Contents

Floriculture Research in Nepal: Status and Challenges

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Abstract

This paper intended to review on floriculture researches carried-out to date so as to recommend future research strategy and plans for boosting up the floriculture enterprise in Nepal. Altogether 14 research and technical papers were cited for the study. It has been found that research emphasis was given mainly to major cut-flowers and these were done by different organizations and institution during last decade. Most studies were concentrated on survey rather than agronomic and post-harvest studies. Floriculture Association Nepal had made several efforts for the floriculture development in the country. Since 1994, a dozen of studies have been brought on the marketing and policy level. Besides, Institute of Agriculture and Animal Science, Rampur has done several researches; especially in cut flowers viz. gladiolus, rose and carnation with respect to crop husbandry and post-harvest aspect. Similarly, National Agriculture Research Council has mandatory to cut flower research and two projects on gladiolus are underway. The paper has present information mainly on the following headings: current research status, challenges and research needs for the floriculture development.

Key words : Cut flower, export business, bio-diversity, floriculture

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1. Introduction

Presently, Nepal's floriculture business transacted at worth NRs. 230.0 million of the total flower demand about 80% is met by internal production (AEC/FAN, 2007), while few years ahead, there was the condition of importing by same percentage in Nepal. Commercial cut flower production in Nepal has been started since early 1990. But, this enterprise has been growing up rapidly and expected to be further extended to 1000 ha by next few year. Thus, floriculture has enormous potential for the significant contribution to the national economy in future (Yanai et al., 2007). Despite being flourishing with great possibility, this sector is at very earlier stage of establishment. Floriculture development in Nepal has been commenced solely in the private sector personal initiatives of growers and entrepreneurs virtually without research and development support (Tamang, 2006). Number of problems associated with the agronomic, pathological, edaphic, and post-harvest have been raised along the increase acreage of ornamental crops and confronted this sector. Hence need of research has been felt over the time. Due emphasis has not being given in the horticulture research by the government institutions and organizations. Nevertheless, some works has been culminated in the past by some organizations and individuals.

2. Methodology

The article was prepared based on the review of finding relevant researches and investigations done in Nepal. A total of seven research papers, and seven investigation articles carried out by different institutions/organizations and individuals were extensively reviewed to prepare this paper. Information were critically reviewed, and concretely presented.

Results and discussion

1. Current Research Status in floriculture sector

1.1 Agro-husbandry

A study on the date of planting in gladiolus has been carried under M.Sc. Ag. Thesis at IAAS, Rampur in 2000. The result revealed that December and January planting as the optimum time for gladiolus in Chitwan condition. In the study, five cultivars: American Beauty, Pacifica, Friendship, Eco Wonder and Her Majesty were evaluated. American Beauty performed promising in terms of growth, flowering behavior and flower yield followed by Pacifica, Friendship, Eco Wonder and Her Majesty. As the best performer cultivar, American Beauty was earliest in emergence (25 days), but it took longer days (85.5 days) for spike initiation as compared to Her Majesty (71.5 days) and Pacifica (77.8 days). Cultivar, Friendship and Pacifica had longer spike length (respectively 83.2 cm, and 80.9 cm) than those of American Beauty (74.2 cm) and Eco Wonder (73.2 cm). The study concluded that cultivars: American Beauty and Pacifica were found better for the commercial cut flower production in Chitwan condition (Regmi, 2000).

With respect to soil fertility, a study on "the effect of nitrogen and

phosphorus on growth and development of gladiolus cut flower production" was carried out under M.Sc. Ag. Thesis at IAAS, Rampur in 2002. The results showed that nitrogen and phosphorus and their interaction significantly affected the leaf development. Similarly, higher level of phosphorus with medium level of nitrogen increased the corm yield and 100 kg/ha phosphorus with 50 kg/ha nitrogen resulted to a maximum number of florets production. Similarly, another study was done on "the effect of plant growth regulators on yield and quality of spike production of gladiolus" under M.Sc.Ag. Thesis at IAAS, Rampur in 2006. The effect of plant growth regulators such as Indole Acetic Acid (IAA), Gibberellins (GA_3) and Kinetin with their four concentrations (0, 100, 500 and 1000 ppm) on growth and yield of gladiolus cv. American Beauty were evaluated. The results concluded that IAA @ 100 ppm was found the most effective for spike production and consistently gave the highest number of cormel (643.0 /m^2), longest spike length (103.03 cm) and rachis length (51.5 cm), whereas kinetin @ 1000 ppm was resulted the best for the production of corms. Moreover, IAA @ 100 ppm showed the maximal plant height (106.03 cm) and cent percent sprouting. Effect of GA_3 @ 500 ppm as well as 1000 ppm had resulted to the highest corm diameter (5.6 cm) and the highest number of fully opened floret (6.5 nos). Similarly, the effect of kinetin @ 1000 ppm was come to the best for quality corm and spike production.

IAAS, Rampur has also carried out another study on the effect of pruning on flowering in different cultivars of rose during 1993 to 1994. A lot of variation of responses to pruning was noticed on different cultivars in terms of days to first flowering, flower yields and number of flushes, while cultivars: Message, Kiss of Fire and Theresa were come into earlier flowering categories and the yields of flower per plant was highest of Edith Nalli Perkins (13.9 nos) followed by Theresa (12.8 nos) and Noritu (11.3 nos). Another study on "the effect of media on number of leaves and root production and growth of stem length for the establishment of orchids in Chitwan" done by IAAS, Rampur has come up with some recommendations for managing the media for orchids. The results revealed the media sphagnum moss and coal quite superior for the effect on number of leaves and roots production; and growth of stem length of tissue cultured orchid as compared to media; sphagnum moss + brick + coal, sphagnum moss + brick and brick + coal (Pun, 1995).

NARC has research mandatory on cut flower and made some initiatives for last few years. In connection, Horticulture Research Division, Khumaltar has been doing a research on the project entitled "Collection, evaluation, date of planting and bulb production of gladiolus cut flower since 2002. Similarly, a project on gladiolus is underway at Agriculture Research Station, Pakhribas for last three years. The results suggested narrower spacing for increased spike and corm yield, while

wider spacing resulted into quality flower and larger corm production. Dormancy in gladiolus corm is the major limitation for off-season production since the results showed chilling treatment as the most effective for earlier initiation of root (44.2 days) as well as shoot initiation (56.2 days) as compared to scale removal and water soaking treatment.

1.2 Post-harvest study

Post-harvest study has been firstly carried out in carnation cut flower under the M.Sc.Ag. Thesis at IAAS, Rampur in 2008. To determine the variation on vase life due to the effect of growing locations and cultivars, four common cultivars viz. Eskimo, Helix, Nelson, and Lisa grown at four locations of Kathmandu valley. The results revealed that a significant variation on the vase life was obtained due to the effect of growing locations and cultivars as vase life of these cultivars grown at different locations ranged from 2.7 days to 6.9 days in control vase solution. Variation on vase life by virtue of growing locations and cultivars are attributed to pre-harvest environmental factors and genetic makeup of the cultivars that imparts physical characteristics of the crops. Similarly, physical characteristics such as flower head diameter; stem diameter and length; and chlorophyll and sugar content were found varied and correlated to vase life. The chemical vase solution treatment experimented to extend the vase life, sucrose (5%) + HQS was reported super (11.6 days) as compared to control (2.7 days) (Pun, 2008). Another study on the effect of different concentrations of sucrose on the vase life behavior of gladiolus was done at IAAS, Rampur indicated that 12% sucrose solution to be the most effective substrate in prolonging the vase life (11.3 days) and the maximum number of floret opening compared to control one (9.0 days) (Pant, 2002).

1.3 Marketing and policies

In Nepalese floriculture sector, several studies have been carried out during last decade on marketing and policy issue. These investigations have raised some important issues and made recommendations for the floriculture development in Nepal. A list of studies and key findings are presented in Table 1.

Table 1 : An overview of studies and key findings

Title of the studies	Key findings
A Study on Floriculture Development in Nepal.	• Nepal has good potential of domestic demand and production is growing at a healthy rate. • Western markets for traditional cut flowers are huge; however, India, Bangladesh, and Pakistan could be potential export markets in future. • Nepal is not ready, in terms of scale and infrastructure, for flower export to a meaningful level and may not be able to penetrate overseas markets on its own. Foreign collaborators with established players in the importing countries are essential to achieve success. • Many small entrepreneurs are facing difficulties to adapt and develop export oriented production in the absence of support from stakeholder institutions and government. • The industry is entirely private sector-led and the governmental agencies have virtually played no role so far.
Symposium on Prospective of Floriculture Industry In Nepal (2001)	• There are commercial nurseries in 18 districts. They are producing mostly roses, carnations, gerbera, cymbidium, lilium, tube rose, anthurium, gladiolus, and other various seasonal flowers. • Number of constraints comprises as lack of expertise for research and development, no market promotion support, poor quality output, poor post-harvest handling infrastructure, no solid marketing partnership, etc. Prospects of some projects for foreign joint ventures are: rose, carnation, orchids, chrysanthemum, and seasonable flower seed production.
Trade Competitiveness NRs. 375 of the Floriculture million in 2006. Sub-sector in Nepal 5 years if addressed. But this policies, strategies	• Altogether 550 small flower growers have invested about million in 80 ha of land and had turn over of NRs. 230 • Land under cultivation can be increased to 1000 ha withinsome of the development constraints are properly sector is thriving ill-defined and clear governmentand incentives. • Over the five years time, export of floricultural productsgrew by seven times to NRs. 32.6 million in 2005/06 as against NRs. 4.0 million in 2001/02.
Identification Mission has developed in Report: Flower, climate of Nepal Dairy, and Seed production, and Development in Nepal	• The floriculture sector in Nepal is relatively young and the light of growing demand in the local market. The gives a relative advantage over India for summer allows production of high quality flowers in a wide range of crops : Gladiolus, Roses, Gerbera, Tuber Rose and Marigold. • Attempts to export carnations to Japan resulted in a high return, but were not economic due to the high airfreight. Attempts are being made to export to India in summer as carnation quality is high in June.

Recently, a noticeable study has been carried out with respect to "Export Development of Priority Sectors of Nepal: Sector Study on Floriculture" in 2007. The study concluded that Nepal's floriculture sector has been making remarkable progress in recent years on the domestic front, the next step of developing the sector to become internationally competitive. Report also says that Nepal possesses unique natural advantages and could compete in the international floriculture market. Accordingly, innovative growers and entrepreneurs are coming up in Nepal, but government is not creating an encouraging environment for export. Besides, at present, the sector lacks the financial support for the export quality product that requires hi-tech cultivation investment and airfreight. Thus, these pose a major challenge for Nepalese floriculture business. The study also made suggestions for the following future actions: testing the most appropriate agro-technical methods to achieve high quality flower; trying and practicing the most appropriate export destinations and marketing models.

1.4 Botanical/breeding

Nepal is rich in bio-diversity with a wide variety of topographical and climatic conditions within a short distance. The country houses 2.2 % of the world flowering plants, which consists over 5,160 species of flowering plants. It also includes 246 species of flowering plants that are endemic to Nepal (Pun, 2001). These have ornamental values as well and could be utilized for breeding. Many of these can be utilized to develop new and novel varieties, but are under exploited. There is a need for selection, domestication and improvement for the development of commercial floriculture.

As many as 380 species of orchids are available in Nepal. Eastern Nepal is rich in Epiphytic species, West in Terrestrial species, and Centre possesses both types and these are the exportable commercial importance and these need to be further innovation, commercialization and diversification. Also Nepal as endowed with special appropriate micro-climate could enable seed and bulb production of several seasonal flower species.

Challenges for floriculture development

Floriculture development has been commenced in the private sectors as well as personal initiative of the growers in Nepal virtually without research and development support. The government agencies have played no significant role so far in the development of the industry. However, floriculture has got the maximum attention of growers and new investors since 1994. Although, research and development is an integral part of any industry in the modern world, Nepalese floriculture industry is seriously lacking of investment and support in the area of research. Domestic production of cut flowers is generally not of high quality and is of limited varieties; productivity too is generally low. Good quality planting material and varieties is quite problem for its availability that the number of growers cannot afford importation due to lacking scientific

information on specific flower crops and varieties. Problem of high volume and standard quality as well as cost-effective production for the export in international market prevail in Nepal. Lack of marketing, post-harvest and enterprise development skills are some other challenges to floriculture research and development in Nepal.

Research needs for the floriculture development

Nepal possesses a good scope and possibility of floriculture business. Thus, the country must be given due priority to capture this opportunity in time. The important of floriculture business had resided to export potential and it must be targeted to international market business of fresh flowers and flower seeds and bulb in future. Therefore, research and development activities should be directed towards the following areas and issues:

i. Standard quality and quantity production
ii. Cost effective technologies
iii. Year round production
iv. Hi-tech and green house technologies
v. Propagation and tissue culture
vi. Research on promising endemic plants with a long term perspective and vision
vii. Potential pockets for seed production and cutflowers.

The important aspects of floriculture development include greenhouse, plant health management, and modern post-harvest technique. The private sector entrepreneurs are developing technologies knowledge and skills on their own kinds in a very limited scale. The governmental institutions like NARC, Nepal Academy of Science and Technology (NAST), Department of Plant Resource (DoPR), and Department of Agriculture (DOA) should take sole responsibility of research and extension, but at present research on this sector is greatly lacking. Basically, inadequate programs, lacking of qualified manpower and inadequate budgetary provisions are the facts. Government research-extension system is very necessary to promote floriculture as a high value crop at the farmer's level. Strategically, we should effort on off-season export that requires quite hi-tech production technique and varieties, thus the research should concentrate on this front. A small-scale green house technology needs to be introduced at the farmers' level. Also, establishment of model farms at the farmers' level with low production technology is crucial for future research. Export of flower seeds and bulbs have commercially viable, thus, it is one of the potential areas of research. Other general possible research subjects on floriculture are: plant protection problems; introduction of new flower crops and establish their agro-techniques; collection, identification, evaluation and improvement of wild ornamental plants; and establishing micro-propagation technique for wild ornamental plants.

NARC should thrust seriously for the research on this sector and it should be market driven and follow the collaborative research with the

participation of individual growers. Similarly, other organization such as NAST and DoPR should begin concretizing and directing their effort to the research program on promising endemic plants with a view to support the floriculture industry in the long run. Government should encourage private sectors to invest on this sector and make consistent and clear policies to marketing and transport of flowers especially airfreight, and develop infrastructure base.

Conclusion

Floriculture enterprise has good scope and flourishing speedly. However, systematic development of this sector has not been commenced yet. Floriculture is entirely private sector-led enterprize. Some developmental activities have been carried out with the initiatives of private sector as well as personal initiatives of growers and entrepreneurs. Therefore, this sector is marching without research and development supports from the government. Nevertheless, few researches have been culminated in the past by NARC, IAAS, NAST, DoPR. These researches were concentrated mainly on cut flower like gladiolus, rose, and carnation on agro-husbandry and post-harvest aspects. The findings of these researches, whether relevant or not, are not adopted and scaled-up the growers and entrepreneurs level effectively. The importance of floriculture business had resided to export potential due to climatic advantage and human resources and country must capture this opportunity. Accordingly, research and developmental activities should proceed towards building competitiveness to the international flower market.

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Harvest Plant Density and Estimated Yield of Spring Maize (Zea mays L.) in Farmers' Fields of Inner-terai Conditions

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An on-farm crop cut survey in spring maize was carried out at Sharadanagar in Chitwan and Gaindakot in Nawalparasi. Results showed about 3.6 plants/m^2 of harvest plant density and an estimated yield of 3.07 t/ha on an average, and a strong positive density and yield relations ($r=0.501_{p<0.01}$). By fertility levels, mean plant densities of 3.57, 4.00 and 3.26 plants/m^2 and mean yields of 3.67, 3.16 and 2.34 t/ha were found at high, medium, and low fertility conditions, respectively. There was significant variation between yields at all three fertility conditions. Correlation analysis revealed a positive and significantly strong plant density and yield relationship at high ($r = 0.628_{p<0.01}$) and medium ($r = 0.661_{p<0.01}$) fertility conditions while it was positive but not significant ($r = 0.215_{p>0..05}$) at low fertility conditions.

Key words : spring maize, plant density, crop cut survey

Introduction

Maize stands as second most important crop in Nepal after rice. It occupies about 830947 ha area with average yield of 2.04 t/ha. Its coverage and yield in the terai regions are 165957 ha and 2174 kg/ha, respectively (MoAC, 2006). Due to the higher demand of maize grain for the feed and food processing industries (NARC/CIMMYT Nepal, 2001) and the year round consumption of the green cobs, winter and spring maize area in terai and inner terai regions is increasing. Spring maize accompanies cooler and sunny initial days, possess longer growth period (Singh and Zaidi, 1998; Shrestha, 2007), escapes monsoon flood and could have better uptake and use of growth factors thus has higher yield potential over normal season crop (Bangarwa et al. 1988). In spite of the fact that about 86 percent of the total maize area in Nepal is under improved varieties (MoAC, 2006) with yield potential around 5.0 t/ha (Adhikari, 1998), the attained yield level is low. There is wide gap between potential yield, station yield and farmers' average yield (Amgain and Timilsina, 2004). One of the important factors for low yield is the low plant

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density (Gurung and Rijal, 1993; Chand et al., 1991; Koirala et al., 1977). Swaminathan (1993) has stated the density management as one of three important factors responsible for the explosion of maize yields in the USA. Staskopf (1985) had stated that plant density has strong influence on maize yields.

It has been observed that the Nepalese maize farmers maintain lesser plant density. As reported by Chand et al. (1991), maize plant densities were found to be 30% and 40% less over recommended level, respectively at high and mid hills of eastern Nepal. For inner terai conditions, there is dearth of information regarding plant density level in spring maize that farmers retain at harvest. The objectives of this study were to find out (i) harvest plant density levels of spring maize in the farmers' fields, (ii) yield status of spring maize in the farmers' fields, and (iii) plant densities and yields relations of spring maize in the farmers' fields.

Materials and Methods

Survey was carried out at Shardanagar Village Development Committee (VDC) of Chitwan and Gaindakot VDC of Nawalparasi on the last week of June in 2007. A total of 63 crop cut samples were taken randomly from the fields where the crop was matured during the visit and the farmers were available. Sample area was 2x2 m^2 where from, number of plants and weight of ears was recorded. The ear weight was converted to field grain weight as below by multiplying it with the multiplication coefficient: the product of the mean values of open ear fraction of sheathed ear (0.82) and grain fraction of the open ear (0.76) as obtained in the field experiment conducted at IAAS, Agronomy Farm, Rampur in the same year by Pandeya (2008).

Multiplication coefficient = (weight of open ear in kg / weight of ear with husk in kg) (Grain weight kg / weight of open ear in kg) = (ear recovery fraction) (shelling fraction) = 0.82 x 0.76 or 0.623. Field weight of maize grain in kg = (ear weight in kg) (0.623). Palikhe et al. (1998) had calculated ear recovery and shelling percent of some maize varieties. The correlation analysis between plant density and estimated yield levels was performed using MSTAT C to look at the association of these variables at farmers' fields. The plant density levels, estimated yields and correlations were calculated for three different fertility conditions (low, medium, and high) as categorized by the farmers themselves during crop cut. Plant densities and yield means of three fertility conditions were compared.

Results and Discussion

1. Harvest Plant Density

Harvest plant density level was found to be 3.64 plants/m^2 (36429 plants/ha) on an average. Plant density ranged from 1.25 to 5.25 plants/m^2 (12500 to 52500 plants/ha), and the mode as illustrated in Figure 1 equaled to 4.25 plants/m^2 (42500 plants/ha).

2. Densities and yield relations

From the average harvest plant density of 36429 plants/ha, the average yield was 3037 kg/ha. The plant densities and yield levels had a significant positive relationship ($r = 0.501$ $_{P < 0.01}$). A summary of correlation analysis between densities and yield levels is presented in Table 1. The results suggest that there is great scope for increasing productivity of spring maize with the manipulation of optimum plant density. Pandeya (2008) reported that the plant density of 74000 plants/ha produced highest grain yield over lower plant densities at inner terai conditions during spring.

