Sharma *et al.* (2007). Contrary to this, Broderick (1989) and Mehla (1996) reported that the blood glucose level influenced significantly by feeding different sources of protein. The cost per kg body weight gain was slightly lower in group fed mustard cake (Rs. 41.87) as compared to other groups.

CONCLUSION

From this study, it can be concluded sole mustard cake, as source of protein, in the concentrate for growing buffalo calves is economical as compared to soybean and groundnut cake for growing buffalo calves

REFERENCES

Akbar, M.A. and Gupta, P.C. (1990) Faba bean (*Vicia faba L.)* as a source of protein supplement in the ration of buffalo calves. *Indian J. Anim. Sci*. 60: 1474-1480.

AOAC. (2005) *Official Methods of Analysis.* Association of official Analytical Chemists Washington, DC.

Broderick, B.A. (1989) Fish meal vs. soybean meal for lactating cows fed alfalfa silage as sole forage. *Dairy Sci.* 72: 29.

Cutrignelli, M.I., Bovera, F, Marchielo, M, Lella, T.D. and Pacelli, C. (2003) Influence of weaning age on growth dynamics of young buffalo-bulls until 90 days of age. *Italian J. Anim. Sci.*2:334-336.

Din, A.E., Tag, E.L, Nour, A.M, Shazly, K.EI. and Hassan, E. (1992) Evaluation of soybean and glandless cotton seed meal. *Indian J. Anim. Sci.* 62: 677-680.

Finn, A. M., Clark, A.K., Drackley, J. K, Schingoethe, D. J. and Sadhu, T. (1985) Whole rolled sunflower seed with or without additional limestone in lactating dairy ration. *J. Dairy Sci*. 68: 903-13

Francia, A. D., Masucci, F, Rosa, G, Varricchio, M.L. and Proto, V. (2008) Effects of *Aspergillus oryzae* extract and *Saccharomyces cerevisiae* fermentation product on intake, body weight gain and digestibility in buffalo calves. *Anim. Feed. Sci. Technol*. 140: 67-77.

.Gupta, M.K., Srivastava, B.B, Pathak, N.N. and Pandey, H.N. (1992) Effect of replacement of fish meal in calf starter by groundnut cake and mustard cake on performance of crossbred calves. *Indian J. Anim. Sci.* 62: 1002-1004.

Jha, P., Sehgal, J.P, Lather, P. and Jha, N. (2011) Effect of Sulphur supplementation on nutrient utilization of wheat straw based complete feed blocks with fungal zoospores in buffalo calves. *Indian J. Anim. Nutr*. 28: 263-268

Khan, M. A., Lee, H.J, Lee, W.S, Kim, H.S, Kim, S.B, Ki, K.S, Park, S.J, Ha, J.K. and Choi, Y.J. (2007) Starch source evaluation in calve starter: I: Feed consumption, body weight gain, and structural growth and blood metabolites in Holstein calves. *J .Dairy Sci.*90: 5259-5268.

. Kumar, A., Singh, R and Yadav, R.S. (2009) Effect of feeding different source of protein on feeding behavior and performance of buffalo calves. Indian *J Anim. Sci.*79: 422-425.

Kumar, U., Sareen, V.K. and Singh, S. (1997) Effect of yeast culture supplementation on ruminal microbial populations and metabolism in buffalo calves fed a high roughage diet. *J. Sci. Food Agric.* **73:** *231-236.*

Malik, R.S., Srivastava, A. and Mugdal, V.D. (1988) Significance of season influenced changes in haematology of Murrah buffaloes fed varying levels of dietary protein. *Indian J. Anim. Prod. Mgmt*. 4: 22-26

Mehla, O.P. 1996. Effect of source of protein and feeding frequency on growth performance of Murrah buffalo calves. PhD Dissertation. CCS Haryana Agric. Univ., Hisar.

Mehla, O.P.,Yadav, R .S and Singh, L. (2005) Effect of source of protein and feeding frequency on nutrients and water intake of Murrah buffalo calves. *Indian J. Anim. Res*. 39: 57-59.

.Nour, A.M., Tag, EI-Din, A.E, Brohami, B.E. and Hassan, E. (1990) Effect of protected methionine or cooked starter on the performance of the early weaned Friesian calves. *Alexandria J. Agric. Res***.** 35: 25-27.

Oser, B. L. (1965) Hawk's Physiological Chemistry, 14th Ed. Tata McGraw Hill Pub. Co. Ltd, New Delhi, 975-1152.

Palladino, M., Meo, C.D., Espositoand, L. and Zicarelli, L. (1993) Weaning trials of buffalo calves using an acidified milk replacer. *Zoot. Nutr. Anim.*17:7-12.

Ranjhan, S.K. (1998) *Nutrient Requirements of Livestock and Poultry*. 2nd edn. Indian Council for Agricultural Research, New Delhi.

Ravichandiran, S., Sharma, K, Dutt, N., Pattanaik, AK, Chauhan, J.S, Agnihotri A and Kumar A. (2008) Performance of crossbred calves on supplements containing soybean meal or rapeseed mustard cake with varying glueosinolate levels. *Indian J. Anim. Sci*. 78

Richardson, C.R. and Hatfield, E.E. (1978) The limiting amino acids in growing cattle. *J. Anim. Sci*. 46: 740-745.

Sharma, K., Dutta, N, Patra AK, Singh, M and Pattanaik, AK. (2007) Effect of replacing soybean meal with Indian canola quality or high glucosinolate rape seed-mustard meal on performance of growing crossbred calves. *Livestock Research for Rural Development*. 19: 1-13.

Shenu, T. (2000) Effect of managemental regimes on growth performance of female cross bred calves. M.Sc. Thesis, CCS Haryana Agricultural University, Hisar

Singh, I., Varma, A.K. and Akbar, M.A. (1998) Performance of buffalo calves fed combination of different sources of protein. *Indian J Anim. Sci***.** 68:686-688.

Snedecor, G.W. and Cochran, W.G. (1994) *Statistical Methods*. 8th edn. Iowa State University Press, Ames. Iowa, USA.

Vashishtha S. N., Chauhan T.R and Sagar V. (2000) Effect of replacing groundnut cake with expeller and solvent extracted mustard cake on growth and nutrient utilization in buffalo calves. *Indian J. Anim. Sci***.** 70: 1242-45.

Wynn, P. C., Warriach, H.M, Morgan, A, McGill, S, Sarwar, H.M Iqbal,, A, Sheehy, P.A. and Bush, R. D. (2009) Perinatal nutrition of the calves and its consequences for lifelong productivity. *Asian- Austr. J. Anim. Sci.* 22:756-764.

Yadav K.R. and Paliwal V.K. (2001) Extracted sunflower cake as protein supplement in buffalo calves. *Indian J. Anim. Nutr.* 18: 176-179.

Zicarelli, F., Garassi, C, Gazaneo, M.P, Masiello, I, Vecchio, D. and Campanile, G. (2007) Starter protein concentration and weaning of buffalo calves. *Italian J. Anim. Sci.*6: 515-517.

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Nutrient composition of major fodder and soil available in Gandaki region of Nepal

R. Bastola, M. R. Tiwari & L. N. Pandey
Animal Nutrition Division, NARC, Khumaltar, Lalitpur, Nepal
bastola_rupa@yahoo.com

ABSTRACT

This study was carried out to determine the nutrient content of soil and fodder of the three districts (Kaski, Tanahun and Gorkha) of Gandaki zone. Thirty six different fodder and forage samples and thirteen soil samples were collected from these three districts. Samples were analyzed as per standard methods adopted by Animal Nutrition Division and Soil Science Division Laboratory, Khumaltar. The collected fodder and soil samples were analyzed to find out nutrient composition like dry matter (DM), total ash (TA), crude protein (CP), organic matter (OM), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), hemicellulose (HC) and cellulose (C) of fodder whereas soil parameter (pH, OM, P_2O_5, K_2O) were analyzed in soil. In soil, the analysis report showed that very acidic soil P^H in Kaski, (3.98±0.29), Tanahun (4.85 ±0.34) and moderate acidic pH in Gorkha (6.0 ±0.18).The OM content in the soil of Kaski, Tanahun and Gorkha was moderate whereas the nitrogen status in the soil was moderate in all three districts. Available phosphorus content in the soil was too low in Kaski (12.2 ±3.87ppm) and Tanahun (14.0 ±6.93 ppm) but very high level of phosphorus was found in the Gorkha (109.25 ±67.23 ppm). Potassium content was high in Kaski (160.6±101.37ppm), Tanahun (212.5±0.121.5ppm) and very high in Gorkha (300.0±77.79 ppm). Protein content of the fodder and forage of these districts was in moderate level. Due to acidic soil condition the plants may not be able to absorb the other available nutrient in the soil though its content is high and it is advisable to apply agricultural lime periodically for its amelioration in all three districts.

Key words: Animal nutrition, protein, nitrogen, phosphorous, fiber

INTRODUCTION

Fodder trees are indispensable resources of animal feed in Nepal mainly in the dry seasons (Rana *et al*., 1999) and a wide range of fodder trees have been utilized by the ruminants as a major source of feeding materials (Pandey and Osti, 1995). Fodder shrubs/trees as animal feed, particularly during winter and dry period have been the important traditional source of livestock feed especially, in the middle and northern belt of Nepal (Pandey, 1982). The productivity of the fodder trees/shrubs depends on species, age, height of the plant and the lopping cycle. Similarly, the nutrient content of the fodder depends on physical and chemical properties of soils, stage of maturity, plant species etc.

Plant growth and development largely depend on the combination and concentration of mineral nutrients available in the soil. Plants often face significant challenges in obtaining an adequate supply of these nutrients to meet the demands of basic cellular processes due to their relative immobility. A deficiency of any one of them may result in decreased plant productivity and/or fertility

Soil acidity is a major environmental and economic concern. Acidic soil cause significant losses in production. Nitrogen (N), Potassium (K), and Sulfur (S) are major plant nutrients that appear to be less affected directly by soil pH than many others, but still are to some extent, however, Phosphorus (P) is directly affected. At alkaline pH values, greater than pH 7.5 for example, phosphate ions tend to react quickly with calcium (Ca) and magnesium (Mg) to form less soluble compounds. At acidic pH values, phosphate ions react with aluminum (Al) and iron (Fe) to again form less soluble compounds. Most of the other nutrients (micronutrients especially) tend to be less available when soil pH is above 7.5, and in fact are optimally available at a slightly acidic pH, e.g. 6.5 to 6.8. The optimum pH range for most plants is between 5.5 and 7.5; however, many plants have adapted to thrive at pH values outside this range.

Soil organic matter is the foundation for healthy and productive soils. Understanding the role of organic matter in maintaining a healthy soil is essential for developing ecologically sound agricultural practices. Soil organic matter contains nitrogen predominantly as protein, which is considered a nitrogen source exclusively for microbes and animals (Read, 1991). Nitrogen is important for all plant functions due to the major role it plays in building amino acids and chlorophyll production. Phosphorous is an energy source (ATP) during photosynthesis and important for DNA and RNA production. Potassium controls water uptake (stomata) and deficiencies are indicated by abnormal plant shape and color (Markham, 2010).

Hence, this study was undertaken to determine the nutrient content of fodders and soil of these three districts.

MATERIALS AND METHODS

Site selection and sample collection

Three districts of Gandaki zone (Kaski, Tanahun and Gorkha) were selected for the study. Gandaki zone is located in the Western Development Region and this is divided into 6 districts. With the coordination of District Livestock Service Office sample of fodder and soil were collected from the farmer's field from Chiple of Kaski, Putalibazar of Gorkha and Gunadai of Tanahun.

Altogether 35 different types of most commonly used fodder and forage from pasture land and farmers field were collected from the three districts (15 from Chiple, 15 from Putalibazar, 10 from Gunadi). At least 500g of fresh leaves were collected from four

different sites of trees and mixed well. Similarly, 13 soil samples from these sites were also collected. Soil sample (0-20cm) were collected at a distance of 25 cm from selected fodder and forage plants and mixed well and about one kilo of soil sample were packed and labelled.

Chemical analysis

Nutrient analysis of the fodder and forage trees were carried in the laboratory of Animal Nutrition Division at Khumaltar. For the analysis of crude protein Kjeldhals method (AOAC, 1980) was used. Similarly, Van Soest and Robertson (1985) method was used for the analysis of NDF, ADF, ADL, cellulose and hemicellulose. Similarly soil sample were analyzed in the laboratory of Soil Science Division, Khumaltar, Lalitpur. Soil parameter - P^H, Organic matter, Nitrogen, Phosphorus and Potassium was analyzed. Soil P^H was measured by using Potentiometric 1:2 (Jackson, 1973). Similarly, organic matter and nitrogen percentage was analyzed by Walkely and Black (1934) and Kjeldahl (Bremner and Mulvaney, 1982). Modified Olsen's (Olsen *et al*., 1954) and Ammonium acetate (Jackson, 1967) method was used for analysis of phosphorus and potassium in the soil.

Data analysis

The data from soil and fodder trees were analyzed by using Microsoft window Excel 2007. Rating (very low, low, medium, high and very high) of determined values of soil were based on Soil Science Division, Khumaltar.

RESULTS AND DISCUSSION

Soil nutrient content

Soil pH

The result of soil sample analysis showed that the P^H of soil from Chiple (3.98±0.29) and Gunadi was very acidic (4.85 ±0.34) and soil from Putalibazar was moderately acidic (6.0 ±0.18) (Table 1). Acidic soils have a low pH, and this affects the plant's ability to absorb essential nutrients from the soil. A soil with a pH of 4 has 10 times more acid than a soil with a pH of 5 and 100 times more acid than a soil with a pH of 6 (Morre, 1998). In very acid soils, all the major plant nutrients (nitrogen, phosphorus, potassium, sulphur, calcium, manganese and also the trace element molybdenum) may be unavailable, or only available in insufficient quantities. Plants can show deficiency symptoms despite adequate fertilizer application.

Organic matter

The organic matter is considered to be an essential element in the formation of aggregates (Zeytin and Baran, 2003) and on the contrary, the formation of aggregates contributes to the stabilization of soil organic matter by its physical protection in aggregates (Balabane and Plante, 2004). Similarly, the organic matter in the soil was found in normal level in these three districts.

Table 1: Nutrient contents of soil

District	PH (mean ± sd)	OM (%) (mean ± sd)	N (%) (mean ± sd)	Phosphorus (mg/kg) (mean ± sd)	Potassium (mg/kg) (mean ± sd)
Kaski	3.98±0.29	4.46±4.74	0.11±0.15	12.2 ±3.87	160.6±101.37
Tanahun	4.85 ±0.34	3.2 ±2.27	0.12 ±0.05	14.0 ±6.93	212.5±0.121
Gorkha	6.0 ±0.18	2.95 ±1.79	0.12 ±0.04	109.25 ±67.23	300.0±77.79

Total nitrogen

Nitrogen (N) is the vital elements needed for the survival of living things nitrogen in the soil not only enhance yield but also improves plant quality (Ullah *et al.,* 2010). A medium content of nitrogen percentage was found in the three districts. So, addition of fertilizer may not needed in the farmer's field where the fodders have been planted.

Available phosphorus

Average phosphorus content (mg/kg) in the soil of chiple of Kaski (12.2 ±3.87) and Tanahun (14.0 ±6.93) was found within the moderate level whereas extremely high phosphorus was found (109.25 ±67.23) in the soil of Putalibazar of Gorkha. Application of phosphorus is not applicable in these entire three districts but additional steps should be taken to minimize the risk of surface water contamination by limiting runoff losses.

Available potassium

Average potassium (mg/kg) content of soil was high in Kaski (160.6±101.37) and Tanahun (212.5±0.121.5) and very high Gorkha. Fertilization is not recommended in this type of soil.

Fodder nutrient content

The nutrient content of fodders of respective districts is given in Table 2

Crude protein content is the most important criterion for judging feeds and fodder, although ADF, polyphenolics such as lignin and tannin content affect its availability to the animal. The protein content of the fodder trees collected from three districts showed a variation from low to moderate. 60% of the fodder trees fallen under the moderate range in Kaski where as fifty percentage of moderate and low value of CP was found in Tanahun district. Similarly, 90% of fodder sampled were found to have moderate value of CP and only 10% of fodder content less than 10 percent in Gorkha.

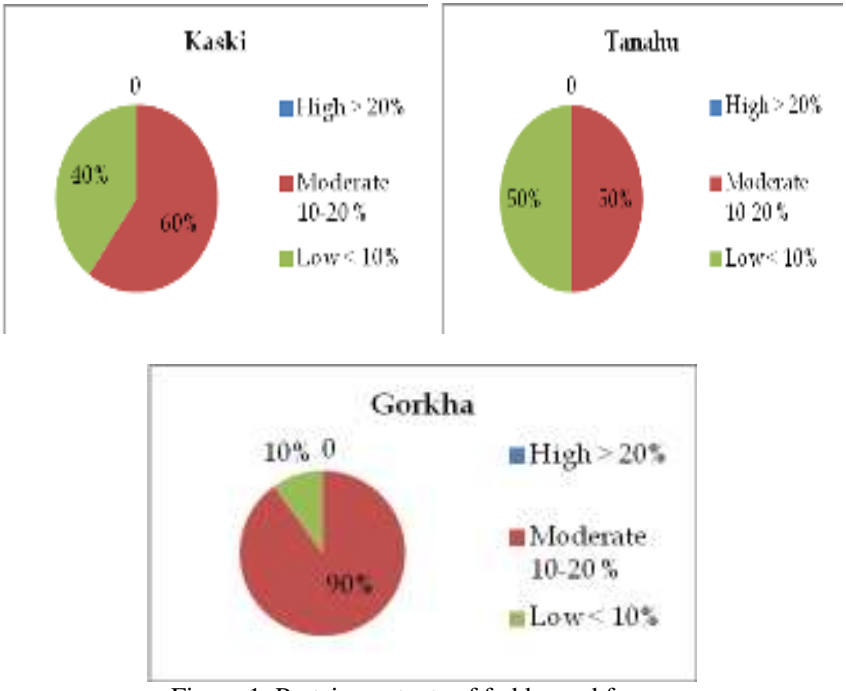

Figure 1: Protein contents of fodder and forage

Table 2: Nutrient content of fodder and forage

Name of Sample	Scientific name	Dist.	FDM	Aash	OM	CP	NDF	ADF	ADL	Hemi cellulose	Cellu-lose
Seto Nimaro	*Ficus roxburghii*	Kaski	33.13	11.88	88.12	9.31	64.26	59.83	33.87	4.43	25.96
Chiple	*Machilus gamblei*	Kask	23.40	13.46	86.54	8.61	70.18	56.10	30.94	14.08	25.16
Dar	*Boehmeria regulosa*	Kaski	24.25	13.56	86.44	11.59	61.62	61.57	35.68	0.05	25.88
Jhano	*NA*	Kaski	37.19	4.26	95.74	9.98	50.16	47.92	18.08	2.24	29.84
Siltimur	*Litsea cubeba*	Kaski	24.12	3.85	96.15	17.81	62.62	52.95	31.17	9.66	21.78
Musure	*Castanopsis*	Kaski	34.83	3.70	96.30	12.6	71.75	61.39	26.04	10.3	35.36

Katush	*spp*					1				6	
Kutmiro	*Litsea monopotela*	Kaski	30.86	3.83	96.17	13.02	68.18	61.19	39.33	6.99	21.86
Dubchilo	*NA*	Kaski	33.29	9.05	90.95	10.59	61.87	54.71	30.12	7.16	24.59
Paiyu	*Prunus serasoides*	Kaski	37.87	7.13	92.87	11.22	51.91	49.44	33.82	2.47	15.62
Raikhanu	*Ficus semicordata*	Kaski	33.87	8.09	91.91	10.38	70.37	63.33	30.02	7.05	33.31
Chuletro	*Brassiopsis hainla*	Kaski	22.61	7.14	92.86	9.76	62.77	55.30	31.70	7.48	23.60
Kathae kaulo	*Machelus odoratissima*	Kaski	50.59	2.42	97.58	7.88	75.31	68.15	39.81	7.16	28.34
Berulo	*Ficus clavata*	Kaski	34.60	8.52	91.48	10.67	49.32	36.82	27.68	12.50	9.14
Kaiyo	*Grevillea robusta*	Kaski	28.09	5.11	94.89	7.38	53.27	47.25	29.62	6.02	17.63
Taki	*Bauhenin purpurea L.*	Tanahun	27.10	5.04	94.96	17.15	59.63	58.41	30.78	1.22	27.63
Mulato (old)	*Brachiaria decumbens*	Tanahun	20.88	9.36	90.64	6.08	71.70	48.50	30.86	23.20	17.64
Mulato (new)	*Brachiaria decumbens*	Tanahun	17.04	10.31	89.69	10.76	79.42	49.24	17.74	30.18	31.50
CF4	*NA*	Tanahun	19.42	10.53	89.47	7.74	76.61	52.50	9.64	24.11	42.86
Paspalum	*Paspalum conjugatum*	Tanahun	20.71	8.72	91.28	7.52	74.74	48.62	17.57	26.12	31.05
Setaria	*Seteria verticillata*	Tanahun	18.19	6.82	93.18	6.23	85.57	59.28	13.09	26.29	46.19
Kimbu	*Morus alba*	Tanahun	20.09	11.93	88.07	17.37	46.32	39.53	20.61	6.80	18.92

Nimaro	*Ficus roxburghii*	Tanahun	26.49	11.55	88.45	10.90	74.50	59.67	20.45	14.84	39.22
Raikhanayo	*Ficus semicordata*	Tanahun	26.14	10.88	89.12	12.36	72.63	62.71	35.60	9.93	27.10
Badame	*Arachis Glabrata*	Tanahun	19.33	10.62	89.38	12.87	57.74	46.00	22.25	11.74	23.75
Gini	*Megathyrsus maximus*	Tanahun	18.28	11.99	88.01	7.61	70.12	30.51	27.98	39.61	2.53
Nimaro	*Morus alba*	Gorkha	51.98	12.71	87.29	11.87	65.47	55.09	29.51	10.38	25.59
Ipil-Ipil	*Laucaena leucocephala*	Gorkha	42.10	10.45	89.55	15.29	68.51	57.19	22.06	11.33	35.12
Napier	*Pennisetum purpureum*	Gorkha	45.61	15.03	84.97	10.19	66.80	50.92	14.93	15.88	35.98
Bakaino	*Malia azedarach*	Gorkha	45.96	13.01	86.99	13.15	59.93	54.55	22.16	5.38	32.39
Gedulo	*Ficus clavata*	Gorkha	47.27	18.24	81.76	16.46	56.79	45.37	17.92	11.42	27.45
Kutmiro	*Litsea monoplotela*	Gorkha	43.52	18.79	81.21	10.37	75.70	68.45	29.37	7.25	39.07
Dabdabe	*Garuga pinnata*	Gorkha	40.15	17.03	82.97	13.51	50.72	46.99	17.89	3.72	29.11
Kimbu	*Morus alba*	Gorkha	41.44	16.99	83.01	11.38	48.88	31.56	16.86	17.32	14.70
Tanki	*Bauhenin purpurea L.*	Gorkha	70.16	17.79	82.21	8.89	68.82	50.37	20.61	18.45	29.76
Kavro	*Ficus lacor*	Gorkha	54.70	19.38	80.62	13.93	62.27	49.29	21.89	12.98	27.40
Khanayo	*Ficus semicordata*	Gorkha	54.24	14.71	85.29	15.99	62.86	57.78	25.35	5.08	32.43

CONCLUSION

Soil acidity is a major environmental and economic concern and in fodder grown in acidic soils, production will be reduced and some legume species may fail to persist. The acidic soil condition in the three districts might unfavour the plant growth and most soil processes including nutrient availability and microbial activity as well restrict root access to water and nutrient. Application of the agricultural lime in the farmer's field where fodder tree is grown is recommended for the improvement of soil fertility.

REFERENCES

AOAC (1990) *Official Method of Analysis*. 15th edition. (Association of Official Analytical Chemist) Washington, DC. USA Pp. 66-88

Balabane, M. and Plante, A. (2004). Aggregation and carbon storage in silty soil using physical fractionation techniques. *European Journal of Soil Science.* **55**:415–427

Bremner, J.M. and Mulvaney, C.S. (1982). Nitrogen total. In: Page, A.L. (editor) *Methods of soil analysis. Agron. No. 9, Part 2: Chemical and microbiological properties.* 2nd edition. Am. Soc. Agron., Madison, WI, USA, 595- 624

Jackson, ML (1967). *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd. New Delhi. Pp. 205

Jackson, ML (1973). *Soil chemical analysis*. Prentice Hall of India Pvt. Ltd., New Delhi

Markham, BL (2010). *Mini Farming: Self-Sufficiency on ¼ Acre*. Skyhorse Publishing. 62-Pp 63

Moore, GP Dolling, B Porter and L Leonard (1998) Soil Acidity. In: *Soil guide. A handbook for understanding and managing agricultural soils*. (G Moore (ed.) Agriculture Western Australia Bulletin No. 4343

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *US. Department of Agriculture Circle.* 9, 39

Panday, K.K. (1982) *Fodder trees and Tree Fodder in Nepal.* Pub Swiss Development Cooperation, Berne Switzweland. Pp 13-105

Pandey, SB and NP Osti (1995) Chemical composition of different varieties of fodder trees. *Nepalese Journal of Animal Science.* 1, 17-27

Rana, RS, Yano, F., Khanal, S.K., and Pandey, S.B. (1999) Crude protein and mineral content of some major fodder trees of Nepal. *Lumle Seminar paper No. 99/13*, Lumle Agriculture Research Center, Nepal.

Read, DJ. (1991) Mycorrhizas in ecosystems. *Experientia.* 47, 376–391

Ullah, M.A., Anwar, M. and Rana, A.S. (2010) Effect of nitrogen fertilization and harvesting intervals on the yield and forage quality of elephant grass (*Pennisetum purpureum L.*) under mesic climate of Pothowar plateau. *Pak. J. Agri. Science.* 47, 231-234

Van Soest, P.J. and Robertson, J.B. (1985) *Analysis of forages and fibrous foods: A laboratory manual for animal science 613*. Cornell University, Ithaca, USA

Walkley, A.J. and Black, I.A. (1934) Estimation of soil organic carbon by the chromic acid titration method. *Soil Science,* 37, 29-38

Zeytin, S. and Baran, A. (2003) Influences of composted hazelnut husk on some physical properties of soils. *In Bioresource Technology,* 88, 241– 244

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Post-harvest practices of strawberry and its role in income generation in Nuwakot district, Nepal

P. Mahat & S. Chaudhari
Himalayan College of Agricultural Sciences and Technology (HICAST),
Kathmandu, Nepal
prithvimahat2040@gmail.com

ABSTRACT

To assess the different aspects of the Post-Harvest Practices of Strawberry (Fragaria spp.) and its role in income generation in Nuwakot district of Nepal was carried out during15th Jan 2015 to15th July 2015. 100 farmers randomly selected from Okharpauwa and Kakani VDCs of the district were interviewed. 50.83 percent of female and 49.17 percent of male workers were involved in processing activity of strawberry industry in selected area. Jam, Jelly, Wine, and Juice were the major strawberry products .But among them strawberry wine was major products. Strawberry farming had provided employment opportunity to the members of each family in every season. Total average annual income generated by strawberry growers was NRs 99100. Most of the respondents used the income was in daily expenses (37%).

Key Words: Strawberry, Income generation, Wine, Farmers

INTRODUCTION

Strawberry is relatively a new cash crop started to be grown in Nepal since long time. Considering that strawberry farming started in Nepal, 20 years back, the lack of proper farming and technology, however, led to it being not very popular for mass production then. Strawberries, at the time were limited to either imprints in the text books or a favorite flavor in candies, ice creams and other confectioneries. Later, an agriculture farm established by Jaiti Nepal, Japanese INGO, 25 km to the north of Kathmandu, in Kakani, started research by cultivating two different varieties of strawberry. The success of the 'Nyoho' strawberries (Japanese variety) is now evident in the local fruit markets around Kathmandu. Owing to its sweetness and high yield, it has become a popular cash crop among the locals in Kakani. Currently more than 700 households are involved in commercial farming, each producing approximately 1000 kg of strawberries per season (MEDEP, 2010).

Nuwakot district has been gaining prominence in strawberry cultivation as a summer fruit. Kakani and Okharpauwa VDCs are regarded as the pocket area for strawberry cultivation. The total area under summer fruit in the district is about 725 ha in 2068/69 and the productive area, production and productivity are 607 ha, 6342 mt and 10.45 mt/ha respectively. The total coverage area of strawberry in Nuwakot is 55 ha and the

productivity is around 495 mt and total house involved in strawberry farming is 254 (DADO, 2014).

Proper post-harvest practice of strawberry is essential to ensure the raw material is of top quality and to reduce losses through wastage. Because of high susceptibility to mechanical damage, strawberry has a small postharvest life. The postharvest losses occur right from harvesting to its subsequently handling. Rough handling of fruits during harvest may cause rotting and some physiological disorder (Gautam and Bhattarai, 2006).

Strawberry cultivation is found to be very profitable business in income generation of the study areas. The studies shows that the average total cost and average total return per ropani was calculated for profitability and Benefit Cost Ratio analysis of strawberry production cost was highest in Ward 6 (Rs.143001per 0.05 ha) of Okharpauwa VDC and lowest in Kakani VDC (Rs.120641.5 per 0.05 ha) (Rijal, 2013). Strawberry farming contributes to multiple food security and the livelihood goals of a wide range of actors in agricultural production, marketing and utilization. These range from the food security needs of remote farming households in Nepal's, hills to the cash-generating opportunities of market-oriented product producers in Kakani and Okharpauwa. With these multiple functions and roles, strawberry plays an important role in economic development in this area (MEDEP, 2013).

MATERIALS AND METHODS

The study was conducted in Kakani and Okharpauwa VDCs during 15th Jan 2015 to 15thJuly 2015 in Nuwakot District of Nepal. Commercial strawberry farmers were the target population for this study. The informal list of strawberry producers was made in collaboration with DADO, Nuwakot and local key informants of respective sites. Altogether 100 respondents were selected purposively, set randomly (75 respondents from Okharpauwa VDC and 25 respondents from Kakani VDC) for the interview and 11 experienced farmers, as recognized by local Farmers' Group and DADO, Nuwakot were selected for focus group discussion (FGD). Primary data were collected through direct interview of 100 household heads with the help of pre-tested semi-structured interview schedule. At the end of the survey a Focus Group Discussion was carried out at the study area to understand local knowledge and perception towards Post-Harvest Practices of Strawberry and its role in income generation. Descriptive statistics like mean, percentage and frequency were used to describe different aspects of vegetable production under plastic cover. Data entry and analysis was done by using computer software package MS Excel 2007.

RESULTS AND DISCUSSION

Harvesting index of strawberry

Harvesting indices of the strawberry fruits was categorized into three, i.e. a) Taste b) Color c) Dropping of mature fruits. The studies showed that 89 percent of the respondents were determining the harvesting index (HI) of strawberry by color. Ten

percent of the respondents were determining by the taste and only 1 percent respondents were determining by dropping of mature fruits (Figure 1).

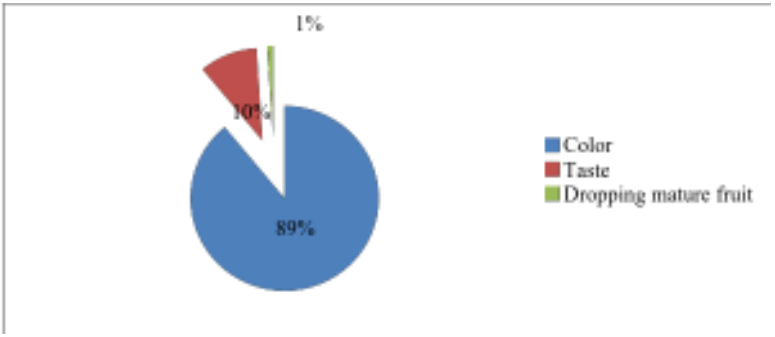

Figure1: Harvesting indices of strawberry

Materials used for strawberry packing

The strawberry growers of the Kakani respondents were using different materials for strawberry packaging. Majority of the respondents were using crate (67%) for strawberry packaging while 30 percent were using basket and only 3 percent were using tray (Figure 4).

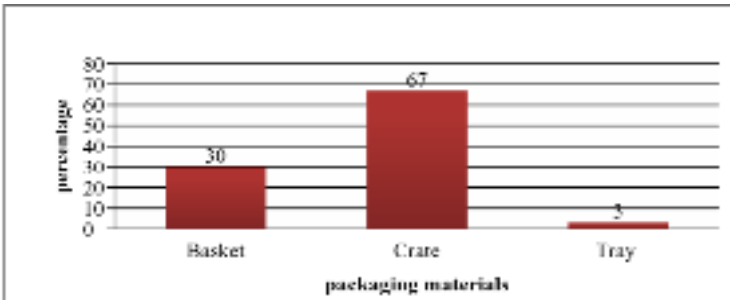

Figure 4: Materials used for packing

Strawberry transportation

Most of the respondents were using three types of vehicle for transportation of strawberry from the farm to the market. Majority of them (76 %) were transporting on the roof of bus, while 14 percent of the respondents were transporting by truck (Figure 5).

Post-harvest losses

There are many factors of post-harvest losses of strawberry production. The main factors of losses regarded as during transportation, storage/disease and marketing stage. The highest post-harvest losses were found 25 percent in transportation, 20 percent were founded from pests, 15 percent were founded in harvesting and marketing activities (Figure 6).

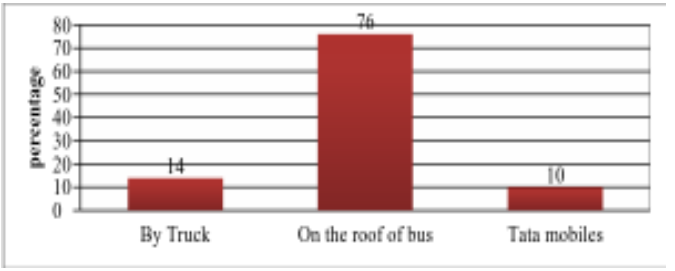

Figure 5: Transportation means used for strawberry

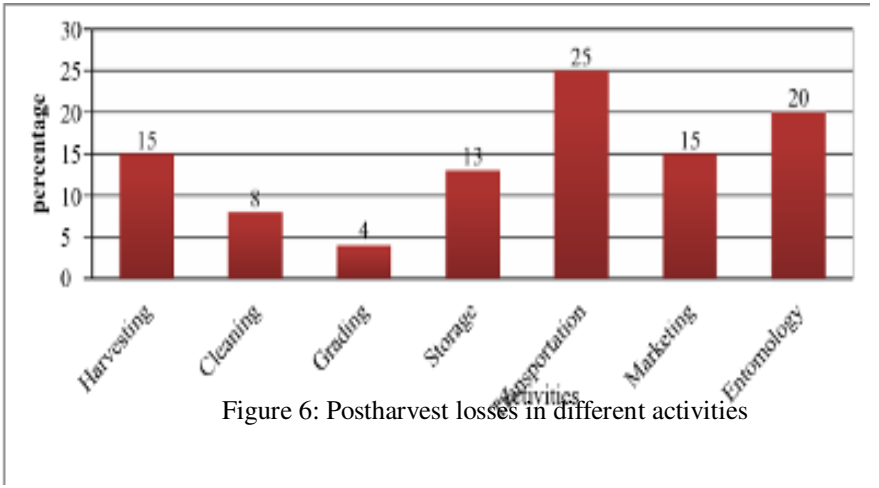

Figure 6: Postharvest losses in different activities

Role of Strawberry in employment and income generation

Strawberry farming provides employment and income generation opportunity to the family members and other local people because cultivation of strawberry requires more labor as compared to other crops production. Thus one to six family members were engaged in strawberry farming and on an average 3 family members were directly engaged in strawberry farming.