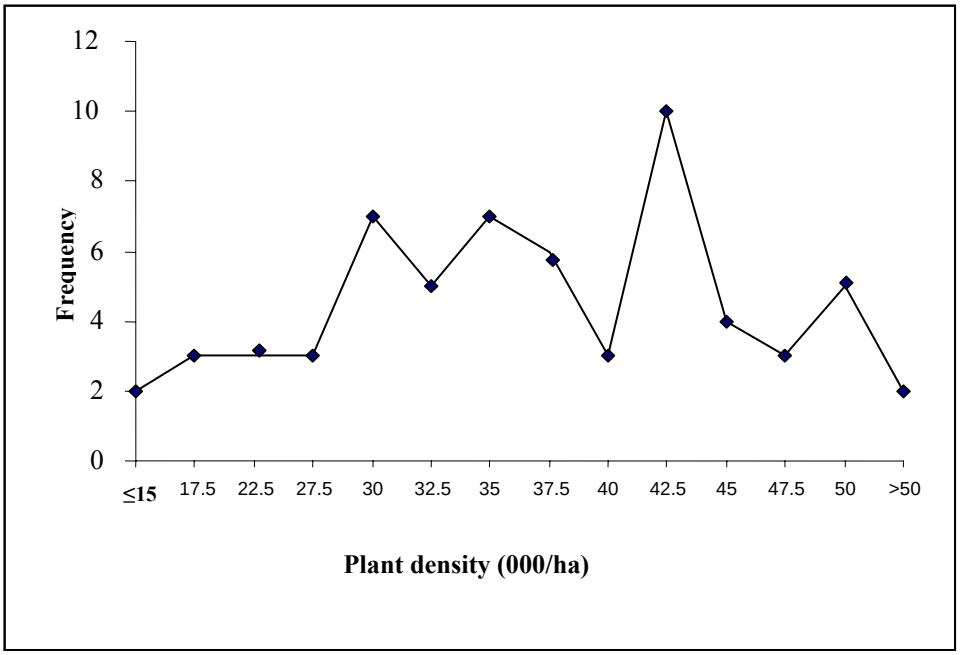

Figure 1 : Frequency distribution of plant density levels on spring maize in the farmers' fields in Chitwan, 2007

The observed density was 32 percent less than the recommended density 5.33 plants/m^2 and 51 percent less than the highest yielding density 7.41 plants/m^2 as signified by the field experiment (Pandeya, 2008). Gurung and Rijal (1993) found 3.48 plants/m^2 and 3.07 plants/m^2 of harvest density under maize/millet and maize-toria cropping pattern of eastern hills, respectively. There seemed higher scope for increasing productivity of spring maize with higher plant density.

Table 1. Mean plant densities, mean yields and their associations on spring maize in the farmers' fields in Chitwan and Nawalparasi, 2007

Description	Results
Number of samples	63
Mean plant density	36400 /ha
Variance for plant density mean	93894009.22
Mean grain yield	3.073 t/ha
Variance for grain yield mean	878492.06
Correlation coefficient (r)	0.501**
Probability	0.000

** Highly significant

3. Density-yield relations by fertility conditions

Twenty, 24 and 19 sample sites were (as categorized by the farmers) under high, medium and low fertility conditions, respectively. Mean plant densities of 37500, 40000 and 32632 plants/ha and corresponding mean yields of 3670, 3160 and 2340 t/ha were recorded at high, medium, and low fertility conditions, respectively (Table 2). A significant variation was found in the mean yields recorded for different fertility conditions. Similarly, mean plant density of medium (40000 plants/ha) and low fertility conditions (32632 plants/ha) also varied significantly while the plant densities of high (37500/ha) and medium fertility conditions and high and low fertility conditions were statistically similar (Table 3). Though the plant density and yield relationship was positive at all three conditions, it was not significant in low fertility sites ($r = 0.215_{P>0.05}$) where as it was significant at high ($r = 0.628_{P < 0.01}$) and medium fertility conditions ($r = 0.661_{P < 0.01}$).

Table 2 : Summary results of correlation analysis between plant densities and yield levels of spring maize observed at farmers' fields at different fertility conditions at Chitwan and Nawalparasi, 2007

Description	Results		
	High fertility condition	Medium fertility condition	Low fertility condition
Number of samples	20	24	19
Mean plant density/ha	35750.00	40000.00	32631.58
Variance for plant density	71776315.79	91304347.83	98245614.04
Mean grain yield (Kg/ha)	3669.55	3160.00	2335.47
Variance for grain yield	560031.21	773341.30	466945.26
Correlation coefficient (r)	0.628**	0.661**	0.215 ns

Probability	0.003	0.000	0.377

** Highly significant (P≤ 0.01), ns: Not significant

Lower harvest densities at low fertility conditions might be due to the excessive barrenness where farmers harvested barren plants earlier as fodder. The significant yield variation between the fertility conditions might be largely due to the differential crop response with the plant density at different fertility conditions.

The varied correlation coefficients between the density and yield at different fertility levels (Table 2) indicated differential crop responses with varying fertility levels. This situation complies that adequate nutrient supply is a pre-requisite to take yield advantage from higher level plant densities. Existing density levels in medium and high fertility conditions seem inadequate for more efficient use of growth factors to reach the attainable yields. However, the insignificant association of plant densities and yield at low fertility condition indicated that just increasing the density level in lower fertility conditions would not result a tangible increment in yield. Further crop cut cum soil/plant analyses are required to verify and establish knowledge about crop response to density levels under varying conditions of farmers' fields.

Table 3 : Calculated values for Student's 't's and level of significance (at corresponding degree of freedom and $\alpha = 0.05$) for the differences of means of plant densities and estimated grain yields of spring maize at different fertility conditions of farmers' fields, 2007

		Medium fertility	**Low fertility**
Plant density	High fertility	1.543 ns	1.058 ns
Estimated yield	High fertility	2.047*	5.80*
Plant density	Medium fertility	-	2.465*
Estimated yield	Medium fertility	-	3.35*

*Significant, ns: Not significant

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How Reliable are the Names Given by Farmers to Sponge Gourd Landraces?

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Reliability study on the names of landraces given by farmers is useful for on-farm management of agro-biodiversity. This paper evaluates whether the names given by farmers to sponge gourd are reliable. Information on sponge gourd landraces based on the local names was collected through household survey from Kaski and Bara sites. Important landraces of these two sites were collected and grown in on-station in Kaski. A total of 25 qualitative data were studied in 3 individual plants of each landrace. Simple matching coefficients, cluster and principal components analyses were applied. Reliability analysis, number of farmers handling the landrace by same name, simple matching coefficients between all possible pairs, clustering and principal components plotting showed that name of sponge gourd landraces given by farmers of Kaski and Bara are reliable and consistent in naming their varieties.

Key words : reliable names, sponge gourd, reliability analysis, qualitative traits, multivariate analysis

Introduction

Farmers manage crop diversity by the names they give to their local varieties or landraces. Generally, a landrace is named on the basis of few important traits. Within the community, most of the farmers use the same name for a variety. However, other communities may use a different name for the same genotype, or they may use the same name or character but apply it to a different genotype. If names of landraces given by farmers represent the genetic diversity, it would be great support for developing conservation strategy. In some crops, names are consistent and in some it is not on the basis of study at biochemical and DNA levels (Bajracharya et al., 1999, 2003a, 2003b, 2003c). Different approaches may be applied to test the reliability of names given by farmers (Kebebew et al., 2001; Teshome et al., 1997; Sambatti et al., 2001). Study on morphological characters is simple and cost effective approach.

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Both folk taxonomy and botanical taxonomy should be taken into account to facilitate the understanding of the challenges of variation and diversity for today's needs of holistic, comprehensive, clearly defined and scientifically acceptable biotic classifications (Teshome et al., 1997). Reliability means how the genotypes based on the names are genetically different. If the basis of recognizable units is same to a particular variety in the community, this name may be reliable. In other words, if many farmers handle variety by the same name, it can be considered reliable. If name of landraces given by farmers has different characters or simple matching coefficient with other landraces is less than one, this also supports the reliability. Reliability is likely to vary among crop species and according to the extent of the reference area.

Samples of sponge gourd landraces were taken from Kaski and Bara sites. Sponge gourd is a cross-pollinated crop and each household usually maintains two to three individual plants (Rana et al., 2000a, 2000b). Fruit characteristics are the basis of naming and distinguishing landraces in both sites Baniya et al., 2005; Joshi et al., 2005). During baseline survey 16 and 15 landraces were reported in Kaski and Bara respectively (Rana et al., 2000a, 2000b). These names given by farmers to sponge gourd landraces in both sites were analysed to test their reliability.

Materials and Methods

Information on sponge gourd landraces based on the local names was collected through household survey from Kaski and Bara sites. The data obtained from the interview were treated in the binary form (presence or absence) and subjected to a reliability analysis to quantify the variations among informants and the varieties. The number of households growing landraces by the same name was also reported.

Important landraces of these two sites were collected and grown in Agricultural Research Station of NARC at Malepatan in Kaski. Six accessions of sponge gourd from Genetic Seed House of Agriculture Botany Division were also included in this experiment. A total of 25 qualitative data (Table 1) were studied in 3 individual plants of each landrace. These landraces were scored as per the descriptors of sponge gourd (Joshi et al., 2004). Simple matching coefficients were estimated between all possible pairs based on these qualitative data to know whether any pair of landrace matched. Cluster and principal components analyses were applied on these data to see how they are diverse and to know the most important traits in term of variability expressed.

Table 1 : Qualitative traits and their code used in this study

SN	Character	Class and code
1.	Cotyledon size	Small (1), Medium (2), Large (3)
2.	Cotyledon colour	Green (1), Intermediate (2), Dark green (3)
3.	Shape of stem	Rounded (1), Angular (2)
4.	Tendrils	Present (1), Absent (2)

SN	Character	Class and code
5.	Leaf size	Small (1), Intermediate (2), Large (3)
6.	Leaf margin	Smooth (1), Dented (2)
7.	Leaf lobes	Absent (1), Shallow (2), Intermediate (3), Deep (4)
8.	Dorsal leaf pubescence	Absent (1), Low (2), Intermediate (3), High (4)
9.	Ventral leaf pubescence	Absent (1), Low (2), Intermediate (3), High (4)
10.	Growth habit	Bushy (1), Intermediate (2), Prostrate (3)
11.	Stem pubescence	Absent (1), Thin (2), Dense (3), Very dense (4)
12.	Flower colour	White (1), Yellow (2), Orange (3), Other (4), Light yellow (5)
13.	Sex type	Monoecious (1), Hermaphroditic (2)
14.	Peduncle shape	Round (1), Semi-angled (2), Sharp-angled (3)
15.	Peduncle separation from fruit	Easy (1), Intermediate (2), Difficult (3)
16.	Blossom end fruit shape	Depressed (1), Flattened (2), Rounded (3), Pointed (4)
17.	Stem end fruit shape	Depressed (1), Flattened (2), Rounded (3), Pointed (4)
18.	Fruit shape	Oblong blocky (1), Elongate slim (2), Elongate blocky (3), Elliptical (4), Elongate Tapered (5), Pyriform (6), Elongate elliptical (7)
19.	Fruit ribs	Absent (1), Superficial (2), Intermediate (3), Deep (4)
20.	Fruit colour	Light green (1), Dark green (2), White-mottled (3), Blackish (4), Others (5), White (6)
21.	Fruit skin texture	Smooth (1), Grainy (2), Finley wrinkled (3), Shallowly wavy (4), Netted (5), With warts (6), Scabrous (7)
22.	Flesh colour	White (1), Cream (2), Yellow (3)
23.	Flesh flavour	Insipid (1), Intermediate (2), Bitter (3), Favorable (4)
24.	Seed colour	Black (1), Gray (2), Brown (3), White (4)
25.	Sponge quality	Soft (1), Intermediate (2), Hard (3)

Results

Reliability analysis was carried out to quantify the rate of farmers' disagreement in naming their landrace varieties of sponge gourd. The reliability analysis (Table 2) revealed that there was no significant difference between informants in naming the landraces suggesting remarkable degree of consistency between farmers naming of landraces varieties in both sites, Kaski and Bara. There were highly significant differences between farmers' varieties.

Table 2 : Results of reliability of local names given by 188 farmers to 15 landraces in Kaski and by 134 farmers to 16 landraces of sponge gourd in Bara.

Source of variance	Kaski				Bara			
	df	SS	MS	F	df	SS	MS	F
Between farmers' varieties	14	125.31	8.95	165.76***	15	12.70	0.85	13.14***
Between farmers	187	5.356	.029	0.53^{ns}	133	1.69	0.013	0.20^{ns}
Residual	2618	141.36	.054		1995	128.55	0.064	

***: Significant at 0.001. ^{ns}: Not significant.

The number of farmers handling the landrace by same name was minimum of 3 for *Hariyo Madhyam* to maximum of 129 to *Hariyo Chhoto* in Kaski and 3 for *Ghiuwa* to 44 to *Galphuli* in Bara (Figure 1). It revealed that farmers were consistent in handling the landraces of sponge gourd by their names.

The simple matching coefficients between all possible pairs of 21 sponge gourd landraces are given in Table 3. The highest matching coefficient was between *Lamka Ujarka* and *Hariharka* and the lowest between 4 pairs (*Jhingani Hariyo Lamo, Sagputi Ghiraunla* and *Hariyo Lamo, Seto Basaune* and *Sano Ghiraunla*, and *Seto Lamo* and *Sano Ghiraunla*). As the coefficient increased, their similarity also increased. All pairs were not matched i.e. names given by farmers did not overlap and reflect the diversity.

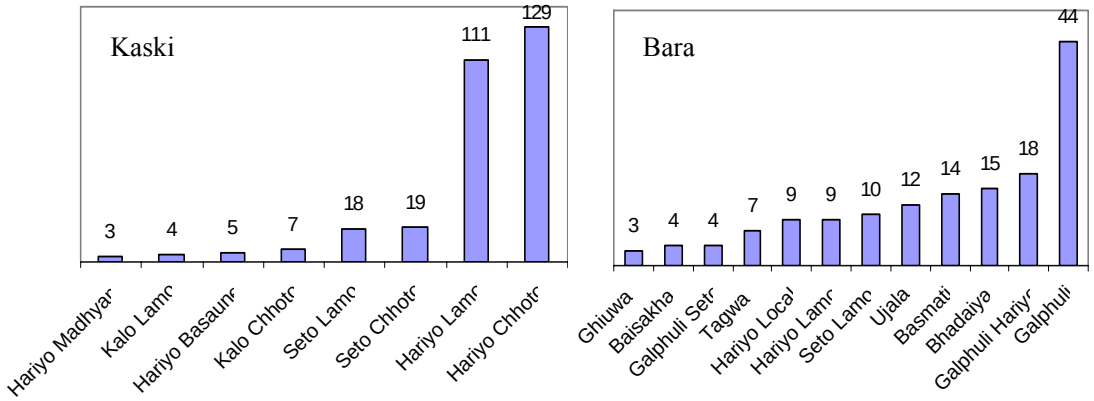

Figure 1. Number of households growing by same name of landraces of sponge gourd in tow sites, Kaski and Bara

Table 3 : Simple matching coefficients between all possible pairs of 21 sponge gourd landraces based on 25 qualitative traits

SN	Landrace	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Basaune	1																				
2	HarihaTagwa	0.6	1																			
3	Hariharka	0.8	0.72	1																		
	Hariyo Basaune	0.8	0.52	0.8	1																	
5	HariyoBose	0.76	0.56	0.6	0.8	1																
6	HariyoChhoto	0.72	0.44	0.72	0.76	0.64	1															
7	HariyoLamo	0.72	0.68	0.8	0.72	0.68	0.76	1														
8	JangaliGhiraula	0.56	0.6	0.6	0.52	0.56	0.44	0.52	1													
9	Jhimni	0.56	0.48	0.56	0.48	0.6	0.56	0.52	0.56	1												
10	Jhingani	0.6	0.48	0.56	0.52	0.56	0.56	0.4	0.52	0.64	1											
11	LamkaUjarka	0.76	0.72	0.88	0.68	0.64	0.68	0.76	0.56	0.6	0.56	1										
12	LamoBose	0.8	0.56	0.64	0.72	0.84	0.76	0.76	0.56	0.56	0.52	0.64	1									
13	SagputiGhiraula	0.48	0.44	0.48	0.44	0.52	0.44	0.4	0.56	0.8	0.8	0.48	0.48	1								
14	SanoGhiraula	0.48	0.44	0.56	0.44	0.4	0.48	0.44	0.52	0.68	0.76	0.56	0.4	0.76	1							
15	SetoBasaune	0.68	0.56	0.6	0.72	0.76	0.56	0.6	0.56	0.56	0.48	0.68	0.64	0.48	0.4	1						
16	SetoBose	0.72	0.52	0.64	0.64	0.64	0.84	0.6	0.48	0.56	0.6	0.64	0.72	0.44	0.44	0.6	1					
17	SetoLamo	0.76	0.6	0.68	0.8	0.76	0.72	0.64	0.56	0.44	0.6	0.6	0.8	0.44	0.4	0.64	0.68	1				
18	Toriya	0.52	0.64	0.56	0.6	0.68	0.52	0.6	0.76	0.52	0.52	0.6	0.6	0.52	0.44	0.64	0.52	0.6	1			
19	Ujarka-B	0.72	0.64	0.76	0.68	0.6	0.64	0.56	0.52	0.52	0.68	0.72	0.56	0.48	0.48	0.64	0.72	0.68	0.52	1		
20	Ujarka-N	0.88	0.56	0.76	0.8	0.76	0.68	0.64	0.6	0.52	0.6	0.72	0.72	0.44	0.44	0.68	0.72	0.72	0.52	0.76	1	
21	Ujarka-R	0.8	0.56	0.68	0.72	0.72	0.76	0.64	0.56	0.6	0.64	0.72	0.76	0.48	0.44	0.68	0.68	0.76	0.56	0.76	0.8	1

UPGMA (unweighted pair-group method using arithmetic averages) clustering and principal components plotting also revealed their identity with respect to names (Figure 2 and 3). Each landrace makes separate cluster at coefficient 0.89. Collections of Agriculture Botany Division (ABD) of NARC at Khumaltar tended to make a separate cluster. Similarly, Kaski and Bara landraces were separated each other except some landraces.

The first five principal components gave eigen values greater than 1.0 and all together explained 77.01 percent of the accumulated variation (Table 4). The first principal component explained 34.39 percent of the variation and was associated with fruit colour, fruit skin texture, flesh colour, flesh flavour, seed colour and sponge quality (Table 5). The second principal component explained 23.61 percent of the variation and was associated with cotyledon size, shape of stem, tendrils, leaf margin, sex type and peduncle shape. The third component explained 8.36 percent of the variation and was associated with stem end fruit shape, fruit skin texture and fruit ribs.

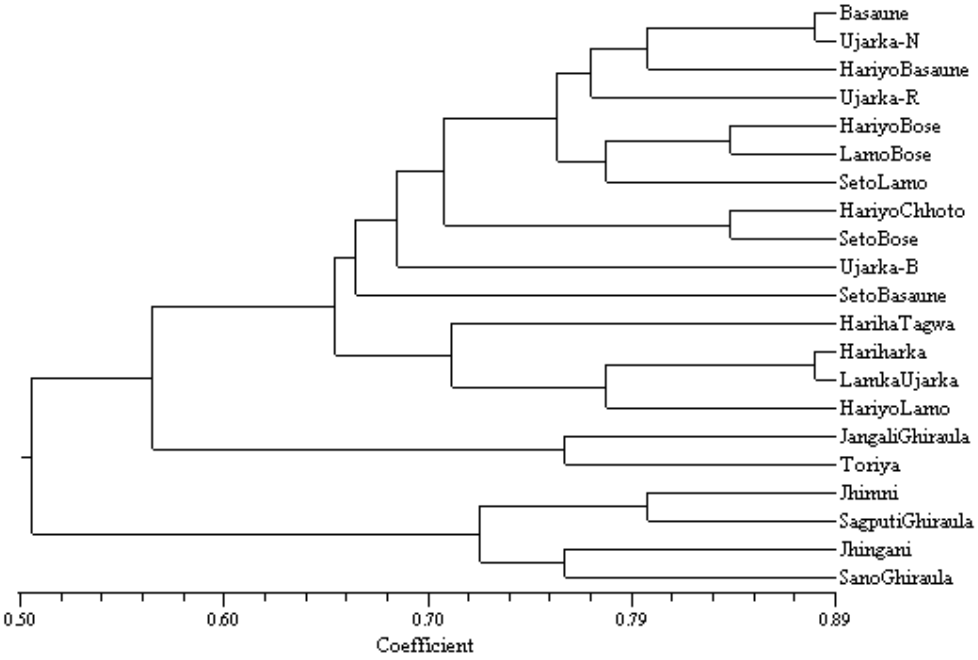

Figure 2. UPGMA clustering of 21 sponge gourd landraces based on 25 qualitative traits

The plot of first two principal components showed clear differences among these landraces. The ABD collections tended to have more negative values along the second PC. Landraces from Kaski and Bara sites tended to have positive values along both axes.

Table 4 : Eigen value, percent of the variability explained by each component

Principal component	Eigen value	Percent variability	Cumulative variability
1	8.59	34.39	34.39
2	5.90	23.61	58.01
3	2.09	8.36	66.37
4	1.48	5.94	72.32
5	1.17	4.69	77.01

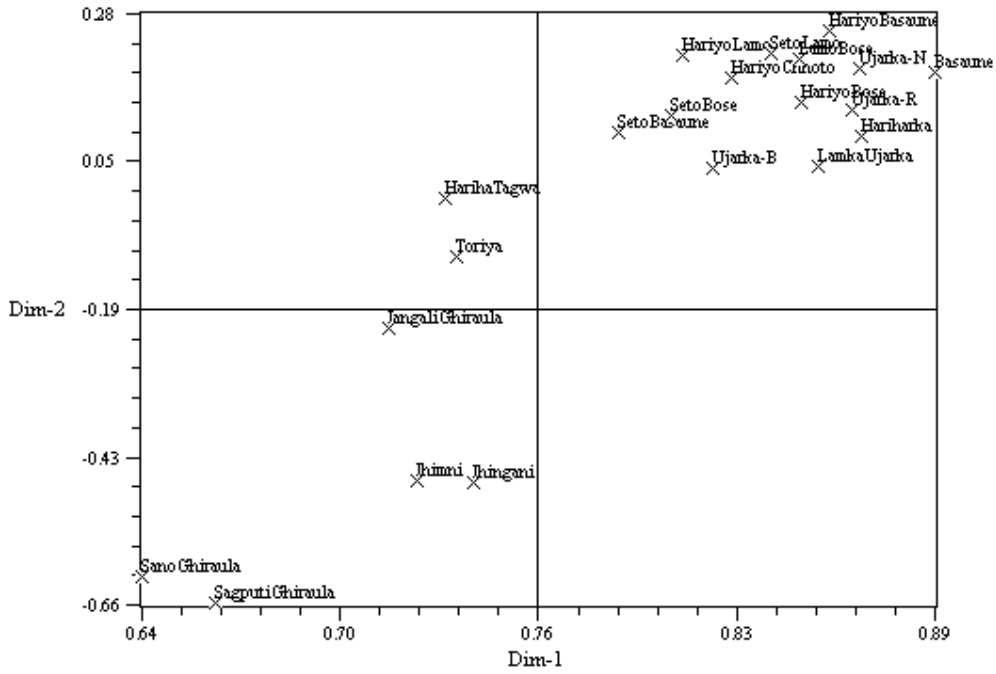

Figure 3. Plotting of 21 sponge gourd landraces in first two principal components based on 25 qualitative traits

Table 5 : Eigen vectors of each character with respect to its principal component (PC)

SN	Character	PC 1	PC 2	PC 3
1.	Cotyledon size	0.64	0.60	0.07
2.	Cotyledon colour	0.57	0.47	-0.004
3.	Shape of stem	0.68	0.61	0.14
4.	Tendrils	0.70	-0.63	0.06
5.	Leaf size	0.57	0.30	0.001
6.	Leaf margin	0.66	0.67	0.14

7.	Leaf lobes	0.46	0.42	-0.43
8.	Dorsal leaf pubescence	0.60	0.18	-0.13
9.	Ventral leaf pubescence	0.54	0.14	-0.16
10.	Growth habit	0.69	-0.68	0.05
11.	Stem pubescence	0.63	-0.44	0.05
12.	Flower colour	0.57	0.57	0.24
13.	Sex type	0.66	0.67	0.14
14.	Peduncle shape	0.69	-0.68	0.05
15.	Peduncle separation from fruit	0.52	-0.54	-0.15
16.	Blossom end fruit shape	0.21	0.08	-0.71
17.	Stem end fruit shape	0.09	0.03	-0.76
18.	Fruit shape	0.32	0.05	-0.27
19.	Fruit ribs	0.19	0.18	-0.64
20.	Fruit colour	0.59	0.26	0.04
21.	Fruit skin texture	0.72	0.42	0.25
22.	Flesh colour	0.69	-0.68	0.05
23.	Flesh flavour	0.52	-0.36	-0.12
24.	Seed colour	0.69	-0.52	0.04
25.	Sponge quality	0.70	-0.59	0.07

Discussion

Reliability analysis, coefficients of all possible pairs and multivariate analyses clearly showed that names given by farmers to sponge gourd landraces are reliable in both sites, Kaski and Bara. Similar results were obtained in naming of barley (Kebebew et al., 2001) and sorghum landraces (Teshome et al., 1997) in Ethiopia. Farmers know which crops and which varieties of each crop are grown in their village or district or are being sold in the local market. Local names of landraces may not always correspond to botanical distinctness but they are often quite descriptive of the cultivar grown. However, loose taxonomic system was reported for cassava by Sambatti et al. (2001).

Farmers maintain two to three individual plants of sponge gourd per household and they maintain seeds by themselves. In such a crop, which has few number of plants in a farm, names of landraces are reliable and they are morphologically different. Reliability of names in other crops which has large population of each landrace in a farm e.g. rice may be more consistent or reliable. Fruit characters are the most important descriptors used by farmers for distinguishing and naming the sponge gourd landraces (Yadav et al., 2003; Pandey et al., 2003; Bajracharya et al., 1999). Bajracharya et al. (1999) also reported that farmers were consistent in identifying the landraces of sponge gourd.

Researchers partition the available variation and assigned name to each variation. If they get new variation over generation, it is assigned new name. However, farmers give names considering certain important traits and do not consider each variation to be

assigned separate name. The given name remains same over generations within community. Therefore, variation within landraces based on names may be high and only the varietal richness index might not be enough to assess diversity of landraces within community. Farmers talk, exchange and sell landraces based on the local names, therefore, names given by local authority can be considered reliable.

For reliability study, each landrace was planted in a separate plot and observations were made accordingly. In such condition, some bias could be imposed during data recording. Growing all landraces together and recording data on the basis of individual plant would be better option for reliability study. The data obtained from such an experiment should have a provision to link with the names of landraces given by farmers.

The names of sponge gourd landraces in these areas are mostly associated with exhibited fruit characters such as fruit shape, fruit colour, fruit size, etc. For example, the local names *Hariyo Lamo* refers to the green and long fruit, *Basaune* refers to its aroma during cooking, etc. The farmers in both sites were consistent in naming their varieties. This shows that farmers know best their landraces and what genetic traits they possess. Since farmers are in constant interaction with the environment, the conservation and selection of genetic references is in a dynamic process. Their keen observation and selection activities generate and provide genetic traits valuable to their needs.

Conclusion

Name of sponge gourd landraces given by farmers of Kaski and Bara are reliable or consistent in naming their varieties. Qualitative traits also revealed the consistency within community. Therefore, the name landraces can be considered to manage crop diversity. In addition to this, molecular tools can be better to link in such study taking sample from more communities.

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Nutrients Management in Banana in the River Basin Areas of the Western Mid Hills of Nepal

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Studies on response of banana to different doses of chemical fertilizers and to different types of organic manures (cattle, poultry, goat, oil cakes) were conducted at Chambas, Tanahu (450 masl) in farmers' fields for two consecutive years from 2006 to 2008. Application of fertilizers in different doses and combinations significantly increased the number of new leaves, number of new suckers, plant girth, plant height and fruit yield compared with the control. Application of 200:75:200 g NPK per plant per year significantly increased fruit yield (51 t/ha) with the incremental benefit cost ratio (IBCR) of 3.56. The increase in yield was at par with the higher doses of NPK. The same amount of nitrogen (200 g) when applied through chemical fertilizer and FYM at 50:50 ratio the fruit yield was significantly decreased (46 t/ha). The fruit yield was increased up to the level (54 t/ha) with IBCR 3.65 when the dose of NPK was increased to 300:100:300 g, of which half of the 300 g nitrogen was applied through chemical fertilizer and the other half thorough FYM. Among the manures evaluated, application of 10 kg poultry manure per plant per year produced the highest fruit yield (52.17 t/ha) with IBCR 5.08.

Key words : banana, fertilizer dose, compost material, river basin

Introduction

Banana (*Musa* sp.) is one of the major fruit crops in Nepal. It is the second most important fruit after citrus in terms of production, and is popular under subsistence farming in the hills (LARC, 1993). The average national productivity of banana is 14 t/ha, but under better management condition, the yield potential is up to 50 t/ha. Total area under banana cultivation in Nepal is 5375.3 ha and in the western hills is 573.8 ha (MOAC, 2006).

In the western hills, the productivity of banana is very low due to poor management practices. Farmers do not maintain the clumps and suckers for high production and quality. In general, additional nutrients are not supplied and banana is cultivated in the marginal land. Some commercial farmers in the hills apply compost only. Although different type of organic manures like cow dung, goat manure, poultry manure, oil cakes etc are available in the farms, farmers are unaware of effect of these manures,

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application methods and application time. Some farmers apply both organic and inorganic fertilizers in unbalanced dose.

Banana being a heavy feeder plant requires very large quantity of nutrients for growth and yield, accounting for 20-30 percent of the total cost of production (ICAR, 2003). Therefore, addition of mineral fertilizers is required for its cultivation on many soils. In general, hill farmers cultivate banana in marginal land or low fertile homestead where fertilizer is not applied during the whole crop period. Among macro-nutrients, nitrogen is the most essential element for normal plant growth and development. ICAR (2003) recommends 100-250 gram nitrogen per plant, depending on nutrient status of soil and cultivar. Urea is commonly used as a source of nitrogen and applied in 3-4 splits. It is also recommend that application of 25 percent nitrogen through FYM is ideal better nutrient management (ICAR, 2003). The objectives of the present studies were to identify and recommend the appropriate dose of fertilizer, and the best organic manure for banana in the river basin areas of the western mid hills of Nepal.

Materials and Methods

Two different experiments were conducted at Chambas (Bhanu VDC-8), Tanahu district (450 masl) during 2006-2008. In both the experiments, farmers' banana orchards with William Hybrid variety of same age were selected. Farmers participated in the experiments were Mr. Ram Lal Shrestha, Ms. Goma Sapkota and Mr. Shyam Kumar Shrestha.

In the first experiment, following seven different treatment combinations of NPK and FYM were evaluated along with farmers' practice as control (farmers generally do not apply fertilizer and manures) in randomized complete block design (RCBD) with 3 replications (farmers as replicates):

Treatment 1 : 200:75:200 g NPK/plant/year
Treatment 2 : 300:100:300 g NPK/plant/year
Treatment 3 : 400:150:400 g NPK/plant/year
Treatment 4 : Half N through FYM and half N through urea of T1
Treatment 5 : Half N through FYM and half N through urea of T2
Treatment 6 : Half N through FYM and half N through urea of T3
Treatment 7 : FYM only equal to 300 g N/plant/year
Treatment 8 : Control (no NPK and no FYM)

Nitrogen was supplied through di-ammonium phosphate (DAP) and urea, phosphorus through DAP and potassium through murate of potash. Manure prepared by using animal droppings in farmers' farm was used as FYM. NPK and FYM were applied in three splits in February, May and August.

In the second experiment, following four treatments of different manures were evaluated against NPK application and the farmers' practice as control in RCBD with 4 replications (farmers as replicates; two replications in Mr. Shrestha's orchard). Manures and NPK were applied in three splits in February, May and August.

Treatment 1 : 30 kg cattle manure/plant/year
Treatment 2 : 20 kg goat manure/plant/year
Treatment 3 : 10 kg poultry manure/plant/year
Treatment 4 : 5 kg oil cake/plant/year
Treatment 5 : 300:110:300 g NPK/plant/year
Treatment 6 : Control (no NPK and no FYM)

For both the experiments, seven plants were randomly selected and tagged for each treatment. The plants were in a distance of 2 m x 2 m between plants and rows. Hoeing, weeding and mulching were done as and when needed. Data were collected from the tagged plants. Economic analysis for each treatment was made using incremental benefit cost ratio (IBCR) on prevailing market price using following formula:

$$\text{IBCR} = \frac{\text{Additional return over control}}{\text{Additional cost over control}}$$

The IBCR analyses are based on following market prices: DAP = NRs 48.00, Urea = NRs 26.00, Potash = NRs 24.00, goat manure = NRs 1.50, poultry manure = NRs 2.50, oil cakes = NRs 15.00, FYM = NRs 0.75, banana fruit = Rs. 10.00.

Results and Discussion

1. Appropriate Dose of Fertilizer in Banana

Besides the identification of appropriate dose of fertilizer application, an attempt was also made to study the effect of NPK application through chemical fertilizer and FYM. Hence the results have been interpreted in two different perspectives, appropriate dose and appropriate source (chemical fertilizer and FYM).

Appropriate dose of chemical fertilizer: Compared to the farmers' practice of not applying any nutrients as control, all the treatments studied showed highly significant differences in number of leaves, number of suckers, girth of plant, height of plant and fruit yield (Table 1). Application of fertilizers in different doses and combinations significantly increased the number of new leaves, number of new suckers, plant girth, plant height and fruit yield up to 34.2, 111.5, 58.4, 19.6 and 145 percent, respectively compared with the control. Within the different levels of chemical fertilizer application (treatments 1, 2, and 3), no significant differences were observed in all the parameters evaluated. Since there was no significant response to higher levels of NPK, the treatment 1 with 200:75:200 g NPK per plant per year can be considered the appropriate dose. This treatment also gave the highest incremental benefit cost ratio (IBCR) i.e. 3.56 among the first three treatments (Table 2).

Application of FYM equivalent to 300 g nitrogen per plant per year was almost at par with all the combinations of chemical fertilizer in terms of yield traits, but the fruit yield was significantly decreased. This might be due to the fact that the nutrients applied

through organic sources are not as readily available as that applied through chemical fertilizer. Besides, along with nitrogen, FYM also contains some amount of phosphorus and potash. Nevertheless, in the long run the application of FYM may prove to be equally effective.

Application of nitrogen through chemical fertilizer and FYM: The above results showed that 200 g nitrogen along with 75 g phosphorus and 200 g potash (treatment 1) was the appropriate dose yielding 51 ton fruit per ha. However, the same amount of nitrogen when applied half of it through chemical fertilizer and half through FYM (treatment 4) the fruit yield was reduced to 47 ton per ha. It must be again due to the fact that the nutrient through FYM was not readily available. The fruit yield increased up to the same level (54 kg/ha) when the amount of NPK was increased to 300:100:300 g, of which half of the 300 g nitrogen was applied through chemical fertilizer and the other half through FYM (treatment 5). This finding also seemed to agree with the appropriateness of sole application of FYM equivalent to 300 g nitrogen (treatment 7). Based on the results of this experiment to get the same level of fruit yield half of 300 g nitrogen through chemical fertilizer and half of that through FYM is needed. This treatment also gave the highest IBCR value of 3.65 (Table 2).

Table 1 : Effect of different combinations of NPK and FYM on different yield traits and fruit yield of banana at Chambas, Tanahu during 2006-2008*

No.	Treatments	Number of leaves	Number of suckers	Girth of plant (cm)	Plant height (cm)	Fruit yield (t/ha)
T1	200:75:200 g NPK/plant/year	33.23	3.27	33.67	217.67	50.97
T2	300:100:300 g NPK/plant/year	33.20	3.57	33.67	217.67	52.07
T3	400:150:400 g NPK/plant/year	34.40	3.43	32.33	219.67	50.87
T4	Half N through FYM and half N through Urea of T1	32.43	3.40	33.33	217.33	46.73
T5	Half N through FYM and half N through Urea of T2	34.07	3.70	34.00	219.33	54.13
T6	Half N through FYM and half N through Urea of T3	32.43	3.87	34.33	219.67	53.00
T7	FYM equal to 300 g N/plant/year	32.20	3.33	32.00	215.67	46.00
T8	Control	25.63	1.83	21.67	183.67	22.10
	P-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	LSD	1.60	0.52	2.31	7.95	3.70
	CV%	2.80	9.10	4.10	2.10	4.50

*Average of two years data

Table 2 : Incremental benefit cost ratio (IBCR) of the fruit yields of banana given in Table 1

Treatment No.	Fruit yield (t/ha)	Increased yield over control (T8)	Increased return (NRs)	Additional cost (NRs)	Additional return (NRs)	IBCR
T1	50.97	28.87	288700	63274	225426	3.56
T2	52.07	29.97	299700	90147	209553	2.32
T3	50.87	28.77	287700	124548	163152	1.31
T4	46.73	24.63	246300	53576	192724	3.60
T5	54.13	32.03	320300	68850	251450	3.65
T6	53.00	30.9	309000	104152	204848	1.97
T7	46.00	23.9	239000	75000	164000	2.19
T8	22.10	-	-	-	-	-

2. Application of Manures Prepared from Different Materials

Among the six different treatments, significant differences in number of new suckers, plant girth, plant height and fruit yield were observed (Table 3). Application of 10 kg poultry manure per plant per year in three equal splits produced the highest number of new suckers (4.8/plant), the biggest plant girth (36.00 cm), the tallest plants (219 cm) and the highest fruit yield (52.17 t/ha). From this experiment it can safely be concluded that application of 10 kg poultry manure per plant per year is the most appropriate one and it is at par with the application of 300:110:300 NPK g per plant per year. The application of poultry manure also gave the highest IBCR value of 5.08 (Table 4).

Table 3 : Effect of different manures on different yield traits and fruit yield of banana at Chambas, Tanahu during 2006-2008*

No.	Treatments	Number of suckers	Girth of plant (cm)	Plant height (cm)	Fruit yield (t/ha)
T1	30 kg cattle manure/plant/year	4.57	33.67	218.30	45.58
T2	20 kg goat manure/plant/year	3.87	31.00	215.00	40.56
T3	10 kg poultry manure/plant/year	4.80	36.00	219.30	52.17
T4	5 kg oil cakes/plant/year	3.23	29.33	213.30	39.15
T5	300:110:300 g NPK/plant/year	3.80	33.00	216.00	51.28
T6	Control	2.63	28.33	187.30	14.20
	P-value	< 0.001	< 0.001	< 0.001	< 0.001
	LSD	0.40	2.75	7.97	1.89
	CV%	5.80	4.70	2.10	3.10

*Average of two years data

Table 4 : Incremental benefit cost ratio (IBCR) of the fruit yields of banana given in Table 3

Treatments	Fruit yield (t/ha)	Increased yield over control (T6)	Increased return (NRs)	Additional cost (NRs)	Additional return (NRs)	IBCR
T1	45.58	31.38	313800	56250	257550	4.58
T2	40.56	26.36	263600	75000	188600	2.51
T3	52.17	37.97	379700	62500	317200	5.08
T4	39.15	24.95	249500	187500	62000	0.33
T5	51.28	37.08	370800	93552	277248	2.96
T6	14.20	-	-	-	-	-

Conclusion

Application of 200:75:200 g NPK per plant per year seems appropriate when the nutrients are to be applied through chemical fertilizers alone. When the nutrients are to be applied through both the chemical fertilizers and FYM the fertilizer dose needs to be increased up to 300:100:300 g NPK per plant per year. Besides them, application of poultry manures 10 kg per plant per year seems the most effective. Both the chemical fertilizers and organic manures were applied in three equal splits in February, May and August.

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Rejuvenation of Declining Mandarin Orange Orchard with Improved Management Practice in Mid-western Hill of Nepal

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A two year on-farm participatory research cum demonstration on rejuvenation of mandarin orange was carried out in Dailekh district for two consecutive years 2007 and 2008. The study included one orchard at each of three commercial pockets. Among 30 randomly selected mandarin fruit trees at each site, 15 received improved practice of orchard management and 15 received farmers' practice as control. The improved practice increased significantly number of fruits per tree (72%), average fruit weight (14.5%) and tree yield (121%) compared with the farmers' practice. The use of improved practice showed good prospect for rejuvenating declining mandarin trees to increase the productivity of the orchard. With this participatory research cum demonstration, farmers in the project area started adopting improved practice of orchard management.

Key words : improved practice, mandarin orange, tree yield

Introduction

Mandarin orange (*Citrus reticulata*) is one of the major cultivated citrus fruits in Nepal, covering 20 percent (20167 ha) of total fruit growing areas. It is grown on semi-commercial to commercial scale in 55 mid hills district from east to west (MoAC, 2008). Citrus fruits produced in Nepal have very good quality (Roistacher, 1996) and thus, has great potential for export (Gurung, 2003). Despite very good prospect of quality citrus fruits production in the mid-hills of Nepal, the average productivity at present is only 11.37 t/ha (MOAC, 2008), which is very low compared to more than 50 t/ha in many citrus producing countries (FAO, 2004).

Several constraints that are limiting the productivity of citrus in Nepal have been reported (ARS, 2006; Paudyal et al., 2002; Subedi and Jacobsen, 2000). Of them, unsuitable soils, drought, lack of proper manuring, use of poor quality planting materials, improper orchard management, different diseases and insects are the major ones. Citrus is 5-10 times more profitable than cereals and there is plenty of opportunity to increase productivity and quality with appropriate technological backing. Agriculture Perspective Plan (NPC, 1995) of Nepal has also placed citrus in the top priority fruit crops for the mid-hills.