The study showed that on an average annual income from strawberry was found that NRs 99100.

Table 1: Average annual income of the respondents from strawberry per Ropani

S.N.	Yearly income	Amount (NRs)	Total (NRs / Ropani)
(A)	Grade A	58150	
	Grade B	50100	

	Grade C	67000	
	Grade D	23500	
	Total		**198750**
(B)	Annual Variable Cost		
	Human resources	39500	
	Seedlings, plant nutrients, plastic sheet	44500	
	Total		**84000**
(C)	Gross Profit= A-B		**114750**
(D)	Fixed cost		
	Drip Irrigation, Water cane, Sprinkle	9000	
	Depreciation(Farm equipment's)	6650	
	Total		**15650**
	Net profit = C-D		**99100**

CONCLUSION

Strawberry business is gaining popularity among farmers in Nuwakot due to its high return; and has become an important enterprise for income generation. In study sites average annual income from strawberry was found NRs 99100 per Ropani. It was reported by the respondents that about one fourth of the produce was lost during transportation as most of the growers used to transport it on the roof of the local buses.

REFERENCES

DADO, (2014) *Annual agricultural development program and statistical bulletin*. District Agriculture Development Office, Nuwakot, Nepal.

Gautam, D.M. and Bhattarai, D.R., (2006) *Post harvest practices of horticulture*. Public Printing Press.Newplaza, Putalisadak, Kathmandu, Nepal.

MEDEP, (2010) *Strawberry farming technology.* Micro-Enterprise Development Program. Dhobighat, Kathmandu, Nepal.

MEDEP. (2013) *Strawberry production in nuwakot*. Micro-Enterprise Development Program. Dhobighat, Kathmandu, Nepal.

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Effect of incorporating different level of mustard cake on body weight gain of goat

M.H.Azad[1], D. Adhikari[2], S.H. Ghimire[2], B. Dhakal[2], D. P. Adhikari[2] & M. S.Ali[2]

[1]Animal Nutrition Division, Khumaltar, Lalitpur
[2] Goat Research Station, Bandipur, Tanahun
azardhusneid@hotmail.com

ABSTRACT

An experiment was carried out from 2014 to 2016 A.D on growing goats at the Agriculture Research Station (Goat), Bandipur, Tanahun. Each year an experiment of 90 days was carried out with sixteen growing goat breeds such as Jamunapari cross, Local breed, Sannen breed and Boers cross at the Agriculture Research Station (Goat), Bandipur, Tanahun after maintaining an adaptation period of 10 days. The average body weights of goat were 10.18 kg, 9.75 kg, and 13.78 kg in the first, second, and third year of trial, respectively. Every year RCBD design was employed by making four blocks including four goats per block with four diet treatments having different concentrate mixtures (t1was a commercial feed; t2, t3 and t4 had 10%, 15% and 20% of mustard oilseed cake, repectively). Diet treatments 1, 2, 3 and 4 had the following compositions: T1: s*easonal fodder ad lib + farm feed (t1) @ 1.5% of body weight; T2: seasonal fodder ad lib + concentrate mixture (t2) @ 1.5% of body weight; T3: seasonal fodder ad lib + concentrate mixture (t3) @ 1.5% of body weight; and T4: seasonal fodder ad lib + concentrate mixture (t4) @ 1.5% of body weight. The CP% of feed was maintained within 16-17% for treatment (T2, T3 and T4) concentrates on the basis of DM content. The dry matter requirements of goats were calculated @ 5 kg per 100 kg body weight. The highest feed intakes observed in the year 2014, 2015 and 2016 were T2 (188.79 g/day), T2 (184.46 g/day) and T3 (260 g/day), respectively. Likewise, the highest fodder intake observed in the year 2014, 2015 and 2016 were in T4 (1.58kg/day), T1 (3.157kg/day) and T3 (2.598 kg/day), respectively. Feed conversion ratio (FCR) was higher in T1 (2013 and 2014) and T4 (2016). The actual daily body weight gain was recorded in T2 in all years; and that varied from* 59 ± 14.1 *(2015) to* 77 ± 22.40 *g (2014).*

Keywords: Goats, fodder, concentrates, Feed Conversion Ratio, weight gain

INTRODUCTION

Livestock farming contributes about 26.8% to total Agricultural Gross Domestic Product (AGDP) and about 11% to total Gross Domestic Product (GDP) as reported by MOAD (2016). Cattle, buffalo, sheep, goat, pig and poultry are the major livestock species widely being reared in Nepal. Goat farming is being the most popular means of self-

employment among the youths in the country. Current statistics regarding to goat population indicated that there are more than 10.25 million of goats in the country (MOAD, 2016). The most recent genetic analysis confirms the archaeological evidence that the wild Bezoar ibex of the Zagros Mountains are the likely origin of almost all domestic goats today. Probably, goat has the widest ecological range (Epstein, 1971). In Nepal there are four commonly documented breed of goats as Chyangra, Sinhal, Khari and Terai goats. Chyngra goats are found in 2400 meters in high Himalayans, while Sinhal found in high hill ranging 1500-3000 meters from sea level. Khari are available across the hills of Nepal while Terai goats are available in Terai region of Nepal. Chyangra (1%), Sinhal (15.6%), Khari/hill goat (56.2%) and remaining 27.2% are of Terai region and other breeds (Kharel and Neopane, 1997). In Nepal the total population of goat is about 9,786354 (MOAD, 2015) in which about 13.7 percent are crossbred goats. The goat population is growing by 2.4% each year. Goats are used for meat, pack, manure, and milk. The total production of goat meat (chevon) was 55578Mt goat meat per annum (MOAD, 2012/13).

Since last few years, there are so many farmers engaged in goat husbandry in Nepal. They are feeding their animals in traditional way without any feeding package. Farmers are unable to minimize cost of feed so far. The expensive feed ingredients like soybeans, Ground nut, Sunflower, linseed, fish meal etc has been applied for feed formulation of Goat Since a long time. Many researchers are not giving priority for using locally available cheap agricultural by products as Ruminant feeds. Mustard cakes are easily available in all regions of Nepal. Mustard cakes are cheapest source of proteins in comparison to soybean meal, Groundnut cakes, Sunflower oil cakes, Linseed oil cakes, cottonseed cakes, fish meal etc. However, Mustard cakes inclusion level in Goat feeds are limited up to 20% due its toxic effect on small ruminants like Goat and Sheep (Ewing, 1998).Oil-cakes of high crude fiber content cannot be included in high proportions in feeds for non-ruminant animals but can be used in ruminants. Ruminant animals such as sheep, cattle and goats have compound stomachs; they have some capacity to digest dietary fiber and to convert non-essential amino-acids in their diet into essential amino-acids through rumen microbial fermentation. Similarly, the introduction of exotic breed of goat and crossing with Nepali local breed causes to supply extra feeding diet for those cross breed to gain the weight of goat.

MATERIALS AND METHODS

Experimental animals

This three years experiment was carried out on sixteen number of available growing goats from 2014 A.D.(2070B.S.) to 2016 A.D. (2072 B.S.).Each year 16 goats (4 goats from each breed) from 4 breeds such as Jamunapari cross, Local breed, Sannen breed and Boers cross were selected at the Agriculture Research Station (Goat), Bandipur, Tanahun. The experiment was carried out every year from December to March. Every year RCBD design was formulated by making four blocks including four goats in each group. In 2014, every block (Two boers crosses, one local cross and one sannen cross) were

replicated. Similarly, in 2015 at every block (Two jamunapari crosses, one local cross and one Boer cross) were replicated. Finally, in 2016 at first block (Two jamunapari crosses, one local cross and one boer cross) were replicated followed by (Three jamunapari crosses and one local cross) in second block, followed by (Two jamunapari crosses, one boer cross and one local cross) in third block and finally (Two jamunapari crosses and two local crosses) were replicated in fourth block. The average body weight of first year selected 16 goats were 10.18 kg, while in the second and third year that was 9.75kg and 13.78 kg, respectively. The adaptation period of 10 days was carried out in each 90 days of trial. They were drenched with Fenbendazole @ 10 mg/kg body weight against internal parasites before assigning in experiment.

Concentrate mixture composition

Feed ingredients used were maize, mustard cake, gram, rice bran, minerals and salt; procured from Champapur Feed Industry, Chapagau, and Lalitpur. For t2, t3 and t4 concentrate mixtures were composed by using procured feed ingredients with 16-17% crude protein level (Table 1) while for control treatment (t1) feed produced by Pancharatna Feed Industry, Narayangadh, Chitwan was used.

Experimental diet of the animals

The dry matter requirements of goats were calculated @ 5 kg per 100 kg body weight. Following diets (T1 to T4) were formulated for experimental animals (Table 2).

Table 1: Composition of concentrate mixture used for experiment

Ingredients	t2 (10% MC)	t3 (15% MC)	t4 (20% MC)
Maize	30	30	30
Gram	21	23	23
Rice bran	37	30	25
Mustard cake	10	15	20
Salt	1	1	1
Mineral mixture	1	1	1
Total	100	100	100

Table 2: Experimental diets of the goats

Treatments	Experimental diet
T1	Seasonal fodder *ad lib* + farm feed (T1) @ 1.5% of body weight
T2	Seasonal fodder *ad lib* + concentrate mixture (T2) @ 1.5% of body weight
T3	Seasonal fodder *ad lib* + concentrate mixture (T3) @ 1.5% of body weight
T4	Seasonal fodder *ad lib* + concentrate mixture (T4) @ 1.5% of body weight

Feeding regime

Compound feed and *ad lib* amount of fodder was provided to the experimental animals individually in plastic vessel. Compound feed was provided once a day in the morning whereas fodder was supplied twice a day (morning and evening). Quantity of compound feed and fodder given daily to the animals was weighed daily and refusal was weighed in next morning. Experimental goats had free access to drinking water.

Chemical analysis

The samples of feed ingredients, prepared compound feed and forest mixed fodder were analyzed at the Animal Nutrition Division, Khumaltar, and Lalitpur for proximate analysis. Representative samples were analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), Total digested nutrient (TDN) and total ash contents (TA). The DM was determined by oven drying at 100°C for 24 hrs. Crude protein of the samples was determined using the Kjeldahl method. Ash content was determined by ashing at 550°C in a muffle furnace for 16 hrs (AOAC, 1980). Crude fibre of the samples was determined using the Van Soest method (Goering, H.K. and Van Soest, 1970).

Observation recording

The trial period consisted of 90 days after an adaptation period of 10 days. Total feed intake by the goats was recorded daily for all experimental periods. The body weight of individual animal was measured at the interval of 15 days.

Data analysis

Data of feed intake and body weight gain were analyzed using *One Way Annova* test for every measurement using computer statistical package Minitab 2003, versions 13.20.

RESULTS AND DISCUSSION

Chemical composition of feedstuffs

The results of chemical analysis have been given in Table 3 and crude protein content of prepared concentrate mixture was verified in laboratory which is presented in Table 4.

Table 3: Chemical composition of different feed ingredients (on DM basis)

Ingredients	DM%	OM%	CP%	CF%	TDN%	T. ASH
Maize	90	97.94	10.19	3.81	84	1.94
Gram	90	93.5	22	12.56	80.6	4.02
Rice bran	90	89.5	14	15.25	76.00	4.33
Mustard cake	89.76	90.5	31	11.77	80.5	8.82
Mixed forest fodder	30	88.19	10.5	NA	NA	11.25

Table 4: Chemical composition of prepared concentrate mixture (on DM basis)

Particular	DM	OM	TA	CP	CF
Farm feed	93.13	88.14	11.75	16	8.50
Concentrate mixture	93.40	87.30	12.78	16.5	7.10

Feed intake

Average feed and fodder intake of experimental animals is presented in Table 5. Table 5a showed that highest compound feed intake was for T2 (188.79g) followed by T4 (187.14g), T3 (185.31g) and T1 (179.15g) which was highly significant (P<0.001). Similarly, highest fodder intake was recorded for T4 (1583.33 g) followed by T3 (1558.33g), T2 (1511.66g) and T1 (1423g) respectively which was statistically significant results. The highest dry matter intake for T4 (29.91 kg) followed by T3 (29.53kg), T2 (29.40) and T1 (27.80 kg) respectively. The FCR was higher for T1 (5.1:1) followed by T3 (4.6:1), T2 (4.4:1) and T4 (3.6:1), respectively.

Table 5a: Feed intake of experimental animals/day/animal (2014/2070)

Feed stuffs intake	Mean ± SD			
	T1	T2	T3	T4
Feed intake, g	179.15± 23.07	188.79±28.38	185.31±32.3	187.14±34.3
Fodder intake, g	1423±0.04	1511.66±0.04	1558.33±0.05	1583.33±0.05
Dry matter intake/day, g	308.90	326.74	328.17	332.37
Crude protein intake/day, g	170.96	181.37	185.48	188.27
Total dry matter intake (DMI), kg	27.80	29.40	29.53	29.91
Total crude protein intake, kg	15.38	16.32	16.69	16.94
Feed conversion ratio (FCR)	5.1:1	4.4:1	4.6:1	3.6:1

Table 5b: Feed intake of experimental animals/day/animal (2015/2071)

Feed stuffs intake	Mean ± SD			
	T1	T2	T3	T4
Feed intake, g	172.27± 17.3	184.46±24.05	172.96±20.90	178.96±19.22
Fodder intake, g	3161±1.92	1951.5±0.05	1900.66±0.08	1917.5±0.06
Dry matter intake/day, g	476.31	366.69	350.91	358.18
Crude protein intake/day, g	343.66	224.66	217.73	220.38
Total dry matter intake (DMI), kg	42.86	33.00	31.58	32.23
Total crude protein intake, kg	30.92	20.21	19.59	19.83
Feed conversion ratio (FCR)	12.6:1	6.1:1	6.3:1	6.7:1

Table 5c: Feed intake of experimental animals/day/animal (2016/2072)

Feed stuffs intake	Mean ± SD			
	T1	T2	T3	T4
Feed intake, g	240± 0.07	255±0.06	260±0.06	220±0.04
Fodder intake, g	2571.66±0.05	2598.31±0.04	2591.66±0.06	2598.33±0.06
Dry matter intake/day, g	480.36	496.98	500.96	464.43
Crude protein intake/day, g	295.56	300.63	300.76	295.03
Total DMI, kg	43.23	44.72	45.08	41.79
Total crude protein intake, kg	26.60	27.05	27.06	26.55
FCR	5.9:1	5.1:1	6.09:1	6.6:1

Table 5b showed that highest compound feed intake was for T2 (184.46g) followed by T4 (178.96g), T3 (172.96g) and T1 (172.27g) which was highly significant (P<0.001). Similarly, highest fodder intake was recorded for T1 (3161 g) followed by T2 (1951.5g), T4 (1917.5g) and T3 (1900.66g) respectively which was statistically significant. The highest dry matter intake for T1 (42.86 kg) followed by T2 (33kg), T4 (32.23kg) and T3 (31.58 kg) respectively. The FCR was higher for T1 (12.6:1) followed by T4 (6.7:1), T3 (6.3:1) and T2 (6.1:1) respectively.

Table 5c showed that highest compound feed intake was for T3 (260g) followed by T2 (255), T1 (240g) and T4 (220g) which was highly significant (P<0.001). Similarly, highest fodder intake was recorded for T4 (2598.33 g) followed by T2 (2598.31g), T3 (2591.66g) and T1 (2571.66g) respectively which was not statistically significant. The highest dry matter intake for T3 (300.76 kg) followed by T2 (300.63kg), T1 (295.56kg) and T4 (295.03 kg) respectively. The FCR was higher for T4 (6.6:1) followed by T3 (6.09:1), T1 (5.9:1) and T2 (5.1:1) respectively.

Growth performance

Average growth performance of experimental goats as per treatments is presented in Table 6.

Table 6a: Body weight gain of goats (2014/070)

Parameter	Mean ± SD			
	T1	T2	T3	T4
Initial body weight, kg	10.02± 1.5	10.3 ± 1.3	10.17 ± 0.5	10.88 ± 1.8
Initial metabolic wt., kg	5.63	5.74	5.69	5.99
Final body wt., kg	15.40 ± 2.55	16.98 ± 3.44	16.53 ± 3.6	16.90 ±2.6
Final metabolic wt., kg	7.77	8.36	8.19	8.33
Total weight gain, kg	5.38±1.05	6.68±2.14	6.36±3.1	6.02±0.8
Average daily wt gain, g	59.7 ± 21.48	77 ± 22.40	70 ± 25.36	71± 20.49

In the beginning of the experiment (2014) highest initial weight was for T1 (10.02 kg) followed by T2 (10.3) and T3, T4 (10.17 and 10.88 kg) treatments, respectively while by

the end of experiment (after 90 days) total weight gain was obtained higher from T2 (6.68 kg) followed by T3 (6.36 kg) and T4, T1 (6.02 kg, 5.38kg). Both initial and total weight gain was statistically similar (P>0.05). The average daily gain was highest for T2 (77 g) followed by T4 (71 g), T3 (70 g) and T1 (59.7g).