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The objectives of this study were to make mandarin orange growers aware of improved orchard management practice and demonstrate them that proper management could rejuvenate old declining orchards into productive ones.

Materials and Methods

Three neglected mandarin orange orchards, one each at citrus pockets of Dullu Village Development Committee (VDC), Kalbhairav VDC and Narayan Municipality of Dailekh district, were selected. The participating farmers (orchard owners) were Bhagbat Hamal of Dullu and Ratna Thapa of Kalbhairab and Pashupati Neupane of Narayan Municipality. Before the project activities started a one-day training on "Improved practice of orchard management" was organized for participating and other citrus growing farmers of the study sites.

In each orchard, thirty mandarin trees of above ten-year old were selected. The selected trees had symptoms of tip dying, yellowish leaves and sick appearance in general. Of the selected trees, 15 trees received improved practice and the other 15 received farmers' practice. The package of improved practice applied is given in table 1. In farmers' practice, only farm yard manure was applied to maize and wheat intercropped with mandarin orange. There were no intercrops in the improved practice.

All practices were carried out by the farmers themselves. Data were recorded on fruiting secondary branches, fruits per branch, average fruit weight and number of fruits per tree. Fifty fruits were sampled from each tree and weighed to obtain average fruit weight and yield per tree. The farmers were involved in the data collection. The study was conducted on same orchard for two years 2006/07 and 2007/08. The yield parameters were analyzed using Z-test.

Table 1 : Package of improved practice

Practice	Application time
Pruning of sucker, diseased, dead, and dying branches	January-February
Application of Bordeaux paint	January-February
Ring application of farm yard manure @ 60 kg, urea @300 g, Di-ammonium phosphate 300 g and Murate of potash @ 500 g/tree	February-March
Application of Multiplex (Commercial liquid formulation of micro nutrients containing Zinc, Boron, Iron, Molybdenum, Manganese and Cupper) @ 6 ml/lit (two times at the interval of 15-20 days)	April-June
Ring application of urea @ 200 g/tree	June
Application of Karathion (Dinocap 48%) @ 1ml/lt to control powdery mildew (two times at the interval of 15-20 days)	May-June
Application of Rogor (Dimethoate 35 EC) @ 2ml/lt to control Green stink bug	July-August

Results

1. Number of fruiting secondary branches per tree, fruits per branch and fruits per tree

The management practices (improved practice and farmers' practice) did not differ for number of fruiting secondary branches. The improved practice exerted significant effect ($p>0.05$) on number of fruits per branch (Table 2). The application of improved practice produced 12 additional fruits per branch compared to the farmers' practice. Similarly, the improved practice significantly increased number of fruits per tree ($p>0.05$) in both the years (Table 3). The increase in number of fruits was 96 percent in 2006, and 49 percent in 2007 (Fig 1). On an average, the number of fruits was increased by 72 percent with the improved practice.

Table 2 : Effect of improved practice (IP) and farmers' practice (FP) on the number of fruiting secondary branches per tree and fruits per branch of mandarin orange, Dailekh district, 2006 and 2007

	Secondary fruiting branches/tree†		Fruits/branch†	
	FP	**IP**	**FP**	**IP**
Mean	8.85	9.90	20.05	32.31
Standard Error	0.39	0.44	1.28	1.96
Variance	9.11	11.77	98.91	229.65
Sample (n)	30		30	
Z cal	1.77ns		5.23*	
Z tab 0.05	1.96		1.96	

ns: not significant; *Z value at 5% level of significance; †: Average of two years

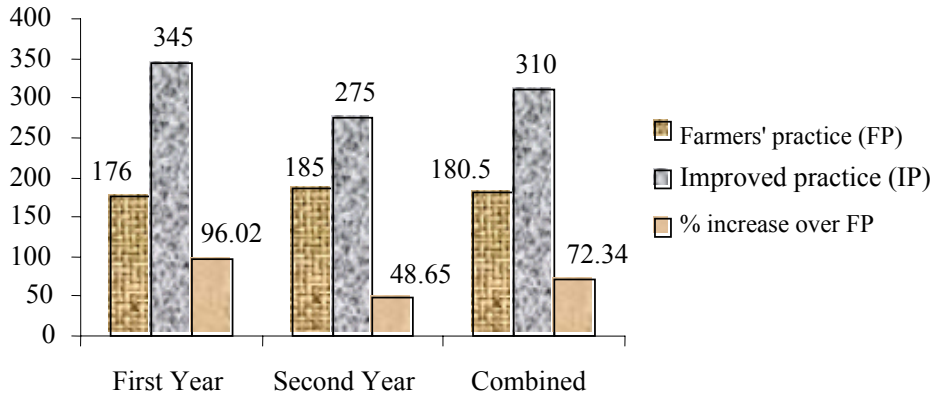

Figure 1. Effect of orchard management practices on number of fruits/tree

2. Average fruit weight and fruit yield per tree

Average fruit weight was 87 g under the farmers' practice and 100 g under the improved practice. The difference was significant ($p>0.05$) (Table 3). On an average, the increase in fruit weight with the improved practice was 14.4 percent compared with the farmers' practice (Fig 2). Similarly, the improved practice significantly increased fruit yield per tree (Table 3). The fruit yield was almost double with improved practice compared with the farmers' practice. The yield was increased by 123 percent in the first year and by 119 percent in the second year (Fig 3).

Table 3. Effect of improved practice (IP) and farmers' practice (FP) on yield and yield attributes of mandarin orange, Dailekh district, 2006 and 2007

	Fruits/tree†		Av. Fruit wt (g)†		Fruit yield/tree (kg)†	
	FP	**IP**	**FP**	**IP**	**FP**	**IP**
Mean	180.69	310.11	86.91	99.50	15.78	31.01
Standard Error	13.16	23.45	1.59	1.57	1.21	2.41
Variance	10398.08	32981.47	150.79	147.20	87.22	348.41
Sample (n)	30		30		30	
Z cal	4.80*		5.61*		5.58*	
Z tab 0.05	1.96		1.96		1.96	

*Z value at 5% level of significance; †: Average of two years

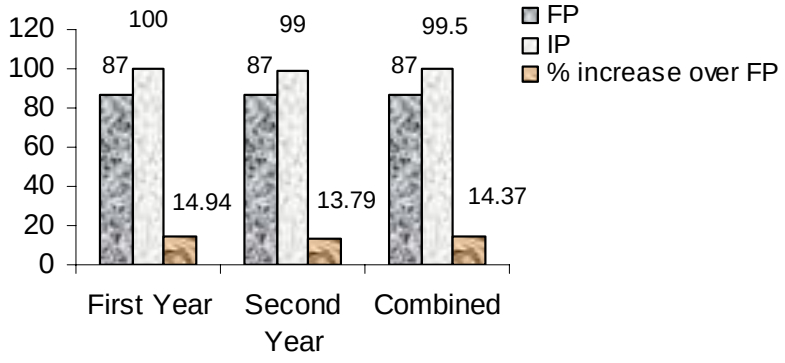

Figure 2. Effect of orchard management practices on average fruit weight

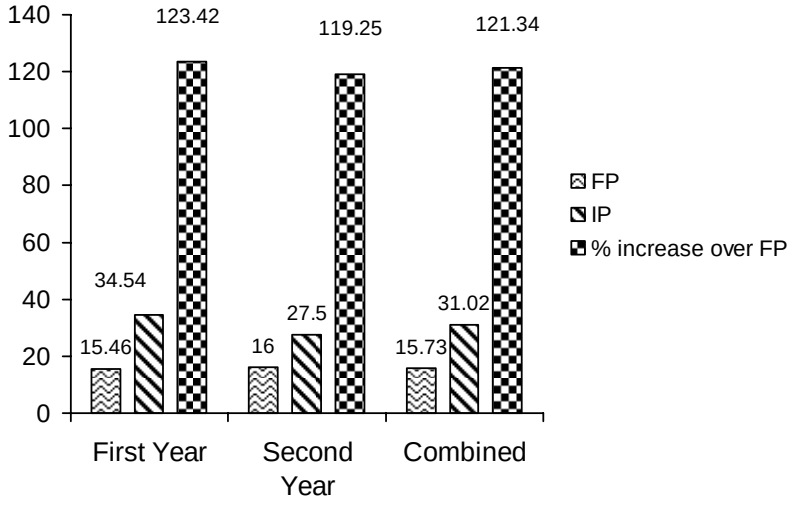

Figure 3. Effect of orchard management practices on yield/tree

Discussion

There was not significant effect of improved practice on the number of secondary fruiting branches. It might be due to the fact that the fruiting branches were developed prior to the application of improved practice. Nevertheless, some positive effect was seen in the second year (data not shown). The overall increase in yield and yield traits with improved practice was directly attributed to the application of chemical fertilizer, micronutrients, pest and disease management and pruning of the unnecessary branches, which were not applied in the farmers' practice. Farmers were only applying FYM to intercrops.

Fruit drop was observed as a major problem in the study sites. Green stink bug (*Nizara viridula* L.) and micronutrient deficiency in soils and plants are reported to be responsible for fruit drops in citrus growing districts, including Dailekh (Shrestha et al., 2008). Less fruit drop was observed on trees with the improved practice (data not shown). Application of Rogor (systemic insecticide) and micronutrients (Multiplex) might have positive effect on less fruit drops and ultimately higher fruit yields per tree compared with the farmers' practice. Powdery mildew was commonly observed on young twigs, especially on trees with the farmers' practice. The incidence of the disease was less on the trees with the improved practice as it included Karathion spray as one of the components. In general, appearance of the trees with the improved practice was lush and of the trees with farmers' practice was pale.

The program of on-farm participatory research and demonstration showed positive impact on citrus growers of the study sites. The participating farmers started storing mandarin oranges in their cellars which were almost empty on previous years due to less production. Several agencies in the district organized visits of citrus producers from other

areas to these orchards. The farmers who visited the orchards were highly impressed with improved tree health and increased productivity. Farmers also started forming Citrus Producers' Groups for management of orchards, including inputs use and marketing of the produce.

Conclusion

The present study revealed that production could be doubled with the improved practice in farmers' neglected or improperly managed orchards. Such participatory research cum demonstration process can be recommended to adopt in other citrus growing areas of the country.

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Farmers' Group Approach for Agricultural Extension in Nepal

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Farmers' Group Approach (FGA) is the dominant approach of Nepalese agriculture extension aimed at empowering farmers and rapid spread of technology. The development of FGs into viable and self-sustaining unit needs attention in group dynamism. FGA has been successful in increasing wider service coverage, capacity enhancement, leadership development, empowerment, capital formation, resource mobilization, increased participation of farmers, increased income and ensuring greater social inclusion in agriculture extension service delivery whereas increased number, low attention in group dynamism, inadequate resources, low level of commercialization and specialization, lack of work plan and implementation in majority groups, poor legitimacy have been found to be hindering factors for success of FGs. Proper attention needs to be paid on overall management of group dynamism for improved and quality service aspects of group including mobilization, facilitation, responsibility division, group meeting ,constitution, welfare fund raising, conflict handling, monitoring and evaluation, and work plan preparation and execution The major issues at present encompass increased quality aspects with increased group number, multiple membership, duplicity of group formation, orientation of group whether commodity or community and proper legitimization of FGs. Timely and appropriate analysis of raising issues accompanied by social mobilization skill of extension staff, better linkage, and intervention of ICT and mobilization of youth and women as well as disadvantaged group through appropriate strategy is required. For enhanced effectiveness, strengths and outputs need expanded, weaknesses removed; opportunities capitalized and threats addressed properly. The strategic approach of FGs needs clarified for getting intended outputs and greater effectiveness as well as efficiency in future.

Key words : Group dynamism, group mobilization, group vitalization/revitalization, empowerment

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Background

The conventional approach of delivery of agriculture extension services was heavily dependent upon government decisions and actions with limited coverage of services, covering especially the elites and the influential, leaving the vast majority beyond the access of such services. There was increased demand for effective farmer-centered participatory agricultural service delivery mechanism. Furthermore, domination of small and marginal farmers, scattered land holdings was other factors challenging the improved access of farmers to government extension services. So, group approach of agriculture extension was implemented to expand the coverage of extension service and have rapid and cost effective service as well as to ensure access of diverse farmers in extension service delivery.

The concept of group approach was first time introduced in Nepal by Small Farmers Development Project (SFDP) through Agricultural Development Bank in 1975/76. However, this was intended for promoting small farmers' easy access of loan on group liability without collateral. This proved to be successful with regards to loan repayment and proper use of the loan money. This created policy implication to initiate group approach. The group approach of agriculture extension was recognized as the official extension approach in 1988/89 by the World Bank funded Agriculture Extension Project (AEP) after observing the encouraging result of this approach in Tanahun, Chitwan, and Morang districts of Nepal. Government of Nepal officially approved group approach as the strategic approach to deliver the agriculture extension services in 1991. Since then, farmers' group approach has been the major strategic approach in service delivery of agriculture and livestock services in Nepal.

Rationale

Farmers are the foci of the group approach. Since conventional approach could not address farmers' needs, problems, skill, capacity and desire, group approach was intervened with the objective of greater participation and creating ownership in the extension program. Furthermore, the availability of staff to provide service is another factor justifying for the need of farmers group. On an average, an extension agent (agriculture and livestock/veterinary services) has to provide service to more than 2000 farm households. Moreover, the limited numbers of service centers could not provide effective service throughout its command area. Farmers on the other hand are more aware than before to get extension services in agriculture and livestock activities/sector. In such situation it is almost impossible to provide service on individual basis to the needy farmers. Group approach can only be the most effective and efficient approach to meet the need of service and technology in agriculture. The rationale of group approach is to establish a simple and farmer oriented participatory extension mechanism that would enable the limited number of government technicians to reach large number of farmers through the groups and facilitate to empower the small farmers with limited resources to stand on their combined strength.

Transformation of subsistence based agriculture to commercial and competitive one has been the major strategy of agriculture in Nepal (MOAC, 2003). Agriculture development has been accepted as the major development strategy to reduce poverty, ensure food security and increase farmers' income through expanded employment opportunities. The ultimate goal of sustainable development and transformation of agriculture to commercial and competitive one cannot be obtained without active participation of farmers. Farmers group provides basic foundation for raising farmers' voice, need based planning, successful implementation of programs and mobilization of local resources. This approach is equally important in increasing access to services as well as social inclusion.

Need of the farmers' group approach

The following points emphasize the need of farmers' group approach in current and future situation in Nepal.

- Develop farmers' group as effective media for the cost effective and rapid dissemination of modern agricultural technology.
- Enhance farmers' capability through their active participation and empowerment.
- Reduce doll out dependency of farmers over government as well as other agencies/organizations and motivate towards self-sufficiency.
- Transform subsistence based farming towards commercialization, diversification and improved marketing services for increased profit.
- Make agriculture service delivery client oriented.
- Ensure farmers' right through improved negotiation and bargaining power.
- Increase net income from agriculture through reduced cost of cultivation and marketing through group and cooperative efforts.

Farmers group concept

A group consists of two or more interacting persons, who share common goals, have a stable relationship, are somewhat interdependent, and perceive that they are in fact part of a group (Paulus 1989 cited in Baron/Byrne, 1998). In Nepalese farmer's case, a farmers' group is a gathering of 20-25 farmers who are organized to achieve a common goal and are located in a specified village setting. Following features qualify the specific characteristic feature of a farmers' group.

- Common/shared goal
- Meaningful interactions among the members
- Perception of group membership
- Fate interdependence among the members
- Stable relationship among members

Farmers groups have been the dominant mechanism and serving as the media for the transfer of technology and capacity enhancement of farmers themselves. Farmers are encouraged to organize within the groups and supposed to be developed as a viable institutional unit at grass root level. They are the grass root institutions formed by farmers' participation for the development of agriculture through accelerated transfer of

technology. There are 17,113 farmers groups under DOA and 13265 farmers groups under DOLS. These groups can be categorized based on gender, commodity and nature of origin as follows.

Based on gender

i. Male farmers' groups
ii. Female farmers' groups
iii. Mixed farmers' groups

Based on nature of origin

i. Natural or self-evolved group
ii. Nurtured or motivated group

Based on commodity

Agriculture

i. Cereal production group
ii. Vegetable production group
iii. Fruit production group
iv. Seed production group
v. Beekeeping group
vi. Agrimarketing group
vii. IPM farmers' group and so on.

Livestock

i. Cow rearing group
ii. Goat/sheep rearing group
iii. Pig rearing group
iv. Poultry rearing group and so on.

Benefits of farmers groups

i) Group is a platform for sharing of information and experiences among farmers.
ii) Participation of people can be increased through group.
iii) Group increases unity among farmers through cooperation and mutual help. There is increased tendency of transforming groups into cooperative.
iv) Through groups, it is very easy to solve difficult problems which otherwise could not be solved individually.
v) Group increases confidence in the work thereby reducing dependency to outsiders. Many groups are now self reliant and engaged in different crops and animal production. They have also been found to be actively involved in farmer-to-farmer extension among the farmers in contact.
vi) Group facilitates cost effective, easy and rapid transfer of technology. It has been one of the effective vehicles for farmers to farmers (F2F) technology transfer.
vii) It increases risk-bearing capacity of farmers.

Group mobilization and strengthening

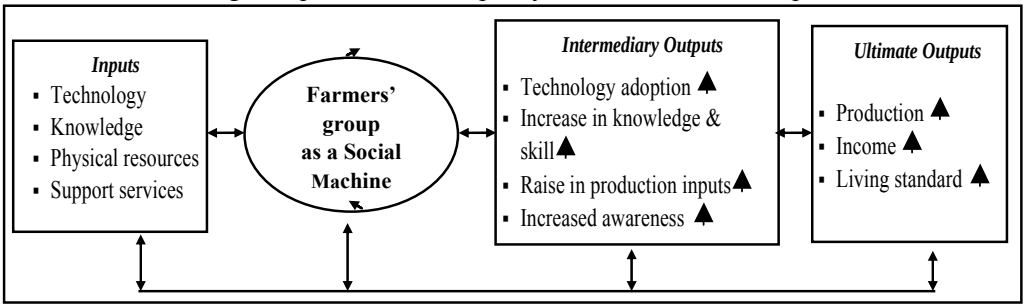
Group does not work and get success only by forming the group. It involves series of activities to accomplish the group objectives and bring about group welfare. Group mobilization involves vitalization as well as revitalization of the group. The major activities under group mobilization consist of conducting an effective group meeting, development of group constitution and its approval, welfare fund collection and its utilization, responsibility division among members, transparency of account and record management, preparation of work plan and its implementation and monitoring and evaluation of activities. Similarly capacity enhancement, transfer of need based technology, leadership development, and access of group members to service

providing agencies provide the bases for the strengthening of the group.

Group dynamism

Farmers' group is a dynamic organization. The group continuously gains short-term and long-term outputs through the use of inputs like human, economic, technical and physical resources. The group continuously works as a social dynamic machine through the interaction of inputs, intermediate outputs and group activities. There are internal and external forces in the group, which can be presented through Figure 1.

Fig 1: Input-Process-Output system in Farmers' Group



Internal as well as external forces influence the dynamism in the group. The internal forces that are within the control of the groups include group goal and objective, group size, capital resources, skill and competency of group members, feelings of unity, communication and its technique, leadership and its development, group activities and performance of the group, decision making and democratic exercise within group, members commitment towards group, and homogeneity as well as heterogeneity of the group members. The external forces contributing to group dynamism encompass the parental organization and its affiliation as well as relation with that organization, value/trust assigned to group by community, competition with other groups and organization, socioeconomic condition of the group, political consciousness and extent of technological adoption.

Policy guidelines for FGs in Nepal

The farmers' group approach has been widely accepted as the major strategy to reach the farmers and work with them. All of the agriculture and livestock extension services are provided mainly through farmers' group. In the initial stages, farmers were encouraged and motivated to form the group. However at present, besides being motivated by outsiders to unite into group, farmers have been constantly being self motivated to form groups. The Government of Nepal has internalized essence of this approach by addressing in its policy and guidelines. Some of the important policies promoting farmers to engage in groups are listed below.