Table 6b: Body weight gain of goats (2015/071)

Parameter	Mean ± SD			
	T1	T2	T3	T4
Initial body weight, kg	9.87 ± 1.5	9.62 ± 1.8	9.5 ± 2.06	10± 1.41
Initial metabolic weight, kg	5.56	5.46	5.41	5.62
Final body weight, kg	13.25± 1.13	15± 2.16	14.48±2.48	14.78± 1.26
Final metabolic weight, kg	6.94	7.62	7.42	7.53
Total weight gain, kg	3.38±0.37	5.38±0.36	4.98±0.42	4.78±0.15
Average daily wt gain, g	37.5 ±9.8	59 ± 14.1	55 ± 10.4	53 ± 9.1

In the beginning of the experiment (2015) highest initial weight was for T4 (10 kg) followed by T1 (9.87 kg) and T2, T3 (9.62 and 9.5 kg) treatments, respectively while by the end of experiment (after 90 days) total weight gain was obtained higher from T2 (5.38 kg) followed by T3 (4.98 kg) and T4, T1 (4.78 kg, 3.38kg). Both initial and total weight gain was statistically significant (P<0.05). The average daily gain was highest for T2 (59 g) followed by T3 (55 g), T4 (53 g) and T1 (37.5g).

Table 6c: Body weight gain of goats (2016/072)

Parameter	Mean ± SD			
	T1	T2	T3	T4
Initial body weight, kg	13.75 ± 1.5	15.3 ± 1.93	14.9 ± 0.97	15.4± 4.16
Initial metabolic weight, kg	7.14	7.73	7.58	7.77
Final body weight, kg	21± 3.7	24 ±2.8	22.3 ±2	21.7± 2.9
Final metabolic weight, kg	9.80	10.84	10.26	10.05
Total weight gain, kg	7.25± 2.2	8.7± 0.87	7.4± 1.03	6.3± 1.26
Average daily wt gain, g	52.2 ± 27.7	60 ± 34.5	55.5 ± 28.6	48.7 ± 24.2

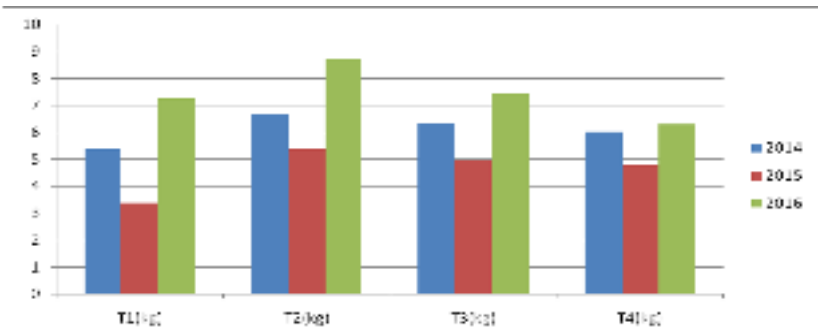

Figure 1: Total weight gain comparisons (2014/15/16)

In the beginning of the experiment (2016) highest initial weight was for T4 (15.4 kg) followed by T2 (15.3) and T3, T1 (14.9 and 13.75 kg) treatments, respectively while by the end of experiment (after 90 days) total weight gain was obtained higher from T2 (8.7 kg) followed by T3 (7.4 kg) and T1, T4 (7.25 kg, 6.3kg). Both initial and total weight gain was statistically significant ($P<0.05$). The average daily gain was highest for T2 (60 g) followed by T3 (55.5 g), T1 (52.2 g) and T4 (48.7g).

DISCUSSION

Mustard cake is used as feed for cattle, poultry and aquatic animals; however, the information on percentage of feed to be given in scanty. In case of sheep and goats, mustard cake do not affect feed intake, feed efficiency, nitrogen balance, mineral balance and growth performance of growing lambs (Kumar 2002). According to Tripathy *et al.,* (2007) partial replacement of soya-bean meal by mustard cake amounting 80 gm/kg diet had no adverse effect on growth and health of growing rabbits.

The crude protein (CP) level, energy and Total digestible energy (TDN) was maintained as recommended by Nepalese feed standard for this trial. The concentrate mixtures with 15% mustard cake have contributed 10.9 µmol glucosinolate/g dry matters (DM), which resulted in decreased methane production without effecting fermentation metabolites. Inclusion of such concentrates at 25% level in Composite feed mixture improved fermentation and reduced methane production efficiency (ml/g digestible OM). Therefore, mustard cake could be used in ruminant feeding as a methane mitigant and could offer an economic option in feed formulation (Durga *et al.,* 2016). Five concentrate mixtures were prepared with containing 30% oil cake, where linseed cake was replaced by mustard cake at the rate of 0%, 7.5%, 15.0%, 22.5%, and 30% in concentrate mixture. Mustard cake contained glucosinolate 72.58 µmol/g oil free dry matter (DM); and contents in diet were 0, 5.4, 10.9, 16.3, and 21.8 µmol/g of concentrate mixture, respectively. Concentrate mixture containing 15.0% mustard cake was found to produce minimum methane which was then used for the preparation of Concentrate feed mixture (CFM) containing 0%, 25%, 50%, and 75% levels with gram straw (Durga *et al;*2016).

At first year (2014) experiment revealed that the highest feed intake was observed in T2 (188.79 g/day) followed by T4 (187.14 g/day) and T3 (185.32 g/day) and T1 (179.15 g/day).Similarly highest fodder intake was observed in T4 (1.58kg/day) followed by T3 (1.56 kg/day) and T2 (1.51 kg/day) and T1 (1.43 kg/day). Second year (2015) experiment revealed that the highest feed intake was observed in T2 (184.46 g/day) followed by T4 (178.96 g/day) and T3 (172.96 g/day) and T1 (172.27 g/day). Similarly highest fodder intake was observed in T1 (3.157kg/day) followed by T2 (1.951 kg/day) and T4 (1.917 kg/day) and T3 (1.912kg/day).Third year (2015) experiment revealed that the highest feed intake was observed in T3 (260 g/day) followed by T2 (255 g/day) and T1 (243.3 g/day) and T4 (226.6 kg/day).Similarly highest fodder intake was observed in T3 (2.598 kg/day) followed by T2 (2.591 kg/day) and T4 (2.605kg/day) and T1 (2.57kg/day). On an average, the Agriculture and food research Council (AFRC) (1998) under predicted Dry

matter intake (DMI) by 92g/day, Whereas National Research Council (NRC) (2007) and CSRIO (2007) over predicted Dry matter intake (DMI) by more than 330 g/day. The recommended average dry matter intake (DMI) for goat is 3.20 % of the live weight or 66 gram DM /$Wkg^{0.75}$. The requirement of dry matter varies from 2.7 to 4.4 % of the body weight of the goat along with the average figure of dry matter (DM) requirement has been used to calculate the requirement for different growth and production stage of the animal as recommended by Nepalese feed standard. This prediction supports the outcome of this research. The digestible protein (DP) requirement for different growth has been determined by several investigators with the average value of 31.53 g DP/Mcal ME. The protein requirement is for maintenance and for maintenance plus growth is 1 Mcal ME =28.8 g DP = 42.3 g total protein (TP) which has been used to calculate the requirement value as presented in Nepalese feeding Standard. The average digestibility of total protein is assumed to be 68 percent. The recommended value of protein is of 2.51 g DP/ $Wkg^{0.75}$ which has been used to prepare the recommendation for this trial. This supports the above crude protein intake by this trial goats.

Tiwari *et al.*, (2013) also reported maximum final metabolic weight, kg in goat at the range of 9.56 to 9.69; that supports this trial maximum level of final metabolic weight in goats.

In the first year trial actual daily body weight gain was recorded as 59g, 77g, 70g and 71 g from treatment 1, 2, 3 and 4 groups, respectively (2014) while in the second year the actual daily body weight gain was recorded as 37.5g, 59g, 55g, and 53 g from treatment 1, 2, 3 and 4, respectively (2015). In third year trial actual daily body weight gain was recorded as 52.2g, 60g, 55.5g and 48.7g from treatment 1, 2, 3 and 4, respectively (2016).That agrees with the results reported by Joshi and Shrestha (2012). AFRC (1998) recommended the 41-101 g/day as the actual body weight gain in goat that supports the outcome of this research. Rahaman *et al.,* (2012) also reported maximum feed conversion rates up to 10.4 in trial goats at ISB (Institute of Biological Sciences) Mini Farm, University of Malaysia, Malaysia treated with soya bean wastes and palm kernel cakes. Tiwari *et al.,* (2013) also recorded the feed conversion ratio (FCR) was higher for treatment 1 (12.93:1 kg) while for treatment 2 it was 12.19:1 kg in his trial. This high feed conversion rates from Tiwari supports this trial. The per kg feed cost of 10, 15 and 20% mustard cake inclusion feeds were found to be cheaper than commercial feed. The feeding cost accounts more than 70% of the total production cost of livestock; and therefore, the economic efficiency of the cost of feeding is a challenge for animal nutritionists. Protein supplements are the most costly feed ingredients used in animal feed. Alternate feed resources are added to the feed chain to increase the availability of feed resources and reduce the cost of feeding. Groundnut cake, soybean meal, linseed, and sesame cake are conventional protein supplements used in goat feeding. However, these are very costly, and availability for ruminant feeding is also limited. Mustard cake is widely available at cheaper prices but its utilization in goat feeding is limited because of its bitter taste and glucosinolate content (Tripathi *et al.,* 2007).

CONCLUSION

It has been revealed that T2 group provided with forest mixed fodder adlib +10% treated mustard cake included concentrate mixture @ 1.5% of body weight increased body weight gain and reduced feed costs than farm feeds. Therefore, further experiment should be carried out to optimize the higher body weight gain and to reduce feed costs ratio without any physiological effects in goats.

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REFERENCES

AFRC, (1998) The Nutrition of Goats. Technical Committee on Response to Nutrients. Report number 10 CAB International, Wallingford, UK.

AOAC (1980) *Official methods of analysis*. Association of Official Analysis Chemists, Washington DC, U.S.A.

CSIRO, (2007) *CSIRO Nutrient Requirements of Domesticated Ruminants.* Commonwealth Scientific and Industrial Research Organization, Collingwood, VIC

Durga, SM, Tripathi, MK, & Dutta, N. (2016) In-vitro fermentation characteristics and methane reduction potential of mustard cake (*Brassica juncea* L.). *Veterinary World,* 9(10), 1141-1146.

Ewing, W.N. (1998) *The Feeds Directory: Commodity Products Guide*. Context Publications, Ashby de la Zouch, UK, pp. 118.

Epstein, H.(1971) *The origin of domesticate animals of Africa.II*. African Publishing Corporation, New York, London and Munich.pp.719.

Goering, H.K. and Van Soest (1970) Forage fibre analysis apparatus, reagents, procedures and some application, ARS, USDA, *Handbook N 397.*

Joshi, BR & Shrestha, B.S. (2068 B.S) *Commercial Goat Production* (in Nepali).

Kharel, M. and Neopane, S.P. (1997) Goat Genetic Resources. N.B. Shrestha (ed.), *Proceedings of the First National Workshop on Animal Genetic Resources Conservation and Genetic Improvement of Domestic animals in Nepal.* Nepal Agricultural Research Council, Khumaltar, Lalitpur, Nepal.pp.48-54.

Kumar, GKA, Panwar ,VS, Yadvan, KR and Sihag, S. (2002) Mustard cake as a source of dietary protein for growing lambs, *Small Ruminanats Res*, 44, 47-51.

MoAD (2012/13). Ministry of Agriculture Development. Agri-Business Promotion and Statics Division. Singha Durbar, Kathmandu, Nepal

MoAD (2014/15). Ministry of Agriculture Development. Agri-Business Promotion and Statics Division. Singha Durbar, Kathmandu, Nepal

MoAD (2015/16). Ministry of Agriculture Development. Agri-Business Promotion and Statics Division. Singha Durbar, Kathmandu, Nepal

NRC. (2007) *Nutrient requirements of small ruminants. sheep, goats, cervids and new world camelids*. National Academy Press, Washington, DC .

Rahman, M.M., Abdullah, R.B., Wan Khadijah, W.E., Nakagawa, T. and Akashi, R. (2013) Feed Intake, Digestibility and Growth Performance of Goats Offered Napier grass Supplemented with Molasses Protected Palm Kernel Cake and Soya Waste. *Asian Journal of Animal and Veterinary Advances*, 8, 527-534.

Tiwari, M.R., Shrestha, B.K., Mandal, P. and Pandey, L.N. (2012) Growth Performance of Khari goats on supplementation of urea molasses mineral block (UMMB) in fodder based diets. *Nepal Journal Science and Technology*.13, 29-32.

Tripathi, M.K, Mishra A.S. (2007) Glucosinolates in animal nutrition: A review. *Anim. Feed Science Technology*, 13(2), 1–27.

Tripathi, M K, Mishra AS, Mishra AK, Prasad R, Mandal D and Jakhmola, R.C. (2013) Effect of graded levels of high glucosinilate mustard (*Brassica juncea* L.) meal inclusion on nutrient utilization, growth performance, organ weight, and carcass composition of growing rabbits. *World Rabbit Science,* 11, 211-226

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Use of wild food products and its importance in livelihoods

S. Shrestha
Research Centre for Applied Science and Technology (RECAST),
T.U., Kirtipur
sajanisk@gmail.com

ABSTRACT

The research was done in the buffer zone where crop depredation by wild animals was prominent and directly effect to livelihood. They are Shivapuri National Park and Parsa Wildlife Reserve. The main objective of this study is to explore the role of forest resources in ensuring household food security and income generation. Livelihood was one of the greatest problems in buffer zone where crop damage by wild life was very common especially among poor and land less people. The research was found that they had adopted different strategies like fuel wood selling, alcohol making by using fuel wood and timber smuggling as alternative livelihood measures. It affects conservation threat for sustainability. It was also found that wild food contributes 2.5% (25gms/day/person) total foodstuff which was projected as 43 kg per year. The annual estimated consumption of wild food was significantly different among indigenous and migrated people. Different products are collected from parks, community forest and fallow land. The major wild food collectors were women. The study was based on research on Use of Wild Food Products in Relation to Household Food Security in Nepal.

Keywords: Wild food, protected area, buffer zone, indigenous people, fellow land, livelihood

INTRODUCTION

Nepal's forestry sector plays a prominent role in the economic and social life of the rural population. The forest plays important role in rural livelihood and its social life in terms of forest food (wild food), fuel wood, and fodders. Pressure on these resources is increasing. Previously, the major part of the land was covered by forest. The rural communities in the Terai and Hills - particularly indigenous community had their dependent on forest products like food, fiber, utensil, medicine, fodder and mulch. Nowadays, forest coverage has declined in Nepal i.e. 60 percent in 1950s, 38 percent in 1978/79 and 29 percent in 2007 Forests in Terai are thin, fragmented and mainly confined to protected areas (PAs). Nepal has 19.70% (28,998.67sq.km) of total land area under the protected areas (www.dof.gov.np). The forest products have declined in terms of quantity, subsequently miming the forest product itself.

Wild food is uncultivated food which are harvested or collected from outside agricultural areas, forests and other bush land areas. It includes wild leafy greens, fruits, spices,

condiments, grasses, bamboo shoots, seeds nuts, roots and tubers, 'wild' birds, 'wild animals, fish, insects and honey. 1,500 wild foods are considered useful. Out of these, 651 species are economically useful including 440 species of wild food plants. About 200 plant species are consumed as vegetables. Most of them are regarded underutilized or neglected (Manandhar, 2002). It is free foods and it provides valuable amounts of nutrients at no costs. Many people are using wild foods by knowing and unknowing (Adhikari, 1999).

Wild foods are excellent nutrient sources, supplying vitamins, minerals, protein and trace elements. For example, 'wild' leaves provide vitamin A, ascorbic acid, folic acid, iron, and calcium or niacin and plant protein, depending on the species. 'Wild' seeds and nuts are sources of energy, essential oils, minerals and protein. Tubers, roots, rhizomes and corms provide starch, and the skins provide some minerals. 'Wild' fruits have higher concentrations of Vitamin C than exotic and domestic fruits (Shrestha, 2011).

Wild tubers and potato yam are staple substitute during winter among poor people of Rai and Sherpa. Six or seven vegetables are gathered in winter and monsoon season. More than one half of the Sherpa women eat *sisnu* and *tusa* two or three times a week during the monsoon period. The research shows that two of the poorest households report that they fetch *sisnu* and *tusa* daily. The *Rais* and poor *Sherpas* use wild food as buffer food in food scarcity period (Daniggele, 1997).

Human physiology needs micro nutrients (vitamins and minerals) in a small quantity to catalyze chemical processes in order to build tissue and fluids, for instance, iron for blood and calcium for bone. Lack of iron and iodine causes serious nutritional disorder. Fluorine, zinc, calcium, sodium and potassium are in shortage when vegetables and fruits are not available at a particular time. A small amount of intake of wild (uncultivated) food fulfills the need for micro nutrients and vitamins (Shrestha, 1993 & 2011). In many communities, wild foods are of great nutritional value particularly in areas where agriculture does not provide much. In time of food shortage when cultivated crops fail, wild food is useful. It is also useful food for rural poor because of its free access to forest and common land. In some communities, it is also the major source of protein which is freely accessible and available among poor communities. Use of wild food is not restricted to buffer zone. Therefore, wild food plays a significant role in rural community.

Many plant species are taken as medicines or tonics and added to cook meals or consumed daily. Forest provides 75-90% source of medicines for a vast majority of the developing world's population (Adhikari, 1999). Mostly, women collect these foodstuffs when they are allowed to enter the forests for fuel wood collection. During the food shortage period, women and children collect and consume wild food plants. This case report mostly is relevant in case of Nepal. Some of the plants are domesticated in the farms. Similar nature is found in different parts of Nepal (Modi & et al, 2006). Therefore, wild food is an important in livelihood for people.

Medicinal value of wild plant is significant in Himalayan region. A case of Humla, 102 species of Medicinal and Aromatic plants have been identified and recorded. The inhabitants of Humla district have traditionally traded goods with India and China. Out of them 16 are commercially used in trade and 31 have potential commercial value and 55 species are used for subsistence purpose in Humla. Apart from commercial harvesting of economic plant species most of the people of Humla use wild plants for a variety of purposes such as food, medicine, fodder, and fuel. They also use it for manufacturing a number of domestic goods. They are also using it for dyes, tannin, fiber, gum, resin, and for making agricultural tools and hunting weapons (Bhattarai & et al, 1999). People living at higher altitude have benefited considerably from selling raw and processed Non-timber Forest product (NTFPs). World Wild Life Fund (WWF)'s report is relevant to focus on the food sources of the Himalayan region. It is stated that the *Yarsha Gumba* (*Tipneollection of cordiceps sinensis)* collection is a major activity for livelihood in Dolpa and almost all high the mountain region of Nepal. Dolpa are primarily dependent on *Yarsha Gumba* collection as main livelihoods and survival strategies. Due to fragile and less fertile nature of lands, agro-farming is not sufficient to meet domestic food needs (WWF, 2007). It is almost similar in all mountain areas of Nepal.

MATERIALS AND METHODS

Two protected areas are selected as study area. One is Parsa Wildlife Reserve (PWR) and another is Shivapuri National Park (SNP). In total, 433 HH (20% of population) samples have been taken for general questionnaire from two protected areas (PAs). Both primary data and secondary information are collected. Primary data are taken by applying household survey, inventory of private trees, direct observation, semi-structured interviews, individual interview, and focus group discussion with different stockholders. Formal as well as informal discussions have been organized to explore the concerns of individuals and organization. Secondary information is collected different agencies as published, unpublished reports and articles. Annual consumption and twenty four hours dietary recall method has been carried. Major wild vegetables are analyzed by AOAC, 1990 method for proximate analysis (AOAC, 1990).

RESULTS AND DISCUSSION

Protected Areas (PAs) have provided adequate wild foods to surrounding communities with encouraging impact on nutritional supply, especially in an abnormal situation where forests outside parks are depleting fast. The study shows the information on how PAs' resources contribute to livelihood of people living in buffer zones. It also investigates the micro nutrient contribution of wild plants and traditional medicinal treatment. More than 64% wild vegetables are collected in protected areas. There is direct relation between vegetable cultivation and wild food collection. If people have sufficient vegetables in their home garden, they are less involved in collection of wild food unless they are much tempted to have wild food as a part of delicious and palatable. **Nature of Works for Livelihood**

Most people are involved in agriculture, service, labor, livestock rearing, vegetables farming, milk and milk products. Some people are involved in alcohol making *(Raksi*) and fuel wood selling for livelihood because of unskilled manpower surrounding area of protected areas. Table 1 shows nature of works and percentage of HH involved in different jobs. Conventional practice of alcohol making requires more fuel wood that has ultimate implications on forest degradation. Selling alcohol is an option to make alternative income in SNP (33%). Almost all households are involved in selling of alcohol in some hamlets like Okherani and Mulkharkh of Sundrialijal VDC inside the Park. Similarly, 4.5% households are involved in fuel wood selling in PWR, in some areas of Pathaliya. Fuel wood selling is main livelihood option for among both men and women. People helplessly sell *Sal* wood which in terms of price comes to very high. But they sell them in fuel wood price for livelihood.

Table 1: Nature of Work in PA's for Livelihood

SN	Professions	No of HH involved	Involved (%)	Remarks
1	Agriculture	331	76.4	
2	Service	176	40.0	
3	Business	73	16.9	
4	Local alcohol making *(Raksi)*	66	15.2	SNP people
5	Fuel wood selling	16	3.7	PWR people
6	Labor	162	37.4	

Source: Field research data, 2017

Wildlife crop damage

Wild life crop damage is one of the challenging issues in buffer zone. It is one of the conflicting issues among local people and protection authority. On other hand, livelihood is one of the big problems in poor community of buffer zone. Crop damage makes it more complex in their food security. Wildlife crop damage is higher in SNP (77%) and 36% in PWR. Wildlife crop damage is significantly high in SNP. Particularly, wild boars and porcupines damage crop seriously. Average damage is 160 kg/household in impact zone. It is almost one person cereal diet for whole year (4 ton paddy is needed per person per year in village standard). Serious damage crops are maize and millet. Leguminous crops like beans, soybean, black gram dal, and cowpeas are least damaged. It might be less palatable to wildlife. Mostly, individual farmers have substantial amount of wildlife damage in impact zone.

Wild food consumption and livelihood

Wild food consumption is an important component for their livelihood. Wild foods are directly and indirectly impact to food security. The consumption pattern depends on the different factors. Major factors are availability, cultural habit, palatability, per capita income, time to collect the wild food and modernization in agriculture. Those entire

factors influence the total consumption of wild food. It is found that more than 95.8% (415) households consume wild food. They provide important nutrient especially during scare season. It is found that still, 49% (210) households collect wild food from national park. Wild food is important to poor farmers and indigenous group for household food security. People consume wild food for different purposes. Mostly, people consume wild food for palatability. Indigenous people such as *Bankaiyas, Majhis and Chepang* consume them as supplementary food.

Table 2: Wild life crop damage in PAs of buffer zone

SN	Crop damage	**PWR**		**SNP**		**Average**	
		HH	%	HH	%	HH	**%**
1	No. of crop damage HHs	97	36.5	129	77.2	226	52.19
2	Total no of sample HHs	266	63.5	167	22.8	433	100

Source: Field research data, 2017

Annual consumption of Wild Food

The consumption of wild food has great difference based on individuals. Some people consume much where as some other consume less. In the study areas, 2.5% (25g/day/person) wild food consumption is apparent in the total diet. Even it is small amount in the diet; the contribution is high in terms of nutrients such as vitamins and minerals. It is found that average wild food consumption is 43.4 kg / a year**.** Wild vegetables are highly consumed than other wild foods. Fish and crabs, mushroom, roots and tuber are 4.2, 4.3 and 5.5 respectively. Fish, crab and mushroom are palatable wild food species among indigenous group. Similarly, mushroom is one of the palatable species of wild food.

Total intake of wild food is highest among indigenous groups than other groups due to their culture and habit. Among the indigenous group, *Bankariya, Chepang, Uraw, Parja, Danwar, Mahato* use most of the wild food. The consumption pattern of wild food among *Bankariya* is found to be higher. Mainly *Bankariya* are dependent on wild and forest food. They highly depend on wild food and they use to stay in forest move from one place to another in the forest. Recently, *Bankariya* are involved in cultivation of food grains because of restriction of movement around the national forest. Otherwise, they are totally dependent on forest resources and collected wild foods for their livelihood. Recently, the government has hand over the national forest as leasehold forest among *Bankariya* group and started cultivation which is supported by LGP/UNDP.

Wild food consumption depends upon different factors. Nature based communities use more wild food. Modernization in agriculture and urbanization reduce the wild food consumption. The consumption depends on availability and palatability of wild food. There is high demand in palatability species of wild food. Some palatable species are economically benefited and their species are in high demand such as *Asparagus purpurea* (kurilo), neuro and mushroom. *Asparagus purpurea* is domesticated for economic

purpose. However, increase in income and lack of availability of wild food show decreasing trend of consumption. Per capita income is another factor in wild food collection. If household have enough income, they are less active in wild food collection. Some palatable species could be bought and are not collected by them. But poor people collect wild food from protected areas, community forest and fellow land. They sell them in the market for livelihood. Therefore, wild food collection is related to economy of the people. So, wild food is called poor man's diet if it has free access.

Medicine and wild Products

Traditional medicine is still in use in isolated and rural areas. Wild resources are essential ingredients in Nepal. An estimated eight percent of the population of Nepal depends on traditional medicine as their primary form of health care (Rajbhandari et al., 1994). Approximately seven hundred medicinal and aromatic plants have been identified in Nepal (Rawal, 1994). Traditional medicinal herbs collection from the forest is one of the major activities in remote areas among *healers.* They do traditional treatment by medicinal plants and they are comfortable to the traditional medicine and procedure. Boker carried out research on the topic "The Chitwan Tharus in Southern Nepal" An Ethno-ecological Approach revealed that Tharu people who are living inside and outside the Royal Chitwan National Park, completely depended on the forest resources. Traditionally, they gathered nutritional and medicinal plants in their daily life (Boker, 1999). Such situation is found in Shivapuri National Park too. Traditional healer practiced their jobs by applying medicinal plants in SNP. In the remote rural areas, traditional medicines are much more popular compared to modern treatment because of cost and distance. Medical facility is very poor in hilly areas due to the far distance of hospital, dispensaries and non-availability of medicines. Village *healers* have knowledge about traditional herbs and their treatment. Minor disease like worms, pimples and headache, children's disease and other minor injuries are treated by local healers and even complicated diseases such as *Jaundice.* It shows the dependency on wild plants for their livelihood.

CONCLUSION

Livelihood is one of the great problems in buffer zone where crop damage by wildlife is very common confronted by poor and land less people. They have adopted strategies like fuel wood selling, alcohol making and timber smuggling as alternative livelihood measures. It has threatened conservation sustainability. Right to food security for livelihood is the fundamental and primary right of men and women. NGO and INGO involved in safe guarding the right to food security for livelihood. It is related to social and economic activities such as improvement in agriculture, irrigation facilities, right against malnutrition, right to employment and gender status for better livelihood. Therefore, government should seriously take these issues.

About 95% people consume wild food such as wild vegetables, fruits and birds. 49% people harvest wild food from national park. Wild food collection is often done by

women (49%). 34 and 17 species wild food are consumed in PWR and SNP respectively. Because of limited availability of wild food, people are switched to agriculture products. Wild food consumption is slightly higher in PWR. It is 25 g/day/person in a total diet, which is 2.5% contribution from wild food to food security. Mean estimated annual wild food consumption is 43.4 kg/household (maximum 320 kg and minimum 2.5 kg/household). It is small amount in the diet; but higher in terms of nutrients, vitamins and minerals. It was found that indigenous people consume more wild food as compared to other groups ($F = 25.467$, $df = 144$, $p<0.01$).

Based on overall scenario, wild food has been playing a very important role in the livelihoods of rural communities. It is an integral part of the subsistence strategy among rural people in Nepal.

RECOMMENDATIONS

Considering this research, following recommendations may be drawn for betterment of livelihood:

- Cultivation of edible and palatable wild plant species should be promoted on wildlife damaged areas.
- Government policy is needed to emphasize on farming of nutritionally and economically valuable wild plant species in community forest, leasehold forest and private land to support nutrition and economic upliftment of the local people.

REFERENCES

Adhikari, R. (1999) *Impacts of WTO Agreements on Food Security*. Report of the National Workshop on Food Security: pp 34-37

AOAC (1984) *Official Methods of Analysis*, 14th edition. Association of Official analytical Chemists, Washington, DC, USA.

Bhattarai, K. N. & Subedi, B.P. (1999) *Proceedings of workshop on medicinal plants at the basis for the relationship between industries and rural communities*" Feb 17, 1998, Banglore, India, pp 89-95.

Boker, U. M. (1999) *The Chitwan Tharus in Southern Nepal: An Ethno-ecological Approach.* Franz Steiner Verlag Stuttgart, pp 113-170.

Daniggelis, E. (1997) *HIDDEN WEALTH The Survival Strategy if Foraging Farmers in the Upper Arun Valley, Eastern Nepal*, Dissertation submitted to University of Hawaii and published by Mandala Book Point in collaboration with The Mountain Institute, Asian Regional Office, KTM, Nepal

Department of Food Technology and Quality Control (2007) *Laboratory Manual Food and Feed Ingredients,* Majesty Government of Nepal, Ministry of Agriculture and Cooperatives, Babar Mahal, Kathmandu.

DNPWC/PCP. (2007) *Management Plan of Parsa Wildlife Reserve and its Buffer Zone,* Department of National Park and Wildlife Conservation/Participatory Conservation Programme

King Mahendra Trust for Nature Conservation (2004) Shivapuri National Park Management Plan, Jawalakhel, Lalitpur

Manandhar, N.P. (2002) *Plants and people of Nepal.* Kathmandu

Modi, M., Modi A.T., and Hendriks, S. (2006) Potential Role for Wild Vegetables in Household Food Security: A Preliminary Case in Kwazulu-natal, South Africa, *Ajfand*, 6(1),1-13.

MoF. (1998) *Master Plan of Forestry*, MoF, Kathmandu

Rajbhandari, T.K. & Bajracharya, J. M. (1994) National Status on NTFPs: Medicinal and Aromatic plants, *Proceedings of National Seminar on Non-timber Forest Products: Medicinal and Aromatic Plants*. Sept 11-12, 1994. Kathmandu, pp 8-15.

Rawal, B. (1994) Commercialization of aromatic and medicinal plants in Nepal. In: *Beyond Timber*, *Social, Economic and cultural Dimensions of Non-Forest Products in Asia and the Pacific*. Patrick B. Durst and Ann Bishop (eds.), FAO.

Shrestha, S. (1993) *Assessment of Wild Food Products and Their Role in Household Consumption Pattern in case study in Bardia District, Nepal*, M.Sc. Thesis, Agricultural University of Norway.

Shrestha, S. (2011) *Use of wild food products in relation to household food security in Nepal from gender perspective on Shivapuri National Park and Parsa Wildlife Reserve*, PhD Dissertation, Tribhuvan University, Kathmandu

WWF. (2007) *Sustainable Livelihoods, Building on Good Governance*: *A case study on inter linkages between conservation, livelihoods and good governance practices in Dolpa,* Nepal, Series no 2. WWF Nepal.

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Disease suppressiveness characteristics of vegetable growing soils in Kathmandu valley

G. Shrestha
Regional Agricultural Research Station, NARC, Khajura, Banke
shresthagautam@live.com

ABSTRACT

Soilborne diseases are possible to manage applying different farm management techniques. Disease suppressiveness characteristic of soil contribute in soilborne disease management. Here, this characteristic of conventionally managed farms was compared with farms managed applying organic methods. Bulk soil and rhizosphere soil samples were collected from 30 each conventional farmers and organic farmers in Kathmandu valley, Nepal. Tomato bioassay experiment with three soil treatments in the soils from two farm types with each five replications was performed for 28 days. Results revealed treatments with rhizoctonia inoculation in autoclaved bulk soil from organic farms followed by soils from conventional farms with similar treatments were significantly (p value = 0.0013) abled in inhibiting damping off than other treatments. As a contributing factor, soil organic matter content had significant positive (adjusted R^2 value = 0.055, p value = 0.000) role in subduing pathogenic microorganisms. Higher soil available nitrogen content had significant negative (adjusted R^2 value = – 0.0132, p value = 0.000) contribution in the disease suppressiveness ability. Following specific farm management practices contributing to soil organic matter content can contribute to the disease suppressiveness property of the soil.

Key words: Bacterial consortium; disease suppressive soil; organic agriculture; sustainable soil management

INTRODUCTION

Vegetable crops are one of the most pesticide used crops in the world (van Lenteren, 2000; Wilson and Tisdell, 2001). In addition, most toxic effect of pesticide occurs when applied in vegetables, because these are also consumed fresh, raw or uncooked (Bhanti and Taneja, 2007). Conventional farmers are bound to use one or more types of chemical pesticides before harvesting their produce. According to Pokhrel and Pant (2009) vegetable farmers use the one fifth proportion of the total pesticides imported in Nepal. The recent increase in pesticide application in vegetables is due to increase in the vegetable production in peri-urban areas (Atreya et al., 2012).

Soilborne diseases pose the serious economic threat to all commercial farmers (Abawi and Widmer, 2000; Oerke, 2006) because these diseases cannot be resolved by applying treatments in the small patches of land having spread in larger area. Soilborne pathogens

can be fungi, bacteria, prokaryotes or nematodes residing in the soil. In general, a gram of soil contains millions of micro-organisms (Brady and Weil, 2012). However, to arise as a damaging pathogen, specific micro-organisms need a favorable environment. In the process, they have to compete for food and space.

Different farming systems favor soil micro-organisms which can best survive the methods followed along with the influence of soil physical and chemical properties. Monoculture (van Elsas et al., 2002), greenhouse horticulture (van Lenteren et al., 2002), excess use of chemical fertilizers (Bending et al., 2002) less use of organic manures promote soilborne disease infestation in the crops.

One of the economically important soilborne pathogens is rhizoctonia species fungi causing worldwide damage to the important crops such as cereals, cotton, sugar beet, potato, vegetables, field crops, turf grasses, ornamentals, fruit trees and forest trees (Aye and Matsumoto, 2012). These fungi are strong saprophytes (Schumann and D'Arcy, 2006). These are able to survive long duration feeding on organic matter in the soil even in absence of the living host. This fungus can persist as mycelium or as sclerotia when conditions are unfavorable. Hence, this saprophyte may become dominating problem in the commercial farms. Koike et al. 2003 have listed diseases caused by this pathogen like damping off, rot in the economically important vegetable crops such as tomato, cole crops, cucurbits, pepper, lettuce, celery etc.

The chemical pesticide based management of rhizoctonia species is not an easy shot. Kataria et al. (1991) found that species of rhizoctonia differed in their sensitivity to fungicides. Out of 14 fungicides with different modes of action, cyproconazole and tolclofo-methyl were generally inhibitory against all tested isolates of five rhizoctonia species (*R. solani*) from cowpea, rapeseed, cotton, potato and rice. Additionally, the pesticidal doses differed to each species. In contrast, in the organic farming, pest and disease management methods with prompt effect are rare (Shrestha et al. 2014a). Hence, for any farming systems, long term field management techniques preventing possibilities of soilborne disease outbreak can be the most viable option.