- The twenty years Agriculture Perspective Plan (APP) has well internalized the concept of pocket package strategy. The pocket package strategy has well addressed the development of agriculture through intensive use of inputs in the pocket areas having infrastructures (road, electricity and irrigation) and technical potentiality of pocket to produce a particular commodity. The strategy focused the allocation of at least 60% resources through such pockets. Farmers are strongly encouraged to run the programs through group in each pocket.
- Farmers are encouraged to register the farmers group in DADO/DLSO and get their registration certificate.
- Implementation of extension and educational program like demonstration, training, exposure visit etc. are explicitly carried out through groups.
- Special provision has been made to make farmers group more inclusive. Especially the women farmers, small farmers, deprived/disadvantaged group, ethnic minority and farmers of backward areas are encouraged to participate in group. Project like Asian Development Bank (ADB) funded Crop Diversification Project (CDP) demanded participation of women and disadvantaged group by 35% and 50%, respectively within the pocket.
- ADB funded CDP made the provision of Farmers Group Coordination Committee and JICA funded Agriculture Training and Extension Improvement Project (ATEIP) emphasized the formation of Agriculture Development Committee (ADC) at village level.
- Group based small irrigation program and cooperative based irrigation scheme are one of the successful programs within DOA. Strong provision has been made by amendment of directives to run the program. Small irrigation programs are implemented through groups registered in DADO/DLSO and even through other groups. Similarly, cooperative irrigation is implemented through farmers' cooperatives registered under Cooperative Act 1992 (2048 B.S.).
- Currently, special directive and guidelines (2009) has been approved to promote cooperative farming. This highly prioritized government program focuses on the agricultural laborers, workers, small and marginal farmers and other farmers to engage in group and cooperative farming.
- Norms have been approved (2008) to attract group funds in agriculture sector and implement project on cost sharing basis.
- The community Livestock Development Project (CLDP) and Third Livestock Development Project (TLDP) has made the provision of farmers' coordination committee in rearing of goat and pig. Farmers are encouraged to come in groups of 10 and each five groups form the Farmers' Coordination Committee (FCC).
- Similarly the provision for contract farming in livestock has been made through well-defined guidelines.
- Contract farming has been enhanced through development of guidelines in livestock sector.

Status of Farmers Group in Nepal

Table 1 : Farmers groups' status, 2008

SN	Indicators	Unit	DOA	DOLS	Total
1	**Total groups**	**No.**	17074	13265	30699
1.1	Women farmers group	No.	3699	4777	8476
1.2	Male farmers groups	No.	2741	2759	5500
1.3	Mixed farmers group	No.	10634	5729	
2	**Total members**	**No.**			
2.1	Women members	No.	158433	88519	246952
2.2	Men members	No.	184400	72316	256716
3	Group welfare fund	Rs 000	256387.75	125239	381626.75
3.1	Women farmers groups	Rs 000	57632.65	N.A.	
3.2	Men farmers groups	Rs 000	28802.9	N.A.	
3.3	Mixed farmers groups	Rs 000	132083.9	N.A.	
4	**Group fund investment**	**Rs 000**			
4.1	Agriculture sector	Rs 000	100532.34	-	
4.2	Non-agriculture sector	Rs 000	27083.23	-	
5	**Groups converted into cooperatives**	**No**	**712**	-	

Source: DOAE/DOA & DOLS, 2008

Similarly, these groups are also categorized on the basis of commodity and specialization (objective) of area. The categorization of FGs of DOA shows the following figures.

Table 2 : Categorization of FGs within DOA

SN	Type	Frequency	Percent	SN	Type	Frequency	Percent
1	Vegetables	5042	29.53	11	Multipurpose	128	0.75
2	Food grains (Agronomy)	4491	26.30	12	DAG and Dalit	90	0.53
3	Fruits	1597	9.35	13	Irrigation	73	0.43
4	Industrial entomology (bee-317, mushroom-162, sericulture-81)	560	3.28	14	Agri production	58	0.34
5	Cash crops (General cash crops-74, Ginger-107, soyabean-89, Pulses-66, coffee-57, oilseeds-46, spices-38, cardamum-32, chilly-20)	529	3.10	15	Orange	34	0.20
6	Horticulture	456	2.67	16	Maize	16	0.09
7	IPM and SSMP	435	2.55	17	Market	5	0.03

SN	Type	Frequency	Percent	SN	Type	Frequency	Percent
8	Seed (seed 259, cereal seed - 31, vegetable seed-37)	327	1.92	18	Organic	1	0.01
9	Fishery	299	1.75	19	Floriculture	1	0.01
10	Potato	265	1.55	20	Others and unidentified	2667	15.62

Source : DOAE, 2008

The above figure reveals that most of groups are formed on horticultural crops especially vegetables, food grains and fruits respectively. The figures also reveal that still there are FGs which could not be categorized. These groups might have been formed as general group and lacks commodity orientation.

There has been increased number of FGs in Nepal. A short scenario of development of FGs is portrayed in the following table.

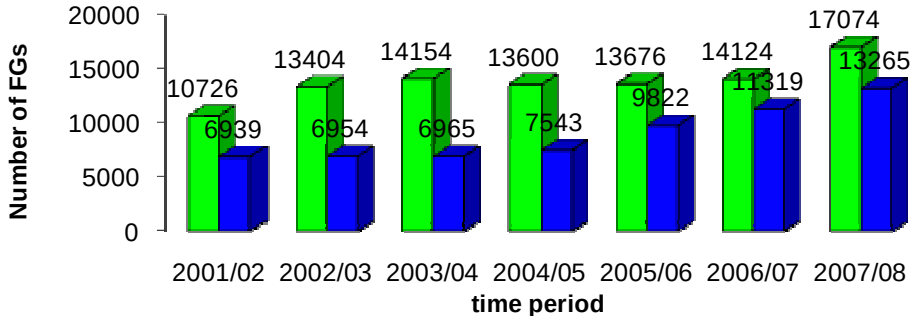
Table 3 : Development of FGs in Nepal

Indicators	Organization	2001/02	02/03	03/04	04/05	05/06	06/07	07/08
Total FGs	DOA	10726	13404	14154*	13600*	13676	14124	17074
	DOLS	6939	6954	6965	7543	9822	11319	13265

* Estimated value

Source: MOAC, DOA and DOLS

Chart 3. Development of FGs in Nepal



Source: DOAE 2008, DOA, DOLS 2008, and MOAC website

Assessment of farmers' group in Nepal

1. SWOT (strength, weakness, opportunity, threats) analysis strength

- Rapid and effective transformation of agriculture technology.
- Farmers' capacity enhancement through belongingness in group and experience sharing.
- Creation of unified and strong voice and pressure group. For example farmers' fora have been established in each district representing each farmers group in the district. They are now trying to form Regional Farmers' Fora.
- Capital formation through collection of scattered resources of farmers.
- Increase in people's participation through active involvement of farmers

Weakness

- Lack of proper knowledge, skill and experience to run the group.
- Motivation to group formation through limited benefit and collapsing.
- Increased tendency of getting personal benefits by group members.
- Increased tendency of social loafing (escaping from responsibility in group).
- Inactiveness of group and dissolution before the attainment of group goal.
- Lack of strong legal authority for group conduction.

Opportunities

- Potentiality of commercialization in agriculture, crop and product diversification and marketing.
- Cooperatization and encouragement for group and cooperative farming.
- National and international market access.
- Increase in agricultural production and productivity by utilization of farmers' capacity and experiences.
- Inclusive development ensuring participation of women deprived and disadvantaged group and youth.
- Development of farmers group as a viable and sustainable institution for delivering of agriculture extension services.
- Development of government policy to promote group and cooperative farming

Threats

- Inability to work according to the sentiment of group and cooperatives.
- Competition with other groups, cooperatives and institutions.
- Problem in access of international market and lack of clear competition.
- Production of quality products for marketing.
- Lack of guarantee for service provision to each group.

2. Outcomes of group approach in Nepal

i. Wider coverage

Previously the government services were provided through individual efforts. But, the formation and mobilization of farmers groups has largely increased the access of majority of farmers to the service of outsiders. Since farmers are organized into unified group, diffusion of technology has become effective than before the groups were formed. ABTRACO, 2007 reported that 97% of the farmers who were the members of FGs agreed on the changes in the adoption of technology after joining in groups. Similarly, there was more than 3 fold in number of FGs in five years as compared to base year (2001) in the project district of CDP (CMS, 2006). Similarly, percentage of the farmers contributing agriculture through tour/workshop/training, FFS, seed multiplication and procurement of agri-input was reported to be 79.2, 17.5, 50.8, and 53.3%, respectively.

ii. Capacity enhancement of farmers

Farmers are being trained on technology as well as group mobilization. The training has been successful in imparting the knowledge and skill among farmers. It is found that 69% of farmers from group received technical training. However, percentage of farmers receiving training on organizational aspect is reported to be 26 (ABTRACO, 2007). Farmers from all most all groups have been trained. The same study reported that increase in knowledge to some extent to more extent in management; leadership quality and technical know-how were 50, 47.6, and 93 percent, respectively.

iii. Leadership development

Leadership is the quality of individual to influence others to achieve objective of organization. Farmers have developed leadership both in technical skill as well as group mobilization through training, skill development, farmers' field school etc. IPM FFS is an effective example where farmers have well demonstrated their leadership in Nepal.

iv. Farmers empowerment

Farmers have been empowered through the groups. It provides appropriate platform to raise their voice and opportunity to unite. RAD, 2007 reported that 84.2% of the FGs have been formed by the motivation of Agriculture Service Centre and DADOs. Currently, farmers are being organized through coordination committee of the farmers groups. They are being motivated to form trade union of farmers to raise their voice. Moreover, their linkage and coordination has also been expanded. ABTRACO (2007) reported that 58% of the farmers groups have linkage and coordination with NGOs.

v. Welfare fund (WF) formation utilization

One of the prominent outcomes of the farmers group is the formation of capital especially group fund. A study on management of farmers' group welfare fund in the project area of CDP reported that mostly FGs have raised fund monthly with 5-100 Rs/head/month. The fund is utilized to full fill personal and group need. The study found that range of utilization as loan by members ranged 100-50000 per head. The major sectors of WF utilization were crop (39.9%), agri-input procurement (11.5%), HH expenses (10.7%), livestock sector (9.6%), education, health and social services (10.9%) and others (2%) and only 15.3% were not utilized (CMS, 2006). ABTRACO (2007) reported that 85% of the group had fund less than Rs 50 thousands followed by 9% of the group with 50,000-10,000 and 5% of group having more than Rs 0.1 million. The figure clearly indicates the collection of welfare fund and its mobilization for income generating activities within agriculture.

vi. Resource mobilization

Farmers groups have equally been found successful in the mobilization of their human resources, labor, skills and their expertise in the agriculture and social sectors. The capacity enhancements of the farmers have been found effective in the effective utilization of the resources.

vii. Peoples participation and ownership

Farmers' participation has been increased in agriculture development through groups. IPM FFS, implementation of small irrigation and cooperative irrigation are the areas where farmers have contributed encouraging participation. It has been equally effective in raising the ownership of program.

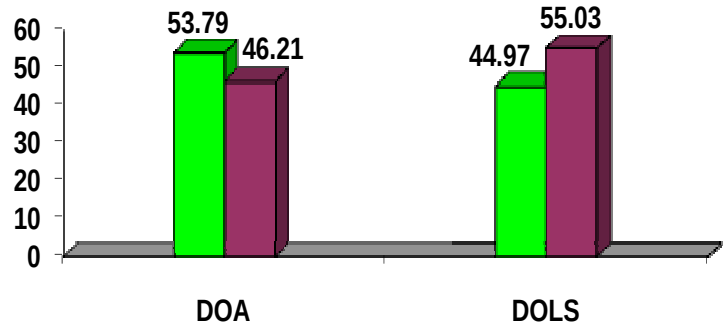
viii. Increased income

The impact study by ABTRACO (2007) revealed that farmers income have been raised by Rs 31,614 at 2006. The income of farmer is as high as Rs 42,986 in 2006 from vegetable, followed by crops and fruits crop. Moreover, 71% farmers reported their increased income by less than 20%, 21 % reported 20 to 40% increase in income 8% reported increase in income by 40-80% and only 1% reported increase in income by more than 80% after joining in groups.

ix. Social inclusion and enhanced gender participation

The group has ensured the social inclusion of deprived, disadvantaged, ethnic minorities, women and backward areas through policy guidelines. It has increased the access of those categories for support and services.

Chart 4. Genderwise participation of farmers (percent) in group, 2008



Source: DOA & DOLS, 2008

Similarly, the participation of female members in the FGs was reported to be 62.2% in the study of study of management of farmer group's welfare fund in the project area. Similarly, female and disadvantaged group in executive level shared 50.8% and 37.7% respectively (CMS, 2006).

Factors responsible for hindering the success of the group

- Group formation motivated by fulfillment of personal needs and desires.
- Ignorance of social, economic and linguistic and religious aspect during group formation.
- Lack of knowledge regarding group mobilization/management.
- Lack of workplan, program implementation, monitoring and evaluation.
  - Lack of workplan
  - Inability to work as per workplan if any.
  - Lack of systematic and effective monitoring and evaluation system.
- Inadequate resources to mobilize the group.
- Lack of transparency (distribution of resource, decision making, balance of power).
- Low level of commercialization and professional specialization.
- Other factors.
  - Lack of complete legitimacy for groups.
  - Poor risk bearing capacity of farmers groups.
  - Political pressure within the groups.

Improving farmers group for better performances

Group vitalization/revitalization

Farmers groups are formed both through self-motivation as well as through external intervention. Such groups formed by interventions rarely run in a sustainable way and tend to disappear as soon as the facilities are pulled back from supply side. This problem can be managed by forming the coordination committee of farmers group and programs can be implemented through these committees. Groups should

not be formed as a target but farmers should be motivated in such a way that they self evolve as a new group. Following points should be considered as bases for the formation of farmers group.

- Potentiality of agriculture commercialization and diversification.
- Farmers' real need, interest and commitment.
- Number of farmers, cooperatives and community based organizations already present in the community.
- The number of the farmers to be served.
- The socioeconomic and physical resource availability.
- Representation of real farmers in the group.
- Social inclusion specially participation of deprived/underprivileged group, ethnic minorities, women and backward areas.

Role of facilitators in group mobilization

The philosophy of helping people to help themselves of agriculture extension fits well in group. By working in group, members of community better know the problems and solution and they are able to find solution with little external facilitation. The facilitator should create an environment to help farmers to form the group. They should not impose any pressure or create influences over them. Their role should be confined on the importance and need of group rather than directly forming groups. However, their role of facilitators changes according to development stages of group. The demand for specific role is varied according to development stages of the group as follows.

Table 3 : Managerial role and appropriate leadership role with development stage

SN	Group development stage	Managerial role	Appropriate leadership style
1	Forming stage	Directive	More directive Less supportive
2	Storming stage	Coaching/Influencing	More directive More supportive
3	Norming stage	Supporting/Facilitating	Less directive More supportive
4	Performing stage	Delegating	Less directive Less supportive

Responsibility sharing

Role, responsibility and authority of executive body should be well defined in group constitution. An ambiguity in role may invite conflict within group.

Group meeting

Group meeting is the main group activity where farmers discuss, debate and decide the group work. The meeting is an important component of group performance. It provides an open forum to increase knowledge, share experiences and resolve conflict. Comparing with mathematical signs as presented below may summarize the output and importance of group meeting.

Table 4 : Activities and outcomes of the group meeting

Symbol	What happens	In what	Result
+	Addition	Opinions	Increase in knowledge and experience
_	Minus	Differences	Conflict minimization
×	Multiplication	Group Unity	Group unity strengthened
÷	Division	Responsibility	Role clarity
=	Equal	Right	Demorctatcic exercise
%	Percentage	Dividend	Increased investment in group
?	Question	Working modality/Existence	Improvement/dissolution

The major weaknesses found in the FGs meeting are inadequate preparation, lack of discussion and decision on a sequencing order, lack of transparency in decision and poor implementation of group decision.

Group constitution

Group constitution helps to bind members in discipline, provide group with legal authority and maintain tripartite power balance among executive body, general assembly and group members. There is flexibility regarding mandatory requirement of constitution for group. However, constitution is mandatory for cooperatives for registration.

Group welfare fund and its mobilization

Farmers use the group welfare fund to solve their personal and group financial needs. It acts as the binding and motivating force for the group. Moreover, it has increased self-reliance and reduced dependency of members over financial institutions.

The major sources of fund include entry fee, regular levy, subsidy available, interest from capital, fine, cash earning from group activities like group farming, cultural program and fixed portion of amount received by the members in their participation in extension program as decided by the group.

The major advantage of the group fund is that it has increased attraction towards group. However, some groups have been facing management challenges like skill deficiency, lack of awareness on fund management, poor accounting and record keeping system, technical and logistic support on WF. There is need for flexible, efficient and responsive financial operation mechanism and skill development of FGs executive members. The potential sectors identified for GF mobilization were irrigation, improved agriculture practice, production of vegetable and cash crops, small business and micro enterprises capacity building, off-season vegetable production. The GFs could also be utilized in infrastructure, agro-vet facility and child education (CMS, 2006). Similarly, 60% of the farmers used their WFs within their groups (RAD, 2007).

Strategic norms and policy has been developed and executed to attract group fund in income generating activities through agriculture on cost sharing basis based on need and demand of farmers'

group. Farmers are being trained regarding overall management and account keeping.

Group conflict and management

The group conflict arises due to differential attitude and views, competition among members, group resource, and its distribution and utilization, decision-making process, group conformity and obedience, ambiguous role and norms. Farmers group should be made aware regarding conflict as an inevitable force. There are two types of conflict intentional and unintentional conflict. Intentional conflict may create tension in group. Open discussion, collaboration, clarification of role and norms, economic transparency, democratic exercise, negotiation and discussion can minimize the conflict and mitigate their negative impact.

Workplan and implementation

The major component to activate group is preparation of annual plan and implementation. It helps to identify project, resources, and division of work, work plan, monitoring and evaluation of the group performance.

Monitoring and evaluation

Participatory monitoring and evaluation is emphasized in the group. It helps to improve learning and create ownership among group members.

Group revitalization

Group is dynamic social institution. The challenges and problems are not the same for every group. It changes over time as environment at which group work is changeable. So for the vitalization of the group, training, capacity enhancement of member, relation with other organization, collaboration and sharing of information should be emphasized.

The study of FGs effectiveness in central region found that 73.3% of the farmers demanded provision of group management training, 67.5% reported provision of improved seeds/saplings, 55.5% reported in-country and abroad training and 51.6% reported mobilization of WF for making FGs more effective (RAD, 2007).

Cooperatization

FGs should be mobilized and motivated to change into cooperatives. The development of FGS into cooperative enables farmers for improved farming, commercialization and creates the environment of self-help. Furthermore, the transformation of FGs into cooperative ensures the legal status of the farmer's institution. Cooperatization should be done on maturity of farmers, potentiality commercialization, diversification and entrepreneurship development and possibility of integrating FGs into one institution. Total number of cooperatives in Nepal is accounted to be 2591 of which only. These comprise of multipurpose 1276, milk 642, saving and credit 511, agriculture 46, coffee 10, users' cooperative 70, small farmers 25, tea 8 and other cooperatives 5. The number of cooperative in Nepal is low as compared to effort made (DOC, 2007).

Major problems and issues

Following are some problems and issues regarding FGs in Nepal.

i) Farmers are being organized in groups spontaneously as well as through

intervention. It is encouraging, though mushrooming of farmers group has increased pressure over government agencies and challenged the quality of service delivery even through groups. RAD, 2007 reported that FGs have also been formed only for getting facility of small irrigation and remained passive after the project.

ii) Group success depends on the management and its mobilization. Front line extension workers, especially JT/JTAs are in direct contact with FGs. So the issues of social mobilization of these staffs should well be considered.

iii) Because of success of groups, there is increased tendency of group formation by multiple agencies. It has created duplication in one side whereas others are still deprived from getting opportunities to be organized into groups.

iv) Multiple memberships are another problem raised because of duplication of group.

v) There is still ambiguity regarding clarity of group orientation whether to prioritize agriculture group based on commodity or community. Heterogeneous memberships are not appropriate for commodity groups.

vi) Though the groups are registered and honored as valid organization. Still, there is not strong legal authority to farmers groups. The issue of legitimacy should be well defined. However, farmers cooperative receive strong legal authority defined by law.