Disease suppressiveness properties of soil have gained momentum in the last few decades as the non-chemical way to manage soilborne diseases in the field (Weller et al., 2002). Disease suppressiveness is defined as the property of soil to contain the population of disease causing microbes to minimum with the help of consortium of beneficial microbes in the soil (Alabouvette, 1999). This property is developed in the soil as a part of inherent soil properties and as a part of farm management practices (Linderman et al., 1983; Baker and Cook, 1974; Mendes et al., 2011).
In this work, I have compared the disease suppressiveness characteristic of soil from the conventional farm with that of organic farm. I have related this property with specific soil physical and chemical properties as index. Soil properties and soil management practices followed by the same farmers have been compared in detail in the other article (see

Shrestha 2014). Plant disease management methods (see Shrestha et al., 2014a); horticultural management practices (see Shrestha et al. 2016) and farm economics (see Shrestha et al., 2014b) of organic and conventional farming compared have been already published.

MATERIALS AND METHODS

Study area

Kathmandu valley was selected purposively for the study. It was because of the increased urban population resulted in high demand for fresh vegetables. Additionally, elite members and health conscious persons are willing to purchase organic vegetables though it is expensive (Bhandari 2006). All three districts, Kathmandu, Bhaktapur, and Lalitpur in Kathmandu valley were included for the study. With total 60 farmers selected, there were 10 each commercial conventional farmers and organic farmers from three districts. We could find only five commercial organic farmers in Bhaktapur. So, we selected 15 commercial organic farmers from Kathmandu district.

Soil sampling

In May 2013, soil samples from sixty commercial farmers were collected. Among them, 30 were organic farmers and other 30 were conventional farmers. Two types of soil samples were collected from the depth of 20 cm. One type of sample was from rhizosphere, which was collected and stored at 4°C (rhizosphere soil). Other bulk soil samples were collected randomly from different spots in each farm and prepared composite soil sample which was air dried and stored in the room temperature. For available nitrogen analysis, soil samples were stored at 4°C.

Disease suppressiveness bioassay

Cell tray, containing 8 x 4 cells, was used for growing tomato seedlings. For bioassay, three soil treatments were prepared namely bulk soil, rhizospheric soil and autoclaved bulk soil. Autoclaved soil was prepared by autoclaving a portion of bulk soil samples at 15 lbs pressure for 30 minutes on two consecutive days (Chuankun et al. 2004).

Having five replications, soils were filled in the hole. Randomization was maintained to minimize error. Two seeds of hybrid tomato variety “Srijana” were sown in each cell.

Inoculum of *Rhizoctonia solani* (isolated from cauliflower) was obtained from the Plant Pathology Division (PPD), Nepal Agricultural Research Council (NARC), Lalitpur. Inoculum was mass produced in potato dextrose agar (39 g PDA per litre of distilled water) at 25°C in the nine centimeter petri dishes. These cultures were incubated four weeks. Each plate filled with *R. solani* was divided into twenty equal parts. Then, top layer of each part was peeled off. The layer was macerated into solution and applied in each cells with rhizosphere soil and autoclaved bulk soil treatments after sowing tomato seeds.

Damping off disease occurrence was counted every week up to the day 28. Symptoms of stem rotting near the soil contact surface of tomato seedlings were counted as damping off disease occurrence (Figure 1).

Figure 1: Tomato seedlings none affected (left) and affected (right) by damping off disease in different soils

Soil analysis

For soil physical and chemical property analysis, about 500 g of soil samples were shade dried before grinding for analysis. Soil pH was measured in 0.01 M Calcium chloride solution with 1:10 soil and solution ratio in a bench top pH meter. Soil organic matter was determined by titration following Walkley Black method using 0.1667 M Potassium dichromate. Soil available phosphorus was determined with extract solution of sodium bicarbonate as described in modified Olsen's method using a spectrophotometer. Soil available potassium was determined with ammonium acetate extraction in a flame photometer. Total nitrogen was determined by titration following Kjeldahl digestion and distillation method using digestion mixture (Sodium sulphate and copper sulphate). Freeze stored soil samples were used to determine soil available nitrogen by titration using 1.0 N KCl as extractant and MgO and Devarda's alloy for digestion (FRSRD 1980). Soil physical properties determined were soil texture (Bouyoucos hydrometer method), bulk density (measuring cylinder method) and particle density (pycnometer method) (Shrestha, 2012).

Data analysis

Data was analysed using R-software version 3.2.4 with two factor analysis of variance (ANOVA) for two factor factorial research design. Level of significance was analysed using Tukey's Highly Significance Difference (HSD) test applying R-package agricolae.

Coefficient of variance was calculated applying R-package raster. Regression analysis results are shown for all the measured parameters.

RESULTS AND DISCUSSION

Bioassay experiment results

Bioassay experiment revealed bulk soils from organic farms had distinct high number of survived seedlings compared to similar soils from conventional farms. However, farming types had no significant effect in the number of survived seedlings (Table 1).

Comparing three soil treatments, autoclaved soils with rhizoctonia inoculation had significant high number of survived seedlings out of two seeds sown in the unit of cell tray. It was followed by rhizosphere soils inoculated with *Rhizoctonia solani*. Even though there was no rhizoctonia inoculation, damping off disease was more prevalent in the bulk soil treatment (Table 1). Looking at the interaction of farming system and soil treatments, significant higher number of seedlings survived in organic soil treatments except rhizosphere soil inoculated with rhizoctonia.

Table 1: Seedlings without damping off symptoms on 28 days after sowing seeds

Farming type	**Soil treatments**	**Seedlings survived (out of sown two seeds)**			
Organic	Bulk soil	1.8	±	0.041	a
	Rhizospheric soil	1.173	±	0.068	bc
	Autoclaved soil	1.047	±	0.041	b
Conventional	Bulk soil	1.62	±	0.053	a
	Rhizospheric soil	1.347	±	0.063	cd
	Autoclaved soil	0.82	±	0.063	d
		p value			
	Soil treatments	0.000			
	Farming type	0.36			
	Soil treatments*farming type	0.0013			
		Tukey's HSD value			
	Soil treatments	0.14			
	Bulk soil	1.71a			
	Rhizospheric soil	1.26b			
	Autoclaved soil	0.93c			
	Farming type				
	Soil treatments*farming type	0.24			

Relating disease suppressiveness with soil properties

Disease suppressiveness characteristic of the soil was significantly influenced by different soil properties (Table 2). Soil organic matter content had significant (p value = 0.000) positive contribution (adjusted R-squared value = 0.055) in the seedlings survival against damping off disease. Similarly, other measured soil chemical properties like soil available phosphorus, soil available potassium and total soil nitrogen had significant positive contribution to fight against damping off disease. Particle density, a soil physical property, had significant positive effect in the suppressiveness characteristic whereas soil separates had negative effect with sand showing highest negative value (adjusted R^2 value = -0.0161) amongst three (Table 2).

Table 2: Relation of disease suppressiveness characteristic with soil physico-chemical parameters

Soil parameters	Adjusted R-squared	p value
Bulk soil pH	-0.0153	0.066
Organic matter	0.055	0.000
Soil available phosphorus (P_2O_5 kg/ha)	0.019	0.000
Soil available potassium (K_2O kg/ha)	0.0433	0.000
Soil available nitrogen (ppm)	-0.0132	0.000
Soil total nitrogen (%)	0.0534	0.000
Bulk density (gg/cc)	-0.0168	0.076
Particle density (gg/cc)	0.0251	0.002
Silt (%)	-0.0151	0.000
Sand (%)	-0.0161	0.000
Clay (%)	-0.003	0.000

DISCUSSION

Role of farming systems and soil treatments

Farming systems showed no significant difference in disease suppressiveness characteristic. For instance, conventional autoclaved soil had comparable effect to that of organic autoclaved soil which was due to comparable quantity of organic manures applied by both organic and conventional farmers as shown in the soil management practices (Shrestha, 2014). Conventional rhizosphere soil had comparatively higher seedlings survived than organic rhizosphere soil; it was maybe due to the higher amount of root exudates produced by plants due to high nutrient availability (Söderberg and Bååth, 2004). Furthermore, these exudates attracted diverse micro-organisms preventing succession of inoculated rhizoctonia fungi.

Soil treatments were made to distinct the soil microbial properties. Bulk soil was expected to have less damping off problem because there was no rhizoctonia inoculation. However, it seemed that bulk soil preserved pathogens like rhizoctonia species in

dormant stage and with suitable environment created by addition of water and root exudates they multiplied and caused disease.

Rhizosphere soil was expected to be the most suppressive against damping off disease. Because rhizosphere soil stored at 4°C was expected to have preserved microorganisms in dormant stage plus organic deposits intact. Moreover, due to cold treatment, pathogen (*R. solani*) population in rhizosphere soil might have declined significantly (Schumann and D'Arcy, 2006). On par with expectation, rhizosphere soil had higher percentage of seedlings survived compared to the bulk soil. Rhizosphere soil contains more micro-organisms compared to the bulk soil because rhizosphere contains higher amount of root exudates compared to the bulk soil (Raaijmakers et al., 2008). Furthermore, rhizosphere soil storage at 4°C provided environment for the survival of more soil microbiota (Bloem et al. 2005) which have outnumbered the inoculated *R. solani* and made possible survival of the more seedlings. However, rhizosphere soil was not the most suppressive treatment against damping off disease.

The most suppressive treatment turn out to be autoclaved bulk soil inoculated with rhizoctonia species. With no doubt, heat treatment decreased pathogen population significantly more than that of cold treatment. In addition, heat treatment broke down organic matter helped seedlings to get enough nutrients and hormones (Chong et al., 2001) to escape rhizoctonia attack. Furthermore, organic farm soil contained higher amount of decomposed organic matter compared to the conventional farm soil (Shrestha, 2014) enabling more seedlings to escape damping off.

Interaction of farming system and soil treatments had the least number of seedlings survived. It was due to the chemical fertilizers used in the conventional farms (Shrestha et al., 2016) which permitted selective microbes survive in the conventional soil. Furthermore, when there is lesser diversity of micro-organisms, pathogen species (example *R. solani*) wins the warfare and rising as a prominent species causing the disease (Mendes et al., 2011).

Relationship with soil properties

Higher soil available nitrogen caused lesser survival of tomato seedlings. Higher available nitrogen decreased disease suppressiveness ability of soil. It was because higher available nitrogen helps fungi to evolve as pathogenic species (Veresoglou et al., 2013).

Higher soil available phosphorus caused positive effect in the survival of tomato seedlings. Optimum supply of phosphorus enhances disease resistance in plants (Huber et al., 2012). Phosphorus helps in vigorous root development to escape the fungal root diseases including seedling diseases (Dordas, 2008).

Increase in the soil available potassium resulted in the higher number of tomato seedlings survival. Potassium nutrient is known for its protective activity by developing thicker

outer walls in epidermal cells and tissue hardening (Marschner, 2012). Potassium decreases the disease susceptibility of plant (Huber et al., 2012; Dordas 2008).

Among soil physical parameters, particle density had significant positive influence in the disease suppressiveness characteristic. Higher sand content in the soil caused lesser suppressive the soil. It is because of the lesser micro-organisms residing in the sandy soil which contains lesser micro-pores, residence of micro-organisms, compared to the silt and clay fractions (Osman 2013).

CONCLUSION

Soil borne diseases are problematic both in conventional and organic farms. Organic farming increases the diseases suppressiveness characteristic of the soil, making organic farming healthier practice from soil perspective in long run than conventional one. In contrast, conventional farmlands become more vulnerable to pests and faces productivity decline in long run due to soil health decline. Maintaining disease suppressiveness characteristic of soil seems to be the promising option to manage soil borne diseases.

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REFERENCES

Abawi, G. S., and Widmer, T. L. (2000) Impact of soil health management practices on soilborne pathogens, nematodes and root diseases of vegetable crops. *Applied Soil Ecology,* 15(1), 37-47.

Alabouvette, C. (1999) Fusarium wilt suppressive soils: an example of disease-suppressive soils. Australasian *Plant Pathology* 28,57-64.

Atreya, K., Johnsen, F. H. and Sitaula, B. K. (2012) Health and environmental costs of pesticide use in vegetable farming in Nepal. *Environmental Development and Sustainability*, 14, 477-493.

Aye, S. S. and Matsumoto, M. (2012) Characterisation of antagonistic soil microbes against Rhizoctonia spp. and Sclerotium hydrophilum. *Archives of Phytopathology and Plant Protection*, 45(20), 2465-2473.

Baker, K. and Cook, R.J. (1974) Biological control of plant pathogens, WH Freeman and Company.

Bending, G.D., Turner, M.K. and Jones, J.E. (2002) Interactions between crop residue and soil organic matter quality and the functional diversity of soil microbial communities. *Soil Biology and Biochemistry,* 4**,** 1073-1082.

Bhandari, D. R. (2006) Community level organic vegetable production program: an experience of Kathmandu district. *In: the Proceedings of a first national workshop on organic farming*, 12 to 14 June (Baisakh 28 - 30, 2063 B.S.), Kirtipur, Kathmandu.

Bhanti, M. and Taneja, A. (2007) Contamination of vegetables of different seasons with organophosphorous pesticides and related health risk assessment in northern India. *Chemosphere*, 69, 63-68.

Bloem, J., Hopkins, D.W. and Benedetti, A. (2005) *Microbiological methods for assessing soil quality*, CABI.

Brady, N.C. and Weil, R.C. (2012) *The nature and properties of soils*, India, Dorling Kindersley India Pvt. Ltd.

Chong, C., Bible, B. and Ju, H. (2001) Germination and Emergence. *In:* Pesarakli, M. (ed.) *Handbook of plant and crop phyiology.* 2nd ed. NY, USA: Marcel Dekker, Inc.

Chuankun, X., Minghe, M., Leming, Z. and Keqin, Z. (2004) Soil volatile fungistasis and volatile fungistatic compounds. *Soil Biology and Biochemistry,* 36,1997-2004.

Dordas, C. (2008) Role of nutrients in controlling plant diseases in sustainable agriculture: a review. *Agronomy for Sustainable Development,* 28, 33-46.

FRSRD. (1980) *Standard methods of analysis for soil, plant tissue , water and fertilizer*. Philippine Council for Agriculture and Resources Research (FRSRD), Los Banos, Laguna.

Huber, D.M., Romheld, V. and Weinmann, M. (2012) Relationship between nutrition, plant diseases and pests. *In:* Marschner, P. (ed.) *Marschner's Mineral Nutrition of Higher Plants.* 3rd ed.: Academic Press.

Kataria, H. R., Hugelshofer, U. and Gisi, U. (1991) Sensitivity of Rhizoctonia species to different fungicides. *Plant Pathology,* 40(2), 203-211

Koike, S., Subbarao, K., Davis, R. M.and Turini, T. (2003) *Vegetable diseases caused by soilborne pathogens*: UCANR Publications.

Linderman, R.G., Moore, L.W., Baker, K.F. and Cooksey, D.A. (1983) Strategies for detecting and characterizing systems of soilborne pathogens. *Plant Disease,* 67,1059.

Marschner, P. (ed.) (2012) *Marschner's Mineral Nutrition of Higher Plants*: Academic Press.

Mendes, R., Kruijt, M., De Bruijn, I., Dekkers, E., Van Der Voort, M., Schneider, J.H.M, Piceno, Y.M., Desantis, T.Z., Andersen, G.L, Bakker, P.A.H.M. and Raaijmakers, J.M. (2011) Deciphering the Rhizosphere Microbiome for Disease-Suppressive Bacteria. *Science,* 332, 1097-1100.

Oerke, E.C. (2006) Crop losses to pests. *Journal of Agricultural Science*, 144, 31-43.

Osman, K.T. (2013) *Soils: principles, properties and management*, Springer.

Raaijmakers, J., Paulitz, T., Steinberg, C., Alabouvette, C. and Moënne-Loccoz, Y. (2008) The rhizosphere: a playground and battlefield for soilborne pathogens and beneficial microorganisms. *Plant and Soil,* 321**,** 341-361.

Schumann, G.L., and D'arcy, C.J. (2006) *Essential plant pathology*, American Phytopathological Society (APS) Press.

Shrestha, G. (2012) *A practical manual on introductory soil science*. HICAST, Kathmandu.

Shrestha, G. (2014) Soil properties and soil management practices in commercial organic and conventional vegetable farms in Kathmandu valley. *Nepal Journal of Science and Technology,* 15(1),13-22.

Shrestha, G., A. Bom, and Shakya, S. (2017) Horticultural Practices in Organic and Conventional Commercial Vegetable Farms in Kathmandu Valley. *In: First international horticulture conference.* Budhanilkanth, Kathmandu: Nepalese Horticulture Society.p398-404.

Shrestha, G., Prajapati, S. and Mahato B. (2014a) Plant diseases and their management practices in commercial organic and conventional vegetable farms in Kathmandu valley. *Nepalese Journal of Agricultural Sciences*, 12, 129-141.

Shrestha, K., Shrestha, G. and. Pandey, P.R (2014b) Economic analysis of commercial organic and conventional vegetable farming in Kathmandu valley. *The Journal of Agriculture and Environment*, 15,58-71.

Söderberg, K.H., and Bååth, E. (2004) The influence of nitrogen fertilisation on bacterial activity in the rhizosphere of barley. *Soil Biology and Biochemistry,* 36, 195-198.

van Elsas, J.D., Garbeva, P. and Salles, J. (2002) Effects of agronomical measures on the microbial diversity of soils as related to the suppression of Soilborne plant pathogens. *Biodegradation,* 13,29-40.

van Lenteren, J.C. (2000) A greenhouse without pesticides: fact or fantasy? *Crop Protection,* 19, 375-384.

Veresoglou, S., Barto, E., Menexes, G. and Rillig, M. (2013) Fertilisation affects severity of disease caused by fungal plant pathogens. *Plant Pathology*, 62, 961-969.

Weller, D.M., Raaijmakers, J.M., Gardener, B.B.M. and Thomashow, L.S. (2002) Microbial populations responsible for specific soil suppressiveness to plant pathogens. *Annual Review of Phytopathology,* 40, 309-348.

Wilson, C. and Tisdell, C. (2001) Why farmers continue to use pesticides despite environmental, health and sustainability costs. *Ecological Economics,* 39, 449-462.

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An assessment on role of plant clinic on farmers' knowledge, attitude and practice (KAP) towards plant health issues in Chitwan, Nepal

R. K. Adhikari[1], P. P. Regmi[2], R. B. Thapa[2], Y. Dhoj G.C[3]. & E. Boa[4]
[1] Himalayan College of Agriculture Science and Technology, Kathmandu
[2]Institute of Agriculture and Animal Science/TU
[3]Ministry of Agriculture, Land Management and Cooperatives,
[4]University of Aberdeen, UK
rajkadhikari@gmail.com

ABSTRACT

Plant clinic is an innovation to complement existing agriculture extension services to respond quickly and benefit comparatively more people. This has been initiated in Nepal since 2008 and has covered in more than 40 districts of Nepal. A study has been conducted in Chitwan district of Nepal to assess the changes in farmer's knowledge, attitude and practice due to the implementation of plant clinics. Total of 175 clinic attendant selected by using simple random sampling method and interviewed by using semi-structured questionnaire.The average household size was 5.11 and the average land holding size was 0.48 ha only, 84% have a membership with the farmer's organization and 64% had participated in the agricultural training. The study found impressive changes in plant clinic attendant's knowledge, attitude towards plant health problems and their management. The average number diseases, harmful insects, and beneficial insects are known by farmers after participating the clinic has significantly increased from before the clinic operation. This study found the significant decrease in doses and cost of herbicide use, but significant increase in dose and cost of pesticide use. The study found the increase in farmers' proportion to better predict the season of disease and pest occurrence from 52.6% to 84% with increased accuracy on the diagnosis of plant health problems. The study found the effectiveness of plant clinic to increase farmers' good practice on adoption of the recommended dose of agro-chemicals and follow the waiting period after the pesticide use.

Keywords: Knowledge, Attitude, Practice (KAP), Extension, Impact, Plant Clinic, Pesticides

INTRODUCTION

Agriculture extension in Nepal has institutionalized since 1950s(K.C. et al., 2003). Then after, different approaches and methods of agricultural extension are being practiced to strengthen the national agriculture extension system. However, access to agriculture extension is still limited with low extension staff to farming household ratio of 1:164 (Adhikari et al., 2013). To complement the existing extension system, the concept of plant clinic has developed to provide primary plant health care service to farmers(Bentley

et al., 2007; Boa, 2009)by local plant protection expert or extension staffs called as plant doctor (Bentley et al., 2007) trained with specialized training course (Danielsen and Kelly, 2010). Since 2008, this concept has been in practice in Nepal(Adhikari, 2009; Boa and Harling, 2008)by different government and non-government organizations(Adhikari et al., 2015, 2016, 2013)to respondfarmers need and demands for plan health services. Earlier studies found positive changeson farm practices and income among clinic participating farmers(Danielsen and Fernandez, 2008; Kelly et al., 2008; Negussie et al., 2011; Srivastava, 2013; Vakilian, 2017) but changes on knowledge, attitude and practices are poorly described. Since the farm output is dependent on the use of physical inputs, the technology that is ultimately influenced by the existing knowledge, attitude, and practices of the farmers.KAP analysis has been used to assess knowledge gaps, behavioral patterns and beliefs and understanding (Bhurtyal et al., 2016; Ngowi et al., 2002) in different field of studies including plant health and pesticide uses (Janhong et al., 2005; Jors et al., 2014; WHO, 2008).Therefore, this study was conducted to see the effectiveness of plant clinics on the change in knowledge, attitude, and practices of clinic attending farmers in Nepal.

METHODOLOGY

This study was carried out in Chitwan district of Nepal, purposively selected because of the clinic operation from initial periods (Adhikari, 2009) and availability of clinic information (Adhikari et al., 2013) to frame the study population and sample. The list of plant clinic attendants mentioned in plant clinic register was taken as study population from which 175 farmers were randomly selected as study sample. The pre-tested semi-structured questionnaire was used to collect primary information from the sampled households. The questionnaire consists of both the qualitative and quantitative variables on knowledge, attitude, and practices related to the plant health. Thus collected data were coded, entered into the computer and analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) v20.0.

RESULTS AND DISCUSSION

Socio-economic description of the study area

The average household size of the respondents wasfound 5.11which is quite above the district average of 4.5 (CBS, 2014). Almost 60% of the respondents were male and 40% female which indicate the better gender ratio than previous studies (Cornhiel, 2006; Gartaula et al., 2010; Maharjan et al., 2012; Miiro et al., 2015; Rajendran and Islam, 2017) in terms of access to information and exposure to external environment for females farmers.The average land holding was 0.48 ha only with a range of 0.10 ha to 3.87 ha. Results of the present study revealed that 84% of the respondents were affiliated with farmer's organization such as groups or cooperatives and 64% of the respondents had participated in the agriculture-related training. The study found 37.7% respondents attended secondary school (6-10 grade) followed by informal education (18.3%), primary

education (14.9%), intermediate (12%), University (6.3%) whereas 10.9% were illiterate. This illiteracy rate is quite lower than the district average of 23.02%(CBS, 2014).

Table 2: Socio-demographic characteristics of the respondents

Parameter		Frequency	Parameter		Frequency
Gender	Female (%)	39.4	Education of the respondents	Illiterate	19 (10.9)
	Male (%)	60.6		Informal	32 (18.3)
Household size	Mean number	5.11±1.52		Up to 5 grade	26 (14.9)
				6 to 10 grade	66 (37.7)
Landholding	Hectare (Ha)	0.54±.52		Intermediate	21 (12.0)
Occupation of the respondents	Agriculture	139 (79.4)		University	11 (6.3)
	Business	6 (3.4)	Participation in farmers organization	Yes	147 (84.0)
	Service	20 (11.4)		No	28 (16.0)
	Student	3 (1.7)			
	Foreign employment	7 (4.0)	Participation in Training	Yes	112 (64.0)
				No	63 (36.0)

Figures in parenthesis indicate the percentage

Knowledge of the insect, pest and disease identification

The study result (table 2) shows the notable changes in farmers' knowledge and skills to identify pest and diseases. The average number diseases, harmful insects, and beneficial insects are known by the farmers after participating the clinic has significantlyincreased from before the clinic operation. This indicates the effectiveness of plant clinic operation to enhance the farmers' knowledge, skill and confidence to identify insect pest and diseases and can take appropriate management action.

Table 3: Knowledge on disease and insect pest identification

Knowledge Parameters	Before	After	Changes
Av. Number of diseases known	1.87	3.62*	1.75
Av. Number of harmful insects known	2.07	3.88*	1.81
Av. Number of beneficial insects known	1.41	3.69*	2.25

** significant at 99% CI,*

Knowledge on the cause of problem and control measures

The knowledge on the season of the disease and pest occurrence along with its cause help the farmers to prepare or take remedial actions against those anticipated problems. The effective control measures of the plant health problems are dependent upon early and accurate diagnosis of the cause and effective response (Stack et al., 2014). This study found the increased number of farmers able to better predict the season of disease and pest occurrence from 52.6% to 84.0% after the clinic. Similarly, the level of accuracy on the cause of the problemhas also found to be increased. The proportion of farmers with no accuracy of knowledge has dropped to 5.1% after the clinic participation from 34.3% before the clinic. On the other hand, the proportion of farmers with always accuracy on diagnosis has increased from 1.1% to 6.3%. Another study by (Rajendran and Islam,

2017) in Bangladesh found the increased ability to quickly identify crop problems among 100% of plant clinic users compared to 16% of non-users. Table 3 presents the proportion of farmers knowledgeable on economic threshold level has increased to 71.4% from 30.9%. Similarly, the proportion of farmers knowing the curative measures against the problems have found to increase from 25.7% to 86.9% and the same on preventive measures has increased from 20.6% to 88.6%. These positive changes are the evidence for the effectiveness of clinic initiatives.

Table 4: Knowledge of cause and solution of problems

Knowledge Parameters		Before		After	
		Frequency	Percent	Frequency	Percent
Know season of disease or pest		92	52.6	147	84.0
The accuracy of knowledge on cause of the problem	Never	60	34.3	9	5.1
	Rarely	93	53.2	77	44.0
	Mostly	20	11.4	78	44.6
	Always	2	1.1	11	6.3
Economic threshold level		54	30.9	125	71.4
Know how of curative measures		45	25.7	152	86.9
Know how of preventive measures		36	20.6	155	88.6

Agro-inputs use in Rice

Agrochemicals are considered as major production inputs but the doses of application depend on farmers' knowledge triggered by advisory services. The changes on use of different agro-inputs by the farmers before and after participating the clinicsare presented in table 4. This study found the significant decrease in dose of herbicide use from 0.37kg/ha to 0.04 Kg/ha and thereby cost on herbicide use was also found to be decreased significantly after participating in the clinic. But there was a significant increase in dose of chemical pesticide applied from 0.41Kg/ha to 0.64 kg/ha after the clinic and the cost incurred on pesticides was also increased significantly.

Although the decrease in herbicide users and increment in pesticide users looks natural, the proportion of farmers using higher doses of herbicides or pesticides has decreased and proportion of farmers using recommended does of these agro-inputs has increased (Table 5). The study found the proportion of farmers knowledgeable on recommended doses to be increased to 75.4% from 29.7% and always adopting recommended doses by 50.9% from 13.1% before the clinic participation. These results are still below the results found in Bangladesh (Rajendran and Islam, 2017) where 97% of the clinic users implemented the recommendation of plant doctors. The study also found distinct progress on the proportion of farmers with knowledge on the appropriate method of pesticide use. The data revealed that only 42.9% of the respondents were familiar with the appropriate method of pesticide use before the clinic which was found to be increased to 85.9% after the clinics. Similarly, the proportion of farmers having knowledge of organic control

measures of pesticide use has increased from 31.4% before the clinic to 64.6% after the clinic.

Table 5: Use of agro-inputs

Particulars		Before	After	Difference
Herbicide	Dose Kg/ha)	0.37	0.04	-0.33*
	Cost (Rs/ha)	567.88	152.79	-415.09*
	Users	25%	21%	-4
Chemical Pesticide	Dose (Kg/ha)	0.41	0.64	0.23*
	Cost (Rs/ha)	869.29	1196.57	327.29**
	Users	33%	42%	9
Chemical fertilizer	Dose Kg/ha)	124.54	141.18	16.64**
	Cost (Rs/ha)	4,324.51	5,453.15	1128.64*
Organic fertilizer	Dose Kg/ha)	4,365.90	4,517.46	151.56
	Cost (Rs/ha)	7,616.29	6,508.40	-1107.89***

* significant at 99% CI, ** significant at 95% CI, *** significant at 90% CI

Table 6: Adoption of the recommended dose of pesticides

KAP Parameters		Percentage of farmers		
		Before	After	Difference
Knowledge of the recommended dose		29.7	75.4	45.7
Knowledge of methods use		42.9	85.7	42.8
Adoption of the recommended dose	Always	13.1	50.9	37.8
	Sometime	7.4	20.0	12.6
	Not yet	9.1	4.6	-4.5
Knowledge of organic measures		31.4	64.6	33.2

Table 7: Practice of adopting waiting periods after application of pesticides

The practice of Waiting Period	Percentage of farmers		
	Before	After	Difference
Not aware	16.0	2.3	-13.7
Rarely	20.6	23.4	2.8
Mostly	17.1	41.1	24
Always	24.6	33.1	8.5
Don't care	21.7	0.0	-21.7

Adoption of the waiting period

The study found impressive change on farmers' knowledge and practice on adoption of waiting periods after the pesticide use (table 6). The proportion of respondents still not aware of waiting periods was found to drop by 13.7% and the proportion of respondents who do not care about the waiting periods dropped to zero from 21.7%. The proportion of

farmers who rarely follow the waiting period was found to increase by 2.8%, those follow mostly increased by 24% and those adopt always by 8.5%.

CONCLUSION

Nepalese agriculture is characterized by the predominance of the smallholder and marginal farm families with limited access to agriculture extension services. This study revealed that most of the farmers in the study area had participated in farmer's groups or cooperatives and received agricultural training but were seriously lacked appropriate knowledge and skillset on various aspects of plant health problems which were improved after the plant clinic operation in the study site. Plant clinic has helped the farmers to shift from the haphazard use of agrochemicals into appropriate use after the recommendation of the plant doctors that lead to a significant reduction in herbicide use while significant increment on pesticide use. The average number crop diseases, harmful insects, and beneficial insects known by farmers after participating the clinic has significantly increased after clinic participation. The changes in the proportion of farmers with knowledge and skill to predict the disease and insect pest incidence are evidence of positive impact of the plant clinics. Although the change in accuracy of prediction has improved but not sufficient. In brief, we can conclude with significant positive impact of plant clinic to change farmers' knowledge, attitude, and practices related to plant health.

REFERENCES

Adhikari, R., Regmi, P., Thapa, R., G.C., Y., Boa, E. (2015) SWOT Analysis of Plant Clinics in Nepal. *IAAS J*. 32, 102–18.

Adhikari, R.K. (2009) *Plant health clinic initiatives in Nepal*. SECARD Nepal and DADO Kathmandu, Nepal.

Adhikari, R.K., Regmi, P.P., Boa, E., GC, Y.D., Thapa, R.B. (2013) Innovation in plant health extension services: the case of plant clinics in Nepal. *Econ. AGRO-Aliment.* 15, 235–245.

Adhikari, R.K., Regmi, P.P., Thapa, R.B., G.C., Y.D., Boa, E. (2016) Determinants of farmers' participation in plant health clinics in Nepal. Nepal. *J. Agric. Sci.* 14, 290–299.

Bentley, J.W., Boa, E., Danielsen, S., Zakaria, A.K.M. (2007) Plant clinics for healthy crops. *LEISA Mag*. 23, 16–17.

Bhurtyal, Y.B., Kanbargi, R., Shrestha, U., Dhungana, S., Poudel, S., (2016) Knowledge, practice and use of pesticides among commercial vegetable growers of Kaski district, Nepal. *Int. J. Sci. Technol. Eng.* 3, 196–200.

Boa, E., (2009) How the Global Plant Clinic began? *Outlooks Pest Manag.* 20, 112–116.

Boa, E., & Harling, R. (2008) Starting plant health clinics in Nepal. Global Plant Clinic-CABI, UK.

CBS, 2014. National population and housing census (2011) Chitwan. National Planning Commission Secretariat, Central Bureau of Statistics, Ramshahpath, Thapathali, Kathmandu, Nepal.

Cornhiel, S.L. (2006) Feminization of agriculture: trends and driving forces (No. 41367). The World Bank.

Danielsen, S. & Fernandez, M. (Eds.), (2008) Public plant health services for all.

Danielsen, S. & Kelly, P., (2010) A novel approach to quality assessment of plant health clinics. *Int. J. Agric. Sustain*. 8, 257–269. https://doi.org/10.3763/ijas.2010.0494

Gartaula, H.N., Visser, L.E. & Niehof, A. (2010) Feminisation of agriculture as an effect of male out-migration: unexpected outcomes from Jhapa District, Eastern Nepal. *Int. J. Interdiscip. Soc. Sci.* 5, 565–578.

Janhong, K., Lohachit, C., Butraporn, P. & Pansuwan, P., (2005) Health promotion program for the safe use of pesticides in Thai farmers. *Southeast Asian J. Trop. Med. Public Health* 36 Suppl 4, 258–261.

Jors, E., Lander, F., Huici, O., Morant, R.C., Gulis, G., & Konradsen, F. (2014) Do Bolivian small holder farmers improve and retain knowledge to reduce occupational pesticide poisonings after training on Integrated Pest Management? *Environ. Health* 13, 75. https://doi.org/10.1186/1476-069X-13-75

K.C., G.K., Pradhan, D., Upadhyay, B.P., & Upadhyay, S., (2003) Sharing country agricultural extension experiences, challenges and opportunities. Presented at the Regional workshop on operationalizing agricultural extension reforms in South Asia, New Delhi, India.

Kelly, P., Bentley, J., Rashid, H., Zakaria, A.K.M., Nuruzzamn, M., (2008) Plant clinics help crub pesticides use in Bangladesh. *Pestic. News* 81, 16–17.

Maharjan, A., Bauer, S., & Knerr, B., (2012) Do Rural Women Who Stay Behind Benefit from Male Out-migration? A Case Study in the Hills of Nepal. *Gend. Technol. Dev*. 16, 95–123. https://doi.org/10.1177/097185241101600105

Miiro, R., Williams, R. & Kizauzi, T. (2015) Gender Responsiveness in Plant Clinic Delivery, in: Listening to the Silent Patient - Uganda's Journey towards Institutionalizing Inclusive Plant Health Services, *CABIWorkign Paper.* CABI, UK, p. 224.

Negussie, Karanja, P., Day, R., Romney, D., Reeder, R., Boa, E., Muriithi, C., Kamau, R., Phiri, N., Danielsen, S., Murage, N., Gitare, I., Wanjiku, R., Mutisya, J., Ngige, D., Kimani, M., Festus, W., (2011) Role of plant health clinics in meeting the needs of small-scale farmers for advisory services: experiences from Eastern Africa. Presented at the International Conference on Innovations in Extension and Advisory Services: Linking Knowledge to Policy and Action for Food and Livelihoods, CTA, Nairobi, Kenya, p. 9.