Recommendation/lesson learnt

Based on the experiences and lessons learnt, following recommendations can be made to mobilize group more effectively in future.

i) Farmers should be encouraged on need and importance of groups such that groups are established spontaneously. Farmers should be encouraged to discuss openly before forming the group. Village level agriculture assistant (VLAA) and Para-veterinarians trained through government and private agencies should be utilized to mobilize groups. Similarly, social mobilization skill of the technical staff should be imparted to mobilize group more effectively since they are in direct contact with group.

ii) Registration of farmers groups should be accompanied by profiles and formal constitution. Legitimization of farmers groups should be ensured through legal assurances like water users association, community forestry groups.

iii) The participation of women and youth is encouraging in group. Participation of women is reported to be 46% (DOAE/DOA, 2008) and youth (20-35 years age group) is reported to be 49% (ABTRACO, 2007). This indicates that women and youth can be better mobilized in agriculture sector through groups.

iv) Groups should be encouraged to promote linkages and coordination with other groups, NGOs and related organizations in order to share experiences as well as get support

from them. Traditional and nonformal groups should also be taken into account.

v) Command area of the group should be well defined. Duplication in group formation by multiple agencies should be eliminated. Likewise, multiple memberships of the farmers in the group should be avoided. Policy should address the provision of services of each service provider to groups.

vi) The issue of group orientation whether commodity oriented or community oriented should be well defined. Commodity orientation demands qualified members based on commodity whereas social inclusion is a concern in community orientation.

vii) Efforts should be made to raise the welfare fund and mobilize effectively. Farmers should be motivated to invest in income generating activities on cost sharing basis.

viii) There is tendency of formation and dissolution before objectives are attained. Training and management support should be ensured for the groups for better performances. Farmers tend to stay in group for economic and social benefit. So, more income generating activities within agriculture should be explored and promoted through groups.

ix) Intervention of Information and Communication Technology (ICT) should be promoted in progressive group to boost up farm business. Frequency Modulation (FM) radio, newspaper should be utilized to transfer technology at local level and access of groups over different media should improved.

x) Initiation of IT system should be done in the progressive farmer's groups. This is a quick and cost effective system by which the farmers in the groups can tremendously increase their business. In this context, the local media particularly FM should be utilized by the group both as a source as well as a receiver for the messages.

xi) Opportunity of international observation tours to members of deserving farmers group also help to improve the effectiveness & efficiency of FGs.

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Abbreviations and Acronyms

ABTRACO	Agribusiness Trade
ADC	Agriculture Development Committee
ADC	Asian Development Bank
AEP	Agriculture Extension Project
APP	Agriculture Perspective Plan
B.S.	Bikram Sambat
CDP	Crop Diversification Project
CLDP	Community Livestock Development Project
CMS	Consolidated Management Services
DOA	Department of Agriculture
DOC	Department of Cooperatives
DOAE	Directorate of Agriculture Extension
DOLS	Department of Livestock Services
F2F	Farmers to Farmers
FFS	Farmers Field School
FG	Farmers Group
FGC	Farmers Groups Coordination

FGCC	Farmers Groups Coordination Committee	JTA	Junior Technical Assistant
FM	Frequency Modulation	MOAC	Ministry of Agriculture and Cooperatives
GF	Group Fund	NA	Not Available
ICT	Information and Communication Technology	NGO	Non Government Organization
IPM	Integrated Pest Management	TLDP	Third Livestock Development Project
JICA	Japan International Cooperative Agency	VLAA	Village Level Agriculture Assistants
JT	Junior Technician		

Methodology for the Assessment of Training Needs of Front Line Extension Workers of Nepal

Rabindra Bahadur Pradhan♣

For effective training, a training program must model in such a way that it could meet the current needs of the trainees. Therefore, this study was conducted to identify training needs of Front Line Extension Workers (FLEWs) in District Agriculture Development Offices (DADOs) Kavre, Lalitpur and Chitwan districts. Personal interviews through pretested questionnaires were employed to collect the data to find out the training needs, determine the relationship between personal factors and level of training needs and the constraints that affect job performance. From the data, training needs of each respondent in each question was rated in four-point scale. The total individual score and the item score were calculated. Training Need Score (TNS) was calculated by dividing the total score obtained by a respondents with the number of question. Higher value of TNS indicated higher training need. The respondents were classified into two categories such as high and low level of training need on the basis of mean TNS. The personal factors were analyzed through statistical tool called chi-square test and the constraints that affect job performance of FLEWs were analyzed through frequency and percentages. The most important area for training was horticulture specific. Overall training needs of respondents ranked were organic farming, seed quality control, WTO and role of agriculture etc. The relationship between age, post and job experience in Department of Agriculture with TNS were found non significant. It means these background factors had no relationship with their training need. However, relationship between education with TNS was found significant. It means the background factor i.e. education had relation with their training needs. They expressed that inadequate budget, coordination and appropriate policies were the serious problems to apply the knowledge and skills learned from training. Majority of the respondents expressed that trainings should be organized one month prior to implement the programs.

Key words : Front Line Extension Workers, training needs, training need score, personal factors.

Introduction

1. Background

The government has given top priority to agricultural development in each plan period. However, the growth of agriculture sector has been very poor. The agricultural GDP growth rate was 2.8 percent in 2004/05 (MOAC, 2005). There are several factors responsible to sluggish agricultural growth. In Nepal, the Departments under the Ministry

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of Agriculture and Cooperatives (MOAC) primarily runs agricultural extension programs. The Agricultural Prospective Plan (APP) of the country has formulated well defined agricultural strategy in 1995/96 A.D. for the period 1997 to 2017 A.D. The strategy continues to emphasis on cereal production in Terai, horticultural production in the mid-hills, and livestock production in the high hills and proposes to focus on the areas of higher production potential for higher level of investment.

For promoting agricultural development program, training of extension workers are necessary. At present there exists a very wide gap between central policies, latest scientific knowledge and information available and the extent to which the these are being utilized. With a view to bridge up the gap, it is necessary to expose the extension workers to new knowledge and information and also to create situations in which it will become possible to utilize the scientific and technological advancements.

2. Statements of the Problem

Continuing education is extremely felt in the case of extension service, which deals with people, either as individuals or in groups, young or adult, farmer or non-farmer. Working with people makes extension a no ordinary task. Attitudes, concept and techniques cannot remain rigid or static when the people and the subject matter with which the extension personnel deals with change rapidly. The extension personnel must not only be up-to-date with technology generated by research institutions that can be transferred to his/her clientele who operate in given social, economic and political environments. This would mean broadening his/her outlooks and this in turn will increase the complexity of the management of the extension process. As new elements are added into the process, management problems become more complex. Considering all these, most extension personnel will need to be trained if they were to be effective in their work.

Furthermore, organizations also believe that placement of a proper person in proper job creates a favorable working environment that will most nearly ensure the success of an organization. Agricultural Training Directorate (ATD), Regional Agriculture Training Centres (RATCs) and the project under Department of Agriculture (DOA) have organized training programs for Subject Matter Specialist (SMS) and Junior Technicians/Junior Technical Assistants (JT/JTAs) of the front line extension workers. In Nepal whether they are private or government organizations, performances of trainings and importance of training for the better output of the organization is not well considered. Outputs from the training are lower than expected (Regmi, 2000). It seems far behind in developing the employees' productivity as per the need of civil service holder of DOA. Basnyat (1993) stated that training is effective, relevant and appropriate if training needs have been carefully assesed.

Hence, this research study tries to investigate following problem by interviewing FLEWs who are working under DADO in Kavre, Lalitpur and Chitwan districts.

1. What are the felt training needs of FLEWs on existing situation?

2. What is the relationship between different independent variables (age, education level, working station, service experience etc.) with training needs?
3. What are the major problems faced by FLEWs to utilize the knowledge and skills learnt during the training?

3. General Objective:

The general objective of this study is to assess the training needs of the FLEWs, who are working at the District Agriculture Development Offices. The specific objectives of this study are to :

i. find out training needs of FLEWs;
ii. determine the relationship between personal factors (service period, education level, age, parental occupation, residential status etc) and level of training needs of FLEWs; and
iii. determine the constraints that affect job performance of FLEWs.

Review of Literature

Information is a vital resource, conferring advantage on those able to make intelligent use of it. The cumulative nature of research information makes effective retrieval and use of information a cornerstone of a quality research. The literature review provides the researcher with the knowledge of the status of their field of study.

1. Training

Dangol (2004) defined that training is a means to educate a person so as to be fit, qualified and proficient in doing a particular job. It is an essential part of extension work in order to develop competence of clients. Training is sequential activity demanding systematic planning, execution and follow-up. 'Training' and 'education' though look alike, both are learning processes, but they differ. Education is vertically focused as it aims to prepare people for future roles whereas training is meant to provide knowledge and impart skills which people can apply in job. Education is concerned with the acquisition of knowledge, attitude and skills needed for performing a job while training refers to all sorts of acquisition with or without pre-specified purpose or job to be done. Content of training are focused on the immediate needs at the work place.

Strayton (1986) cited in Dangol (2004) defined training as the acquisition and development of those knowledge, skills, techniques, attitudes and experiences, which enable an individual to make his most effective contribution to the combined efforts of the team of which he is a member.

Singh and Misra (1996) stated that training is a planned communication process for manpower development by improving knowledge, skills, attitude and other behavioral aspects in accordance with the job requirement for better performance of extension personnel. Knowledge can be gained through books, periodicals, journals, leaflets, films,

radio, television and other mass media. However, the skills can be learned and acquired only through training, practice and working with the professionals.

2. Assessment of Training Needs

Dongol (2004) explained that assessment of individual needs for training is first step toward designing courses relevant to participants and their organizations. Training needs refer to the gap in individual's current level of abilities and those desired to perform a job effectively. Training needs are expressed in terms of gaps or deficiencies in attitude, knowledge or skills. In other term, a need is a deficiency between 'what is' and 'what ought to be'.

When needs are made explicit they are known as training needs. The process of making them explicit is called Training Needs Assessment (TNA). It is not easy to assess training needs. Training needs exist at various levels, and different groups involved in training have different perceptions.

Moreover, they can be expressed in a number of ways. For example, where are the needs for training? Who have those needs? What are the needs? Despite the difficulty, training needs must be assessed as this is the first critical step in the training process.

All the authors and researchers agree that training should be conducted according to the interest and needs of trainees in order to achieve a successful transfer of technical knowledge and skills to the farmers and extension worker. If the training is not oriented to the needs and problems of the trainee, there will be wastage of resources and it can create frustration. Good assessment will assure that scarce resource go to the people with greatest need.

3. Purposes of Training Need Assessment

Basnyat and Pant (1993) explained that assessment of training needs is the base for the whole training process. The following describes why such an assessment should be undertaken during the planning phase of training.

- To provide training to those who really need training (right person right course).
- To identify the deficiencies in an individual job performance in terms of both training and non-training needs.
- To provide a context or background for planning the training function-designing training goals/objective/policies/strategies, etc.
- To determine the objectives, focuses, contents and methods of individual training courses.
- To make training relevant and appropriate as to the requirement of concerned organization and participants.
- To prioritize the training needs and conduct training on a priority basis if the needs cannot all be fulfilled at one time.
- To make the best utilization of the resources available for training by concentrating on the area most needed.
- To form a basis for evaluating the outcome of training efforts.

Training activities that have no need assessment or with an ill-designed assessment process can hardly have any positive results. Thus, it is important here to know how the training needs should be assessed.

Research Methodology

A sample survey design of research was used for this study. The methodological aspect includes selection of research site, instrument development, operational definition of the terms, data collection and methods of analysis.

1. Research Population

The FLEWs, who are involved in government service and working at DADO, Chitwan, Kavre and Lalitpur served as the research population.

2. Location of the Study

The present study was carried out in the Kavre, Lalitpur and Chitwan districts of Nepal.

3. Sampling Procedure

The population list was obtained from District Agriculture Development Offices of Kavre, Lalitpur and Chitwan districts. The names of FLEWs were collected. The data were collected from the 55 respondents among the FLEWs working in three districts.

4. Research Instrument

The data for the study were collected by questionnaire method. Reports of previous research studies were consulted and discussion was held with the related persons before preparing the questionnaire. The questionnaire includes both close-ended and open-ended questions.

The questionnaire was pre-tested with the FLEWs working in DADO, Bhaktapur. The purpose of pre-testing was to find out whether there were any ambiguities, complications or inadequacies in the questionnaire. It also served to check whether the instruments used for data collection needed any modifications so as to make it more valid as well as reliable one.

5. Data Collection and Analysis

After pre-testing, the questionnaire was revised according to the suggestions and comments. Data were collected separately from the FLEWs such as SMS and JT/JTAs of District Agricultural Development Offices of Kavre, Chitwan and Lalitpur districts.

The training needs score of each respondent in each question were rated in four-point scale (4 = highly needed, 3 = partially needed, 2 = needed, and 1 = not needed). Total individual score and item score were calculated. The score for training needs was calculated by

dividing the total score obtained by a respondent with the number of questions as given below.

$$\text{Training needs score} = \frac{\text{Total score obtain by a respondent}}{\text{Number of questions}}$$

Level of training needs : Lastly level of training needs was determined in two levels on the basis of mean of the training needs score. The level of training needs are as follows.

Training need score	Level of training need
2.94 to 4	High
0 to 2.93	Low

Higher the value of training needs score higher would be the training need.

The collected data of personal factors was analyzed through statistical tools such as chi-square test by using SPSS and Microsoft Excel software packages. Constrains that affect job performance and other related aspects of trainings were calculated by frequency and percentage.

Result and Discussion

The data were gathered by using a questionnaire method. Training needs of each respondent in each question was rated in four-point scale from the data. After tabulating the data, the total individual score and the total individual item score were calculated. The TNS was calculated by dividing the total score obtained by a respondents with the number of question. Higher value of TNS indicated higher training needs. On the basis of mean training need score, respondents were classified into two i.e. high and low levels of training needs. The personnel factors were analyzed through statistical tool called chi-square test and the constraints that affect job performance of FLEWs were analyzed through frequency and percentages. The results of the data analysis had been presented in this section.

1. Background Factors of FLEWs

Prior to discussing the major findings on training areas and training needs of FLEWs, it was desirable to give a brief description about their background. Their background information can be summarized as below.

Age is the important characteristic of FLEWs, which indicates their maturity. Table-1 showed that out of 55 respondents, 35 were 43 and less than 43 years old, termed as adult age group followed by 20 were more than 43 years old, termed as old age group. Average age of the respondents was found 43.15 years with 4.89 standard deviation. The range of age was 25 and found between 31 - 56 years.

Table 1 : Age distribution of the FLEWs.

Age category	Frequency of FLEWs				
	Kavre	Lalitpur	Chitwan	Total	Percent
Adult (43 and less than 43)	15	9	11	35	64
Old (More than 43 years)	5	10	5	20	36
Total	**20**	**19**	**16**	**55**	**100**
Mean = 43.51, Standard Deviation = 4.89, Range = 25, Mim. = 31, Max = 56.					

Table 2 : Working station of the FLEWs

Working station	Frequency of FLEWs				
	Kavre	Lalitpur	Chitwan	Total	Percent
DADO	11	14	8	33	60
ASC	9	5	8	22	40
Total	**20**	**19**	**16**	**55**	**100**

The working station of the respondents is an important factor that influences the training need. Table 2 showed that out of 55 respondents, 33 of the respondents worked at District Agriculture Development Office followed by 22 of the respondents worked at Agricultural Service Center under DADO.

Table 3 : Posts of the FLEWs

Post	Frequency of FLEWs				
	Kavre	Lalitpur	Chitwan	Total	Per cent
SMS	4	3	6	13	24
JT	8	5	4	17	31
JTA	8	11	6	25	45
Total	**20**	**19**	**16**	**55**	**100**

The duty and responsibilities differ according to the post. The training need was influenced according to their post. Tables 3 showed that out of 55 respondents, 25 were JTAs followed by 17 JTs and 13 SMSs.

Total 4 : Educational level of the FLEWs (2005)

Education level	Frequency of FLEWs				
	Kavre	Lalitpur	Chitwan	Total	Per cent
SLC	8	7	3	18	33
Intermediate	3	4	4	11	20
Graduate	8	7	8	23	42
Master	1	1	1	3	5
Total	**20**	**19**	**16**	**55**	**100**

Education helps people to acquire knowledge and skills to perform his/her work effectively. Commonly it is assumed that the higher the education a person has, the higher is the level of knowledge and his/her jobs performance. So, their training needs also differ according to their educational level. The educational levels of the respondents varied from SLC to master degree. Out of 55 respondents 23 had graduate level of education followed by 18 of SLC, 11 of intermediate and 3 master level of education.

Table 5 : Service experience of the FLEWs (2005)

Service experience	Frequency of FLEWs				
	Kavre	Lalitpur	Chitwan	Total	Per cent
18 and less than 18 years	10	7	12	29	53
More than 18 years	10	12	4	26	47
Total	**20**	**19**	**16**	**55**	**100**
Mean = 18.04 years	**Standard Deviation = 7.29**		**Max = 33 years**	**Min = 3 years**	

Service experience of the FLEWs is an important character, which indicates their maturity. Table 5 showed that out of 55 respondents 29 belonged to 18 and less than 18 years of service experience followed by 26 of more than 18 years service experience. Average service experience of the respondents was 18.04 years with 7.29 standard deviation. The range of service experience was 30 and found between 3 to 33 years.

2. Important Training Needs of Specific Topics

Training Needs Score (TNS) of the FLEWs was measured through a well-structured questionnaire. Fifty questions were asked about the different packages separately. Each question had 4,3, 2, and 1 marks for highly needed, partially needed, needed and not needed respectively. The total score obtained by FLEWs calculated and training need score were calculated in different packages i.e. extension specific, crop specific, horticulture specific, plant protection specific, planning specific and miscellaneous specific. On the basis of the mean TNS (i.e. 2.93) respondents were classified into high and low level of training need.

Table 6 : TNS and level of training need of extension specific training

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Group formation process	3.05	3.16	2.94	3.05	H	II
2. Group management process	3.15	3.11	3.00	3.09	H	I
3. Group regulation	2.95	3.11	3.06	3.04	H	III
4. Training about cooperatives	3.25	2.68	2.50	2.84	L	VI
5. Group leadership development	3.20	2.84	2.76	2.95	H	V

6. Training about teaching methods	2.80	3.11	3.13	3.00	H	IV
7. Agricultural fair/exhibition	1.95	2.47	1.69	2.05	L	VIII
8. Communication process	2.85	2.74	2.75	2.78	L	VII
Mean score	2.90	2.90	2.74	2.85	L	

Table 6 showed that the maximum importance had been given on the topic of group management process followed by group formation process, group regulation and gave least importance on agriculture fair/exhibition and communication process in the extension specific training. However, group formation process, group management process, group regulation, leadership development and training about teaching methods had high level of training need and training about cooperatives, agriculture fair/exhibition and communication process had low level of training need. Overall mean score of extension specific topics has 2.85, which means low level of training needs. It means that majority of the respondents wanted only refreshment trainings about the extension specific topics.

Table 7 : TNS and level of training need of crop specific training

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Cultivation practices of improved varieties of cereal crops.	3.05	2.89	3.00	2.98	H	II
2. Cultivation practices of improved varieties of oil seed crops.	2.95	2.58	3.19	2.89	L	III
3. Cultivation practices of improved varieties of pulse crops.	2.70	2.68	3.06	2.80	L	V
4. Seed production techniques of cereal crops.	2.95	2.95	2.69	2.87	L	IV
5. Seed production techniques of oil seed crops.	2.65	3.05	2.63	2.78	L	VI
6. Seed production techniques of pulse crops	2.70	2.95	2.56	2.75	L	VII
7. Seed quality control	3.50	3.42	3.44	3.45	H	I
8. Crop cutting methods	1.95	1.95	1.88	1.93	L	VIII
Mean score	2.81	2.81	2.80	2.81	L	

Table 7 showed that the maximum importance had been given on the topic of seed quality control followed by cultivation practices of improved varieties of cereal crops, oil crops and gave less importance on crop cutting methods. The respondents needed high level of training in seed quality control and low level of training need on other topics. It means they have knowledge about crop specific topics whereas they needed high level of training like seed quality control.

Table 8 : TNS and level of training need of horticulture specific training

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Seed potato production technique	3.35	3.16	3.31	3.27	H	III
2. TPS production technique	3.15	3.16	3.38	3.22	H	V
3. Vegetables seed multiplication	3.15	3.11	3.44	3.23	H	IV
4. Vegetable production technique	2.75	2.89	3.06	2.89	L	VIII
5. Off-season vegetable production technique	3.10	3.16	3.31	3.18	H	VII
6. Hybrids seeds of vegetables production.	3.25	3.21	3.63	3.35	H	II
7. Nursery management	2.95	2.84	2.31	2.73	L	X
8. Orchard management	2.65	2.53	2.44	2.55	L	XI
9. Post harvest techniques of fresh vegetable	2.80	2.79	2.94	2.84	L	IX
10. Post harvest techniques of fruits	3.25	3.00	3.38	3.20	H	VI
11. Organic farming	3.50	3.47	3.50	3.49	H	I
Mean score	3.08	3.03	3.15	3.08	H	

Table 8 showed that the maximum importance had been put on the topic of organic farming followed by hybrids seeds of vegetable production, seed potato and True Potato Seed (TPS) production techniques, vegetable seed multiplication and gave less importance on the topic of orchard and nursery management. High level of training needs on hybrids seeds of vegetables, seed potato production technique, TPS production technique, vegetable seed multiplication, off-season vegetable production technique, post harvest techniques of fruits and low level of training need on nursery management, orchard management and post harvest techniques of fresh vegetables. The mean of TNS was 3.08 (high). It means that the respondents wanted more training on horticulture specific topics because higher the TNS meant higher need of training.

Table 9 : TNS and level of training need of plant protection specific training

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Integrated pest management	3.30	3.21	3.50	3.33	H	I
2. Sprayer maintenance	1.95	1.79	1.63	1.80	L	IX
3. Identification and control measure of pest management in food crops	2.75	2.95	2.69	2.80	L	VII
4. Pest management in fresh vegetables.	2.90	2.89	2.88	2.89	L	V
5. Pest management in fruits	2.80	2.84	2.81	2.82	L	VI
6. Post harvest techniques	3.05	3.00	3.31	3.11	H	II
7. Mushroom cultivation	3.20	2.84	3.00	3.02	H	IV
8. Beekeeping	3.15	2.84	3.13	3.04	H	III
9. Sericulture	2.30	2.68	2.56	2.51	L	VIII
Mean score	2.82	2.78	2.83	2.81	L	

Table 9 showed that the maximum importance had been given on the topic of integrated pest management followed by post harvest techniques, beekeeping and mushroom cultivation and gave less emphasis on sprayer maintenance and sericulture. High level of training need on integrated pest management, post harvest techniques, mushroom cultivation and beekeeping and low level of training need on pest controls in different crops, sprayer maintenance and sericulture. Overall mean TNS of plant protection was 2.81 (low). It means the respondents needed least training on plant protection specific topics. But, they needed more training on the topics like integrated pest management (3.33) and post harvest techniques (3.11) because higher the TNS meant higher need of training.

Table 10 : TNS and level of training need of planning specific training.

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Program planning process	3.30	3.21	3.19	3.24	H	I
2. Program monitoring and evaluation	3.15	3.05	3.44	3.20	H	II
3. Participatory rural appraisal (PRA)	2.85	3.00	3.06	2.95	L	V
4. Problem census and problem solving (PCPS)	2.70	3.10	3.00	2.93	L	VI
5. Record keeping	3.30	2.79	2.75	2.96	H	IV
6. Data collection methods	3.15	2.89	2.81	2.97	H	III
Mean	3.08	3.01	3.04	3.04	H	

The most important one among them was program planning process followed by program monitoring and evaluation, data collection methods, record keeping and less emphasis given on problem census and problem solving participatory rural appraisal. High level of training need on program planning process, program monitoring and evaluation, problem census and problem solving, data collection methods and low level of training need on participatory rural appraisal. Overall mean of TNS of planning specific training was 3.04 (high). It means that the respondents wanted more training on planning specific topics.

Table 11 : TNS and level of training need of miscellaneous training

Area or topic for training	Training need score				Level of training need	Rank
	Kavre	Lalitpur	Chitwan	Total		
1. Projectization	3.10	3.37	3.31	3.25	H	IV
2. Contract out program	3.10	2.95	3.25	3.09	H	VI
3. Participatory programming	3.10	2.84	3.44	3.11	H	V
4. Gender	1.90	2.16	1.69	1.93	L	VIII
5. Sustainable agriculture	3.40	3.32	3.50	3.40	H	I
6. Environment pollution management	3.30	3.32	3.50	3.36	H	III
7. Decentralization	2.65	2.58	2.19	2.49	L	VII
8. WTO and role of agriculture	3.25	3.32	3.63	3.38	H	II
Mean	2.98	2.98	3.06	3.00	H	

Under this category of topic sustainable agriculture, WTO and role of agriculture, environment pollution management, participatory programming, projectization and contract out program got high level of training need and low level of training need on gender decentralization. Table 11 indicates that FLEWs had more need on knowing recent developed techniques based on current issues.

3. Areas of Important Training Needs.

The TNS of each of 50 items as well as the major areas were worked out as discussed earlier in the chapter on methodology. Table 15 presents the TNS and mean TNS values of major areas assigned by FLEWs of different districts.

Table 12 : Ranking of mean TNS values of major areas of different districts

Major areas	TNS value			Mean TNS value	Ranking
	Kavre	Lalitpur	Chitwan		
Extension specific training	2.90	2.90	2.73	2.85	IV
Crop specific training	2.81	2.81	2.80	2.81	V
Horticulture specific training	3.08	3.03	3.15	3.08	I
Plant protection specific training	2.81	2.78	2.83	2.81	VI
Planning specific training	3.08	3.01	3.04	3.04	II
Miscellaneous training	2.98	2.98	3.06	3.00	III

Table 12 showed that maximum importance had been shown on the topic related to horticulture followed by the planning, miscellaneous, extension, crop and plant protection specific trainings. The respondents wanted more training on horticulture specific topics because higher TNS, recorded in these topics indicated higher needs of training. In general, most of the respondents expressed their needs for trainings like organic farming, seed quality control, WTO and role of agriculture etc.

In case of Kavre, maximum importance had been put on the topics related to the planning and horticulture specific trainings and least importance on the topics related to the crop specific training. In Lalitpur, maximum importance had been given on the topic related to the horticulture specific training and least importance on the topics related to plant protection specific training. In Chitwan, maximum importance had been given on the topics related to horticulture specific training and least importance on the topics related to the crop specific training.

4. Relationship between Personnel Factors and Level of Training Needs of FLEWs.

After having calculated the training need score and the level of training needs of the FLEWs, an attempt was made to study the relationship of important personal characteristics and their level of training need, which are presented below.

4.1 Relationship between Age and their Level of Training Need

Table 13 showed that out of 55 respondents 28 needed high and 27 needed low level of training needs. Also, 35 of the respondents belonged to adult age group and 20 respondents belonged to the old age group. Out of 35 adults, 18 needed high level of training need and 17 needed low level of training. Also, in the old age group, 10 needed high level and 10 needed low level of training.

Table 13 : Frequency and level of training need of different age group

Age group	Level of training need (n = 55)		
	High	Low	Total
43 and less than 43 years (Adult)	18	17	35
More than 43 years (Old)	10	10	20
Total	28	27	55

Significance level (α) =0.05 $\chi 2$ (tab.) =3.841 $\chi 2$ (cal.) =0.014

Chi-square test was applied to find out possible relation between age and level of training need. The calculated chi-square value was 0.014 which was less than tabulated value at 5% significance level and found non significant. It indicated that there was no relationship between the age of FLEWs and their expressed training need. Based on the chi-square test, it can be concluded that the age had no relation with their training need. It means their expressed training need did not vary on the basis of their age. Koirala (2001) and Adhikari (2003) also reported similar findings on their thesis research.

4.2 Relationship between Working Station and their Level of Training Need

Table 14 showed that out of 55 respondents 28 needed high and 27 needed low level of training need. Also, 33 of the respondents were working at DADO and 22 of respondents were working at ASCs under DADO. Out of 33 working at DADO, 15 needed high level of training need and 18 needed low level of training need. Also, in the working at ASC group, 13 needed high level of training need and 9 needed low level of training need.

Table 14 : Frequency and Level of Training Need at Different Working Station of FLEWs

Working station	Level of training need (n = 55)		
	High	Low	Total
DADO	15	18	33
ASC	13	9	22
Total	28	27	55

Significance level (α) =0.05 $\chi 2$ (tab.) =3.842 $\chi 2$ (cal.) =0.982

Chi-square test was applied to find out possible relation between working station and their level of training need. The calculated chi-square value was 0.982 which was less than tabulated value 3.841 at 5 % significance level and it was found non-significant. It indicated that there was no relationship between the working station of FLEWs and their expressed training need. Based on the chi-square test, it can be concluded that the working station had no relationship with their training need. It meant their expressed training need did not vary on the basis of their working station.

4.3 Relationship between Post and their Level of Training Need

Table 15 showed that out of 55 respondents 28 needed high and 27 needed low level of training. Also, 13 of the respondents were SMS, 17 were JTs and 25 were JTAs. In the position of SMSs, 5 needed high level of training and 8 needed low level of training need. In the position of JTs, 10 needed high level of training need and 7 needed low level of training need. In the position of JTAs, 13 needed high level of training need and 12 needed low level of training need.

Table 15 : Frequency and Level of Training Need of Different Posts of FLEWs

Post	Level of training need (n = 55)		
	High	Low	Total
SMS	5	8	13
JT	10	7	17
JTA	13	12	25
Total	28	27	55

Significance level (α) =0.05 $\chi 2$ (tab.) =5.991 $\chi 2$ (cal.) =1.244

Chi-square test was applied to find out possible relationship between their position and their level of training need. The calculated chi-square value was 1.244, which was less than tabulated value 5.991 at 5% significance level and was found non-significant. It indicated that there was no relationship between the position of FLEWs and their expressed training needs. Based on the chi-square test, it can be concluded that the position of the respondent had no relationship with their training needs. It meant their expressed training need did not vary on the basis of their position.

4.4 Relationship between Education Level and their Level of Training Need

Table 16 indicated that out of 55 respondents 28 needed high and 27 needed low level of training needs. Also, 29 of the respondents have intermediate and below education level and 26 of respondents were graduate and above education level. Out of 29 intermediate and below education levels, 19 needed high level of training need and 10 needed low level of training need. Also, the education level graduate and above, 9 needed high level of training need and 17 needed low level of training needs.

Table 16 : Frequency and level of Training Need of Different Education Level of FLEWs

Education level	Level of training need (n = 55)		
	High	Low	Total
Intermediate and below	19	10	29
Graduate and above	9	17	26
Total	28	27	55
Significance level (α) =0.05	$\chi 2$ (tab.) =3.841	$\chi 2$ (cal.) =5.238	

Chi-square test was applied to find out any possible relation between education level and their level of training needs. The calculated chi-square value was 5.238, which was more than tabulated value 3.841 at 5% significance level and was found significant. It indicated that there was relationship between the education level of FLEWs and their expressed training needs. Based on the chi-square test, it can be concluded that the education level had relation with their training needs. It means their expressed training need varies on the basis of their education level. Rahaman (1990) reported similar findings on their research and Bishwakarma (2003) also reported similar findings on his thesis research.

4.5 Relationship between Service Experience and their Level of Training Need

Table 17 showed that out of 55 respondents 28 needed high and 27 needed low level of training need. Also, 29 of the respondents had 18 and less than 18 years service experience and 26 of respondents had more than 18 years service experience. Out of 29, 18 and less than 18 years service experience group, 16 needed high level of training need and 13 needed low level of training need. Also, more than 18 years service experience group, 12 needed high level of training need and 14 needed low level of training needs.

Table 17 : Frequency and Level of Training Need on Service Experience of FLEWs

Service experience	Level of training need (n = 55)		
	High	Low	Total
18 and less than 18 years	16	13	29
More than 18 years	12	14	26
Total	28	27	55

Where, Significance level =0.05 $\chi 2$ (tab.) =3.841 $\chi 2$ (cal.) =0.446

Chi-square test was applied to find out any possible relation between service experience and their level of training needs. The calculated chi-square value was 0.480, which was less than tabulated value 3.841 at 5 % significance level and found non significant. It indicated that there was no relationship between the service experience of the FLEWs and their expressed training need. Based on the chi-square test, it can be concluded that the service experience had no relation with their training need. It means their expressed training need were not vary on the basis of their service experience. Adhirari (2003) also found similar result in his thesis research.

5. Constrains that Affect Job Performance of FLEWs

All FLEWs had participated in one or more numbers of training on various aspects of agriculture training during their service period. They learned something during the training related to their job. However, various constrains played a barrier role to apply their knowledge and skills to perform their jobs. Some of them have been discussed below.

5.1 Inadequate Budget to Apply Knowledge and Skill Learned from the Training

It was not solely the organization that benefits from good training. Those individuals who participated in training activities were likely to find that they benefited personally. Everyone liked to feel that they were competent at their job and the training helps to give them greater personal satisfaction from the experience of being able to exercise new skills, techniques and procedures. There were some barriers for the exercised new skills, techniques and procedures. One of the serious problem was budgetary constrain to apply their knowledge and skill learned from the training during their job.

Table 18 : Inadequate Budget to Apply Knowledge and Skill Learned from the Training

Seriousness of problem	Kavre	Lalitpur	Chitwan	Total	Rank
Most serious problem	12 (60.00)	3 (15.79)	4 (25.00)	19 (34.55)	II
Serious problem	8 (40.00)	12 (63.16)	10 (62.50)	30 (54.55)	I
No problem	0 (0)	4 (21.05)	2 (12.50)	6 (10.91)	III
Total	20 (100)	19 (100)	16 (100)	55 (100)	

Figures in parentheses indicate percentages.

Table 18 showed that out of 55 respondents, 30 (54.55 %) said serious problem followed by 19 (34.55%) said most serious problem and only 6 (10.91 %) said no problem about inadequate budget to apply their knowledge and skill learned from the training during their job.

DADO Kavre, 12 (60 %) of the respondents had expressed most serious problem about the budget and 8 (40 %) respondents expressed inadequate budget was serious problem. But in DADO Lalitpur and Chitwan, 12 (63.16 %) and 10 (62.50 %) respondents expressed that inadequate budget was the most serious problem and serious problem to apply knowledge and skill learned from the trainings during their job respectively. In all, inadequate budget of DADO for program was the serious problem to apply knowledge and skill learned from the training during their job.

5.2 Inadequate Coordination among the Line Agencies to Applied Knowledge and Skill Learned from the Training

Another problem to apply knowledge and skill learned from the training to perform job was inadequate coordination among the line agencies. Table 19 showed that out of 55 respondents, 25 (45.45 %) respondents said serious problem about the coordination among the line agencies to applied their knowledge and skill learned from the trainings to perform their job followed by 20 (36.36 %) said most serious problem and only 10 (18.18%) respondents expressed on problem. In all, inadequate coordination among the different line agencies was the serious problem to apply knowledge and skill learned from the training during their job.

Table 19 : Inadequate coordination to applied knowledge and skill learned from the training

Seriousness of problem	Kavre	Lalitpur	Chitwan	Total	Rank
Most serious problem	8 (40.00)	4 (21.05)	8 (50.00)	20 (36.36)	II
Serious problem	7 (35.00)	14 (73.68)	4 (25.00)	25 (45.45)	I
No problem	5 (25.00)	1 (5.26)	4 (25.00)	10 (18.18)	III
Total	20 (100)	19 (100)	16 (100)	55 (100)	

Figures in parentheses indicate percentages.

DADO Kavre, 8(40 %) of the respondents had most serious problem about the coordination and 7 (35 %) respondents expressed that inadequate coordination was serious problem. In DADO Lalitpur and Chitwan, 14 (73.68 %) expressed serious problem and 8 (50 %) said most serious problem about coordination to apply knowledge and skills learned from the trainings during their job respectively. In all, inadequate coordination among the line agencies was also serious problem to apply knowledge and skill learned from the training during their job.

6. Other Related Aspects of Training

Most FLEWs want to participate in the training because they wanted to promote their knowledge and skill according to the time need and personally be competent enough at their job. Some of the FLEWs expressed that they got the chance to directly observe the new technologies and other things in the training period. They would also get chance to be familiar with new policies, interact with other persons, get a chance to visit new places and get some financial profit. Hence, they wanted to participate in the trainings.

6.1 Ideal Time for Training

Time for training is an important factor, which affects the participation of trainees. A training organization must consider the ideal time so that the maximum number of interested trainees can be included without loosing their work.

Table 20 : Frequency and ideal time for trainings by the respondents

Category	Kavre	Lalitpur	Chitwan	Total	Rank
One month before implementation	9 (45.00)	11 (57.89)	8 (50.00)	28 (50.91)	I
Fifteen days before implementation	3(15.00)	5 (26.32)	4 (25.00)	12 (21.82)	II
Just before implementation	7 (35.00)	1 (5.26)	2 (12.50)	10 (18.18)	II
During implementation	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	V
Any time	1 (5.00)	2 (10.53)	2 (12.50)	5 (9.09)	IV
Total	20 (100)	19 (100)	16 (100)	55 (100)	

Figures in parentheses indicate percentages.

Table 20 showed that out of 55 respondents, 28 (50.91%) preferred ideal timing for organizing trainings as one month prior to implementation programs. Whereas 12 (21.82%) respondents expressed ideal timing for organizing training was 15 days before implementing the programs. From this it could be concluded that training should be organized one month before implementation of the program.

Conclusion

On the basis of present study following conclusions can be made:

- On the basis of the TNS, the most important area for training was horticulture specific followed by planning, miscellaneous, extension, crop and plant protection specific.
- Based on the TNS, content of the training program must include the topics like organic farming, seed quality control, sustainable agriculture, WTO and the role of agriculture, environment pollution management and hybrid seeds of vegetables production.
- There was no significant relationship between personnel factors like age, post and service experience in DOA and their expressed training needs. Hence, these factors may not affect the training needs of the FLEWs.

- There was significant relationship between education and their expressed training needs. This factor directly affects the training needs. So, the educational factors of the trainees must be considered before preparing the content of the training.
- Inadequate program budget and inadequate coordination between the line agencies were the serious problem to apply the knowledge and skills learned from the training to better perform their job.
- Lack of monitoring and evaluation by the higher officers were also serious problem to apply the knowledge and skills learned from the training to better perform their job.
- Time for training is an important factor which affects the participation of trainees. The training organizations must conduct trainings one month prior to implement the program so that maximum number of training needed trainees can be included without loosing their work.

Recommendations

On the basis of the study, the following recommendations have been made for future considerations.

- Trainings were helpful for FLEWS to improve their existing professional knowledge and skills to better perform their job. It also helps to gain knowledge and skill about change in technologies and policies. So, DAT/RATC and projects under the DOA should take steps to organize training continuously according to their needs.
- Any training program to be effective should be based on the changing needs of trainees. On the basis of expressed TNS, content of the training must include these topics for effective training;
    a. Organic farming
    b. Seed quality control
    c. Sustainable agriculture
    d. WTO and role of agriculture
    e. Environment pollution management
    f. Hybrids seeds of vegetables production
    g. Integrated pest management (IPM)
    h. Seed potato production technique
    i. Projectization
    j. Program planning process
- The relationship between educational level and the training need was significant. It means the training needs vary with the educational level. So, it is strongly recommended that the training organizations must consider the level of education of the trainees before selection for the training.
- The concerned authority must provide adequate program budget, formulate necessary policies and provide required physical facilities to fully apply the knowledge and skills learned from the training to better perform their job.

- The training organizations must conduct trainings one month prior to implementing the program so that maximum number of training needed trainees can be included without loosing their work and available sufficient time to prepare for implementation the programs.

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Service Delivery, Organization Development, Gender Involvement and Associated Socio Economic Problems of Beekeeping in Chitwan, Nepal

Dr. Suroj Pokhrel[3]

A study on service delivery, organization development, gender involvement, honey production and socio economic problems of beekeeping in Chitwan, Nepal accomplished in 2004. The study revealed that Apis mellifera L. kept in Langstroth hive in Terai and A. cerana Fab. in three different hives: 41.1% in improved, 31.2% in traditional log and 27.6% in wall hives in hills, for honey production purpose. More than half (58.6%) of the beekeepers in Terai found trained and adopted necessary management practices, and had assured services, honey market and well developed beekeeper's groups, cooperatives and association. While, only 25.05% beekeepers trained in hills. The adoption of management practices, services delivery, marketing system and organizational development is very poor in hills. There are more than a half dozen institutions providing beekeeping training in Terai and about four in hills. In terai almost half (47.3%) beekeepers supported by loan from different organizations, more than half (57.6%) received subsidy support, majority (100%) received technical support and one forth (24.0%) received marketing support. However, in hills the loan support (8.4%), subsidy support (8.4%), technical support (0.0%) and marketing support (5.6%) were almost negligible. There existed more than half a dozen organizations involved for service delivery in Terai whereas it was nearly negligible in hills. Beekeeping enterprise in Chitwan District seeks balanced gender involvement. Honey productivity (8.1 kg vs 28.7 kg/colony/yr) and gross income from selling honey (NRs 3794.40 vs 184,474.30 /family/annum) were comparatively lower in hills than in Terai. There existed lot of socio economic problems on beekeeping including: limited funds to run the enterprize (3.4%), theft (6.8 %), very poor honey market (31.0 %), poorly defined national policy/program (10.3%), weak organization development (17.2%), poor of co-ordination (20.4%), traffic problem on migration (13.6%) and conflicts for pasture use (76.9%) in Terai, and lack of funds (2.8%) to run beekeeping enterprise in hills. Beekeepers suggested that there should be external support on advance apiculture training, secured honey markets, prompt service delivery, and geographic/species specific program to over come the beekeeping problems for the commercialization of A. mellifera beekeeping in Terai and promotion of A. cerana beekeeping in hills of Nepal. For this a clear-cut beekeeping promotional policy and guideline should be developed and implemented.