Ngowi, A.V., Maeda, D.N. 7 Partanen, T.J., (2002) Knowledge, attitudes and practices (KAP) among agricultural extension workers concerning the reduction of the adverse impact of pesticides in agricultural areas in Tanzania. *Med. Lav*. 93, 338–346.

Rajendran, G. & Islam, R. (2017) *Plant Clinics in Bangladesh: Are Farmers Losing Less and Feeding More*? (No. 19), CABI Case Study.

Srivastava, M.P. (2013) Plant clinic towards plant health and food security. *Int. J. Phytopathol*. 2, 193–203.

Stack, J.P., Thomas, J.E., Baldwin, W. & Verrier, P.J. (2014) Virtual Diagnostic Networks: A Platform for Collaborative Diagnostics, In: *Detection and*

Diagnostics of Plant Pathogens, Plant Pathology in the 21st Century. Springer, Dordrecht, pp. 147–156. https://doi.org/10.1007/978-94-017-9020-8_10

Vakilian, K.A., (2017) Using networks in plant disease diagnosis. *CAB Rev.* 12, 1–12.

WHO, (2008) *Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys.* World Health Organization, Switzerland.

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Economic analysis of tomato farming under different production system in Dhading district of Nepal

P. Paudel and R. K. Adhikari
HICAST, Kathmandu
Pradip2000@gmail.com

ABSTRACT

This study was carried out to analyze the economic analysis of tomato farming under different production systems in Dhading district of Nepal. A pre-tested questionnaire was administered to survey 77 randomly selected respondents from different level of actors of tomato value chain during November to December 2016 A.D. Average cost of tomato production under off-season (poly-house) was found to be NRs 21.73/kg followed by NRs 15.52/kg in off-season (open field) condition and NRs 9.76/kg in main season (open field) condition. The productivity was found highest among main season (open field) condition and least on off-season (poly-house). The benefit-cost ratio was 1.9 in off-season (open field) production system where as 1.84 for other two systems. Marketing efficiency was 0.87, 0.60 and 0.28 for off-season (poly-house), off-season (open field) and main season (open field) cultivation respectively. Lack of suitable transportation facility was found to be the major marketing constraint faced by the farmers of the study site.

Keywords: Off-season, profitability, B: C ratio, marketing margin, marketing efficiency

INTRODUCTION

Vegetables are considered a high-value crop and have received high priority in most of the development interventions in Nepal (PACT, 2014) to exploit its potential for poverty reduction and import substitution (NMDP, 2015). Almost 70% of the farming households in Nepal grow vegetable but only 18% grow for market purpose and only 5% consider vegetable farming as enterprise and a major source of income (CBS, 2011). Tomato is one of the major commodity, second to cauliflower in terms of total cultivated area in the vegetable sector (CBS, 2011). Though tomato is day-neutral crop, its production increases in the warm season. So its production season differs as per the specific location and agro-climatic condition. Required temparture regime exists at different times of the year in different agro-climatic regions of Nepal (PACT, 2014). There are three specific production systems generally adopted by tomato cultivators in Dhading district. Tomato cultivated in poly-house during Jeshta – Shrawan (May –July) is considered as off-season (poly-house) system and during Asar – Bhadra (June – August) in high land under open field condition is considered as off-season (open field) production system. Tomato grown in open field during Shrawan –Magh (August – February) is considered as main season (open field) system.

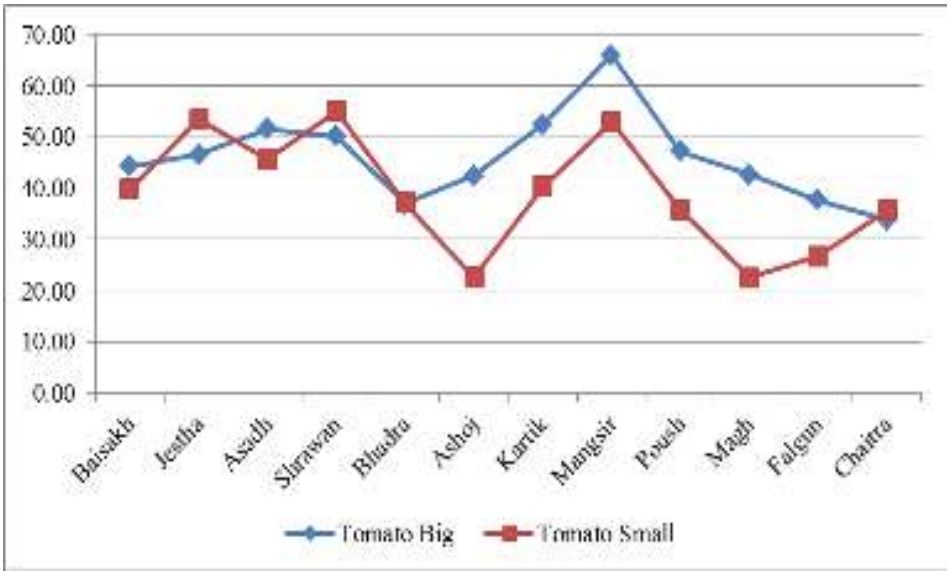

Figure 1: The Average wholesale price of tomato in Kalimati market (14 April 2015- 12 April 2016)

Source: KFVMDB, 2016

The twenty year (2015-2035) Agriculture Development Strategy (ADS) has envisioned value chain development framework as a major vehicle for sustainable growth in agriculture which is being increasingly adopted by different organizations (Adhikari, 2012; ABPMDD, 2016). Vegetable value chain development and off-season production are prioritized intervention by ADS, National Agriculture Policy, Agribusiness Policy and several projects and programs. Different studies on off-season vegetable production have revealed the greater benefit over the normal seasonal production (ABPMDD, 2016, NARC, 2016) but there is not enough evidence to describe the economics of these three different production systems. Therefore, this study was aimed to assess the profitability of different production system and draw recommendations for betterment.

METHODOLOGY

This study was conducted in six villages of Dhading district namely Naubise, Gajuri, Salang, Dhusa, Benighat, and Jeevanpur. They represent different agro-climate zone within the district, comprising of the valley, Tars (flat land) to middle hills and high hills. These villages are purposely selected due to their fame on commercial vegetable production including tomato.

Altogether, fifty-two producers, ten collectors, five wholesalers and ten retailers were interviewed using the pre-tested questionnaire. Respondents were selected using purposively random sampling technique. Producers were asked with the whole set of questionnaire while other market actors (collectors, wholesalers and retailers) were asked with only questions related to price, and market constraints. Relevant secondary information was obtained through review of published literature and reports of different organizations. Thus collected information was coded, tabulated and entered into computer software MS-Excel and SPSS v.16. The cost of production of tomato cultivation under different system was calculated as per the standard cost concept as mentioned in equation (i)

$$Total\ cost = Fixed\ Cost + Variable\ cost \quad \ldots\ldots\ldots\ldots \text{(i)}$$

Here fixed cost includes cost of irrigation equipment, pipes, crates, sprayers, depreciation of tunnel and interest on the loan. Similarly variable cost included all running cost of production.

The benefit-cost ratio was calculated by dividing total return by total cost equation (ii) for different production system separately.

$$B:C\ Ratio = \frac{Total\ Return}{Total\ Cost} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(ii)}$$

Marketing efficiency is the ratio of net price received by farmers to the sum of marketing cost and marketing margin. For each production system, marketing efficiency was estimated by using equation (iii) adopted from Acharya and Agrawal (2001).

$$ME = \frac{NPF}{\sum MC + \sum MM} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(iii)}$$

Where,

ME = Marketing Efficiency

NPF = Net price received by the farmer

$\sum$MC = Sum of Marketing cost

$\sum$MM = Sum of marketing margin of the intermediaries

For assessing the marketing constraints, respondents were asked to tick different options as per their perception. Frequency and percentage were calculated as per their response.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

Out of the total respondents, 80% were male. Average land holding size across the study site was found to be 7.45 ropani with the allocation of 2.45 ropani for main season (open field) tomato production, 1.24 ropani for off-season (open field) and 0.56 ropani for the off-season (poly house) production system in the current year. The majority (46.66%) of

the farmers had over 10 years of experience in tomato farming followed by 45.01% had 5-10 years of experience and 8.33% had less than 5 years' experience.

Cost, revenue, and profit

The cost of cultivation comprised fixed cost and variable costs as presented in table 1. The cost of cultivation was found to be highest for off-season (poly-house) (NRs 30,425/ropani) followed by off-season (open field) (NRs 23,280/ropani) and main season (open field) system (NRs 19520/ropani). Labor was major contributing production in all three production system but off-season production in poly-house was found to be the most labor-intensive one with highest cost contribution. The cost of production in puts was the same for two off-season production systems (NRs 8000/ropani) but a bit lower in main season open field production system (NRs 7000/ropani).

The fixed cost incurred in tomato cultivation was found higher in off-season production under poly-house was NRs 8,125/ropani while only NRs 880/ropani under open field conditions. The study found the least marketing expenses for main season production NRs 3600/ropani while NRs 5200/ropani for the off-season in the poly house and NRs 6000/ropani for the off-season in open field condition. The higher marketing cost includes the more transportation expenses during the rainy season including labor charge for transportation of tomato from farm gate to collection centers. It was found that the collection center charges NRs 0.5 to NRs 2 per kg of tomato depending on the season. Table 1 below provides the detail of the cost and return.

Table 1: Summary of the cost of cultivation, gross revenue, and profit (NRs/ropani)

Particulars	Off - Season (Poly-house)	Off-Season (Open field)	Main Season (Open field)
A. Cost Stream			
A1. Fixed cost *(Depreciation of tunnel, irrigation equipment, pipes, crates, sprayers and interest on the loan)*	8,125	880	880
A2. Labor *(nursery to harvesting)*	9,100	8,400	8,050
A3. Production Input *(Seeds, fertilizers, pesticides etc.)*	8,000	8,000	7,000
A4. Marketing *(transportation from farm gate to collection center and service charge)*	5,200	6,000	3,600
A5. Total cost /ropani	30,425	23,280	19,530
A6. Cost of production/Kg.	21.73	15.52	9.76
B. Revenue Stream			

B1. Average Yield (Kg)/ropani	1,400	1,500	2,000
B2. Average farm gate price	40	30	18
B3. Gross revenue (NRs)/ropani	56,000	45,000	36,000
C. Net Profit/Ropani (B3-A5)	25,575	21,720	16,470

Source: Field Survey (2016)

The average productivity was found to be highest in normal main season production in open field (2.0 MT/ropani) whereas off-season production in the poly-house was found only 1.4 MT/ropani and 1.5 MT/ropani in off-season cultivation in open field condition. For reference, the national average yield for the year 2015/16 was 19.3 MT/ha, i.e 0.98 MT/ropani (MOAD, 2017). However, the price of tomato was found largely lower for production of the main season in open field condition than off-season production. The higher price for tomato produced in off-season under poly house than off-season in open field was due to its quality attributes. Thus the gross revenue and net profit were found to be highest in off-season production in the poly house followed by off-season in open field and main season in open field condition.

Cost-benefit analysis

The study found B : C ratio was found to vary from 1.84 to 1.93 that revealed the tomato cultivation is the profitable enterprise in the study area. The B : C ratio of off-season (open field) was found to be 1.93 while the same for other production system was 1.84. A study conducted by NARC, 2016, had shown that benefit-cost ratio for the poly-house house and main season (open field) in mid hills was 1.5. In contrast to the NARC finding, this study revealed the off-season tomato cultivation in open field condition is more profitable than growing in the poly house. This might be due to lower cost of production in offseason open field.

Table 2: Benefit-cost ratio based on the season of plantation

Type of cultivation	Cost (NRs/*ropani*)	Return (NRs/*ropani)*	B/C ratio
Off-season (poly-house)	30,425	56,000	1.84
Off-season (open field)	23,280	45,000	1.93
Main season (Open field)	19,530	36,000	1.84

Source: Field Survey (2016)

Marketing margin, price spread and marketing efficiency

The tomato goes through various actors with little or no value addition activities from production to final consumption. The major value addition done prior to reaching the final consumer is limited, just cleaning, grading and packaging in plastic crates. The total marketing cost incurred by all market intermediaries (farmers, traders, wholesaler, and retailers) was found to be NRs 15.05/Kg, NRs. 15/Kg and NRs 14/kg (Table 2) for off-season poly house, off-season open field and main season cultivation systems respectively.

Table 3: Profit margin of value chain actors by the production system

Particulars	Production System	Producer	Collector	Wholesaler	Retailer
Cost price (NRs/Kg)	Off-Season (poly-house)	17.00	55.00	65.00	75.00
	Off-Season (open field)	11.52	30.00	36.00	39.00
	Main Season (open field)	7.77	18.00	25.00	28.00
Marketing cost (NRs/Kg)	Off-Season (poly-house)	4.00	3.00	3.10	4.95
	Off-Season (open field)	4.00	3.00	1.50	4.45
	Main Season (open field)	2.00	3.00	1.50	6.20
Sales price (NRs/kg)	Off-Season (poly-house)	55.00	65.00	75.00	90.00
	Off-Season (open field)	30.00	36.00	39.00	50.00
	Main Season (Open field)	18.00	25.00	28.00	45.00
Profit margin (NRs/Kg)	Off-Season (poly-house)	34.00	7.00	6.90	10.05
	Off-Season (open field))	14.48	3.00	1.50	6.55
	Main Season (open field)	8.24	4.00	1.50	10.80
Margin (%)	Off-Season (poly-house)	61.82	10.77	9.20	11.17
	Off-Season (open field)	48.27	8.33	3.85	13.10
	Main Season (Open field)	45.75	16.00	5.36	24.00

Source: Field Survey (2016)

Under tomato marketing, major marketing margin was shared by the producer (45-60 percent), followed by the retailer, collector, and wholesaler respectively. This study found highest price spread in off-season tomato cultivation in poly house condition (NRs 35) followed by main season cultivation (NRs 27) and off-season in open field condition (NRs 20) (Table 4). Whereas, the producers' share was found to be highest in off-season cultivation in poly-house (61.11%) followed by off-season in open field (60%) and main season open field farming (40%). The marketing efficiency was found to be as 0.87 for the off-season in poly-house followed by 0.60 for the off-season in open field and 0.28 for main seasonal cultivation to tomato.

Table 4: Price spread, producers share and marketing efficiency

Production System	Price Spread	Producers share %	Marketing Efficiency
Off-Season (poly-house)	35.00	61.11	0.87
Off-Season (Open field)	20.00	60.00	0.60
Main Season	27.00	40.00	0.28

Marketing constraints

Marketing is equally important as the production technology to obtain a good return. The prioritized list of marketing constraints is presented in table 5. Majority of the farmers (65.4%) mentioned lack of suitable transportation facility as major constraint followed by lack of market information (63.5%), lack of market facilities (48.1%) and the distance to the market center (34.6%). Poor transportation was the major constraint for tomato marketing in the study districts. Insufficient market information was the second major problem followed by the market facility

Table 5: Marketing constraints for producers

Marketing constraints for producers	Frequency	Percentage	Rank
Lack of suitable transportation facility to the market center	34	65.4	I
Lack of market information (price and volume)	33	63.5	II
Lack of market facilities at the market center	25	48.1	III
Distant market center to sell	18	34.6	IV
Low demand than production volume in main-season	16	30.8	V
Limited choice of trading partners	14	26.9	VI
Reliability of buyers/traders	5	9.6	VII

Source: Field Survey (2016)

CONCLUSION

Tomato farming is one of the potential farm enterprises for income of the farmers in Dhading district. The positive B:C ratio indicates the profitability of the tomato farming irrespective of the production system. Although off-season (poly-house) is getting popularity in Nepal, this study found the higher benefit-cost ratio for off-season (open field) system. The study found relatively lower productivity among off-season (poly-house) farming that might be due to the low level of technological know-how and adoption. In contrast, the marketing efficiency was found to be highest for the off-season (poly-house) and least for main season (open field) production. In spite of higher farm gate price for off-season production under poly-house, off-season tomato production in open field condition was found the most suited production system from an economic point of view. The comparative cost analysis also revealed the appropriateness of this production system to scale-up. However, there is need to increase technical assistance to the farmers during the production as well as support market infrastructure and market information.

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REFERENCES

ABPMDD (2016) *Demand and Supply of Tomato in Nepal (2015/2016)*, Agribusiness Promotion and Marketing Development Directorate, Department of Agriculture, Hariharbhawan, Lalitpur

Acharya, S.S and Agrawal N.L. (2001) *Agricultural Marketing in India*, Oxford & IBH Publishing Company, New Delhi

Adhikari, R. P. (2012)Segmenting ConsumeNRs to Inform Agrifood Value Chain Development in Nepal. *International Food and Agribusiness Management Review,* Volume 15, Issue 4.

CBS.(2011) *Vegetable Crops Survey of Nepal 2009-10*. Nepal Central Bureau of Statistics. Kathmandu, Nepal.

KFVMDB (2016) Ministry of Agricultural Development, Kalimati Fruits, and Vegetable Market Development Board

MOAD (2017) *Statistical Information on Nepalese Agriculture 2072/73 (2015/16).* Ministry of Agricultural Development Monitoring, Evaluation and Statistics Division Agri Statistics Section Singha Durbar, Kathmandu Nepal

NARC (2016) *Srijana Hybrid Tomato: A Potential Technology for Enterprise Development in Nepal.* Government of Nepal, Nepal Agricultural Research Council, Socioeconomics, and Agricultural Research Policy Division, Khumaltar, Lalitpur

NMDP (2015) *Vegetable sector in Nepal: Rapid Post Earthquake Market Analysis*. SAMARTH-NMDP, Kathmandu, Nepal.

PACT (2014) *Value Chain Development Plan for Tomato.* Government of Nepal, Ministry of Agricultural Development, Project for Agriculture Commercialization and Trade (PACT), Kathmandu Nepal.

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