Key words : service delivery, organization development, gender involvement, species specific, hills & terai.

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Introduction

1. Background

There are about 126,884 honeybee colonies including 101,684 traditional (log and wall hives), and 25,200 improved (*A. cerana* 17,744 and *A. mellifera* 7,456) hives in Nepal (Bee Keeping Section, DOA, 2004). Total estimated honeybee colony in Chitwan is 7500 (*A. mellifera* 5500 and *A. cerana* 2000) (Neupane, 2002). Annual honey production is estimated of 529.3 mt. Honey is one of the exportable, high value, cash earning commodities of Nepal. Honey export in the year 2003 was equivalent to NRs 441,985 and was 4,439.2 folds higher than year 2002 (Bee Keeping Section, DOA, 2003). The role of bees as crop pollinators has been largely ignored. It has vast potential, to augment national income through increased crop production and productivity. Honey production and crop pollination have to be exploited for the agriculture development and poverty reduction in Nepal. The Asiatic honeybee, *A. cerana* is adopting by the hill caste community in Chitwan. Bee keeping in the Terai of Chitwan District commercialized in the nineties with *A. mellifera* (DADO, 2004/2005). Chitwan seems to be the most potential district enriched with apicultural raw materials, manpower, and market. Nectar and pollen as raw materials they are available both from forest and cultivated areas. Development of road infrastructure provides easy bee migration in all the seasons.

2. Statement of the problem

The beekeeping services, institutional development, honey productivity and market development are not satisfactory in Chitwan District. Beekeepers in Chitwan are in hurdele from different managerial, technical, ecological, behavioral and socio-economical problems and policy issues hindering the beekeeping industry. Thus, it was necessary to know the status of service delivery, organizational development and gender involvement in beekeeping in Chitwan.

3. Objective

The objective of the study was to assess the status of service delivery, organizational development and gender involvement in beekeeping in Chitwan District.

Literature Review

Chepang and the hill caste community are keeping *A. cerana* in traditional hives in hi1ls of Chitwan Nepal (Devkota, 2003). The author also reported that beekeepers in Terai were well organized and associated with different groups but still not yet organized in hills of Chitwan.

Another domesticated honeybee species *A. mellifera* was multiplied during nineties and distributed through both farmers to farmers (59%) and from DADO to farmers (41.0%) in Terai (DADO, 2004/2005). Neupane (2002) estimated total bee

colonies in Chitwan District to be 7,500 (*A. mellifera* 5,500 and *A. cerana* 5,500). Beekeeping in Chitwan was mainly for honey production (Bee Keeping Section, 2003).
DADO conducted apiculture activities as a pocket program in eastern Chitwan. DDC and DFO Chitwan also provided apiculture training and distributed bee frames (Devkota, 2003). Win-rock International, PDDP, Youth Club of Narayanghat, Dabar Nepal, USAID, and Sagun Bikas Samaj were other organizations supporting beekeeping in East Chitwan (Devkota, 2003). DADO developed partnership program with Chitwan National Park (Buffer zone), DDC and VDCs for the promotion of apiculture in Chitwan (DADO, 2004/2005).

Materials and Methods

1. Study area

The study was conducted in Chitwan District (Inner Terai and peripheral Mahabharata hills) at central Nepal. The survey sites of *A. cerana* beekeepers were Chandibhanjyang, Shaktikhor, Korak and Siddhi VDCs. Similarly, survey of *A. mellifera* colonies was carried out in the Terai areas: East Chitwan (Pithuwa, Jutepani, Shaktikhor, Chainpur and Padampur VDCs and Ratnanagar Municipality), west Chitwan (Dibyanagar, Sukranagar and Parbatipur VDCs) and Bharatpur municipality.

A survey on the socio-economic status of beekeepers in Chitwan was carried during September-October 2004.

2. Beekeepers' interview

A questionnaire was developed, pre-tested, revised and the final version of which was duplicated and used for collecting necessary information from the beekeepers (65 households) to assess the socio-economic status of beekeepers in Chitwan District. The information collected from the survey was verified with available literature.

3. PRA mapping

Comparisons and conformation of survey data were made with the help of PRA maps drawn by the *A. cerana* beekeepers once in Chandibhanjyang and another by the *A.mellifera* beekeepers in Bharatpur. The diameters of the comparative circles were measured, converted into percentage and the maps were copied in white sheets of papers. These were further verified with beekeepers (18 households) both from hills and plains. Altogether 40 beekeepers (20 from Chandibhanjyang, 20 from Bharatpur) participated in this exercise.

4. Data processing

Collected data were tabulated using MsExcel sheets and necessary tables, graphs figures were prepared and appropriate statistical parameters were calculated.

Results

The result of this study was derived from 65 beekeepers (36 in hills and 29 in Terai) was accomplished in 2004 to assess the service delivery system, organizational development and gender involvement in beekeeping in hills and Terai of Chitwan.

1. Response on purpose of beekeeping

The purpose of beekeeping in Chitwan was mainly for honey production. However, 27.8% hill and 86.2% Terai beekeepers also replied the role of honeybee on crop pollination and thereby crop diversification (Table 1). All beekeepers in Terai also produced wax from *A. mellifera* combs while it was negligible in the hills.

Table 1 : Main purpose of beekeeping in Chitwan, 2004

SN	Particular	Respondent (%)		
		Hills	**Terai**	**Total**
1	*Honey production*	100.0(36)	100.0(29)	100.0(65)
2	Wax production	8.3(3)	100.0(29)	49.2(32)
3	Pollination awareness	27.8(10)	86.2(25)	53.8(35)

Figure in parenthesis is the respondent number

2. Species of honeybees

Two domesticated honeybees: *A. mellifera* in Langstroth hive in Terai and *A. cerana* in three different hives (41.1% in improved, 31.2% in traditional log and 27.6% in wall hives) mainly in hills, with an mean colony size of 4.4 per household (N=36) in hills and 50.0 per household (N=29) in Terai were adopted by the beekeepers in Chitwan (Table 2). The mean colony number of *A. mellifera* was highest in Bharatpur (87.5 colonies/household) fallowed by East Chitwan (43.6 colonies/household) and West Chitwan (22.6 colonies/household), respectively.

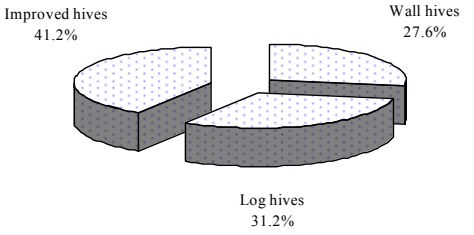

Fig. 1. Type of hives adopted by the beekeepers in the hills of Chitwan, 2004

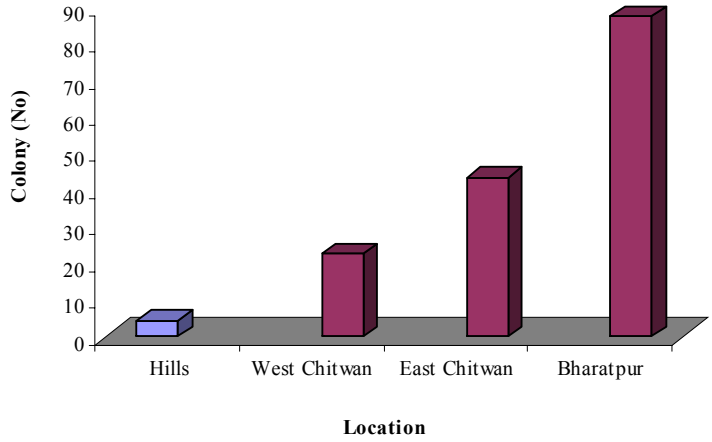

Fig. 2. Mean number of colonies kept by beekeepers in Chitwan, 2004

Table 2 : Honeybee species kept by the beekeepers in Chitwan, 2004

Particulars	Location	*A. cerana*		*A. millifera*		Total	
		Colony	**%**	***Colony***	**%**	***Colony***	**%**
Colony number	Hills	170	99.4	1	0.6	171	10.6
	Terai	-	-	1448	100	1448	89.4
	Total	**170**	**10.5**	**1449**	**89.5**	**1619**	**100**
Hive types	Hills: Improved	70	41.2	1	100	71	4.4
	Log	53	31.2	-	-	53	3.3
	Wall	47	27.6	-	-	47	2.9
	Terai: Improved	-	-	1448	100	1448	89.4
	Total	**170**	**100**	**1449**	**100**	**1619**	**100**
Average colony/hh	Hills	4.4 (36)	-	1(1)	-	4.4 (36)	-
	Terai	-	-	50.0 (29)	-	50.0 (29)	-
	East Chitwan	-	-	43.6 (13)	-	43.6 (13)	-
	Bharatpur	-	-	87.5 (8)	-	87.5 (8)	-
	West Chitwan	-	-	22.6 (8)	-	22.6 (8)	-

Figures in parenthesis are the respondent numbers

3. Service delivery

Training on beekeeping

One-fourth (25.0%) in the hills and more than half (58.6%) of the respondents in Terai had training on apiculture (Table 3). The training duration ranged from 2-15 days. The highest proportions of beekeepers trained on apiculture were from Bharatpur area (75.0%) fallowed by East Chitwan (61.5%) and in West Chitwan (37.5%). DADO, Chitwan provided training to maximum number of beekeepers (10.8%) fallowed by SNV/PCDP (6.2%) and Beekeeping Section Godavari (4.6%). SAPRROS-Nepal, NAF-Tadi, Garelu Vikas Samitee, SFD/ADB, Win-rock International and IAAS, Rampur were some other organizations providing beekeeping training to beekeepers in Chitwan District (Table 3).

Table 3 : Training on beekeeping in Chitwan, 2004

SN	Trainer	Duration	Respondents trained (%)					
			Hills	Terai				
				West	East	Bht*	Total	
1	SAPPROS-Nepal	7 days	5.5 (2)	-	-	-	-	3.1 (2)
2	SNV/PCDP	2 days	11.1 (4)	-	-	-	-	6.2 (4)
3	NAF-Tadi	4 days	5.5 (2)	-	-	-	-	3.1 (2)
4	CARTC-Bharatpur	7 day	2.8 (1)	-	-	12.5 (1)	3.4 (1)	3.1 (2)
5	Gharelu	15 days	-	12.5 (1)	7.7 (1)	-	6.8 (2)	3.1 (2)
6	SFD/ADB	7days	-	12.5 (1)	-	-	3.4 (1)	1.5 (1)
7	DADO Chitwan	4 day	-	12.5 (1)	38.5 (5)	25.0 (2)	27.6 (8)	10.8 (8)
8	BKS Godavari	7 day	-	-	7.7 (1)	25.0 (2)	10.3 (3)	4.6 (3)
9	WIND-ROCK	4 day	-	-	7.7 (1)	-	3.4 (1)	1.5 (1)
10	IAAS Rampur	M.Sc.Ag	-	-		12.5 (1)	3.4 (1)	1.5 (1)
	Total	-	25.0 (9)	37.5 (3)	61.5 (8)	75.0 (6)	58.6 (17)	40.0 (26)

Figures in parenthesis are the respondent numbers *Bharatpur

The services received by the respondents from different organizations regarding loan, subsidy, training, honey marketing, and technical supports are presented in Table 4. Lab-kush co-operative and Praja cooperative were the supporting organizations for loan support (to 8.4%) in the hills. ADB/N (to 27.6%) and Srijara Mauri Palan Samuha (to 13.8%) were the biggest organizations providing loan on apiculture in Terai (Table 4). DADO Chitwan was the biggest organization providing technical support (51.7%) to bee keepers in Terai. Self-helf farmer's group and Nepal Bee Keeper's Association provided technical supports to 17.1% and 20.6% respondents in Terai, respectively. Subsidy on the hives and honeybee colonies were provided from the farmers group (5.9 %), GOs (DADO

Chitwan 18.5%, BKS Godavari 4.6%) in Terai and INGOs/NGOs (SNV/PCDP 3.1%, NAF-Tadi 1.5%) in hills for the extension of beekeeping in Chitwan. Praja-cooperatives provided honey marketing support to 5.6% hill respondents while Nepal Bee Keeper's Association, Beekeeper's cooperatives and VDC trust supported 13.8%, 6.8% and 3.4% respondents in Terai respectively.

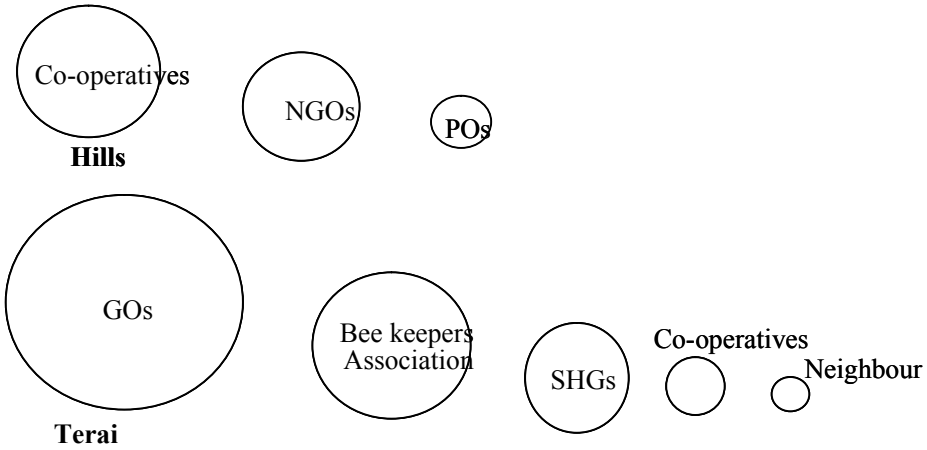

Figure 5. Role of beekeeping service providers in Chitwan, 2004

Table 4 : Organizational supports to beekeepers in Chitwan, 2004

Support	Supporting organization	Respondents benefited (%)					
		Hills	Terai				
			West	East	Bharatpur	Total	
Loan support	Praja Cooperative	2.8 (1)	-	-	-	-	1.5 (1)
	Labkush Cooperative	5.6 (2)	-	-	-	-	3.1 (2)
	Srijara Mauri Samuha	-	50.0 (4)	-	-	13.8 (4)	6.2 (4)
	ADB/N	-	50.0 (2)	23.1 (3)	37.5 (3)	27.6 (8)	12.4 (8)
Subsidy support	Srijara Mauri Samuha and Ratnanagar SHG	-	12.5 (1)	7.7 (1)	-	5.9 (2)	3.1 (2)
	SNV/PCDP	5.6 (2)	-	-	-	-	3.1 (2)
	NAF-Tadi	2.8 (1)	-	-	-	-	1.5 (1)
	DADO Chitwan	-	50.0 (4)	38.5 (5)	37.5 (3)	41.4 (12)	18.5 (12)
	BKS Godavari	-	-	15.4 (2)	12.5 (1)	10.3 (3)	4.6 (3)
Other technical support	Srijara Mauri Samuha	-	37.5 (3)	-	-	10.3 (3)	4.6 (3)
	Gramin Mauri Samuha	-	12.5 (1)	-	-	3.4 (1)	1.5 (1)
	NB Association	-	12.5 (1)	30.8 (4)	12.5 (1)	20.6 (6)	9.2 (6)
	Milijuli Mauri Samuha	-	-	38.5 (5)	-	17.2 (5)	7.7 (5)
	Bij Bridi Samuha	-	-	7.7 (1)	-	3.4 (1)	1.5 (1)
	DADO Chitwan	-	50.0 (4)	46.2 (6)	62.5 (5)	51.7 (15)	23.1 (15)
Honey marketing	Praja Cooperative	5.6 (2)	-	-	-		3.1 (2)
	Bee keeper's Cooperative	-	12.5 (1)	7.7 (1)	-	6.8 (2)	3.1 (2)
	VDC trust	-	12.5 (1)	-	-	3.4 (1)	1.5 (1)
	Nepal BeeKeeper's Association	-	-	-	-	13.8 (4)	6.2 (4)

Figures in parenthesis are the respondent numbers

4.4 Beekeepers organization

There existed 15 registered farmer (beekeepers) groups, included 477 members (98 females), three beekeeper's cooperatives, and 15 registered farms in the Terai. In addition, the head office and the district office of Nepal Beekeeper's Association (NBA) is located in Bharatpur included 200 beekeepers (5 females).

4.5 Gender involvement

Gender involvement reflected both male and female participating in feeding (male 2.8% female 5.5%), care taking (both 66.7%, male 25.0% and female 5.5%), marketing (both 88.9%, male 2.8% and female 2.8 %), cash handling (both 88.5%, male 8.3% and female 2.8%) and site selection (both 22.2%, male 22.2% and female 5.5%) in the hills

(Table 5). As per the responses male were involved in training (22.2%), group meeting (13.9%), and harvesting (both 8.3% and male 91.7%). Moreover, in Terai the male decided the area for colony migration/pasture area (3.4%, male 89.7% and female 3.4%), colony selection (3.4%, male 86.2% and female 3.4%) and also attending group meetings (10.3%, male 75.9% and female 3.4%). However, considerable number of women also involved on training (both 17.2%, male 65.5% and female 6.9%), care taking (both 48.2%, male 44.8% and female 6.9%), feeding (both 58.6%, male 31.0% and female 10.4%), harvesting (both 69.0%, male 31.0%), marketing (both 48.3 %, male 37.9% and female 13.8%) and cash handling (both 62.1%, male 24.1% and female 13.8%).

Table 5 : Gender involvement in beekeeping in Chitwan, 2004

SN	Activities	Gender	Respondents (%)					
			Hills	Terai				
				West	East	Bharatpur	Total	
1	Site selection	Both	22.2 (8)	-	-	12.5 (1)	3.4 (1)	13.8 (9)
		Male	22.2 (8)	100 (8)	100 (13)	62.5 (5)	89.7 (26)	52.3 (34)
		Female	5.5 (2)	-	-	12.5 (1)	3.4 (1)	4.6 (3)
			50%	100%	100%	87.5%	96.6%	70.8%
2	Colony selection	Both	-	12.5 (1)	-	-	3.4 (1)	1.5 (1)
		Male	5.5 (2)	87.5 (7)	100 (13)	62.5 (5)	86.2 (25)	41.5 (27)
		Female	2.8 (1)	-	-	12.5 (1)	3.4 (1)	3.0(2)
			8.3%	100%	100%	75%	93.1%	46.0%
3	Meeting attendance	Both	-	-	23.1 (3)	-	10.3 (3)	4.6 (3)
		Male	13.9 (5)	87.5 (7)	76.9 (10)	62.5 (5)	75.9 (22)	41.5 (27)
		Female	-	12.5 (1)	-	-	3.4 (1)	1.5 (1)
			13.9%	100%	100%	62.5%	89.7%	47.7%
4	Training received	Both	-	12.5 (1)	30.8 (4)	-	17.2 (5)	7.7 (5)
		Male	22.2 (8)	75.0 (6)	69.2 (9)	50.0 (4)	65.5 (19)	41.5 (27)
		Female	2.8 (1)	12.5 (1)	-	12.5 (1)	6.9 (2)	4.6 (3)
			25%	100%	100%	62.5%	93.1%	53.8%
5	Care taker	Both	66.7 (24)	50.0 (4)	38.5 (5)	62.5 (5)	48.3 (14)	58.5 (38)
		Male	25.0 (9)	50.0 (4)	61.5 (8)	12.5 (1)	44.8 (13)	33.8 (22)
		Female	5.5 (2)	-	-	25.0 (2)	6.9 (2)	6.1 (4)
			97.2%	100%	100%	100%	100%	98.5%
6	Feeding	Both	-	8.3 (3)	69.2 (9)	62.5 (5)	58.6 (17)	26.2 (17)
		Male	2.8 (1)	50.0 (4)	30.8 (4)	12.5 (1)	31.0 (9)	15.4 (10)
		Female	5.5 (2)	12.5 (1)	-	25.0 (2)	10.4 (3)	7.7 (5)
			10.3%	100%	100%	100%	100%	49.2%
7	Harvesting	Both	8.3 (3)	50.0 (4)	69.2 (9)	87.5 (7)	69.0 (20)	35.4 (23)
		Male	91.7 (33)	50.0 (4)	30.8 (4)	12.5 (1)	31.0 (9)	64.6 (42)

			100%	100%	100%	100%	100%	100%
8	Marketing	Both	88.9 (32)	25.5 (2)	53.8 (7)	62.5 (5)	48.3 (14)	70.8 (46)
		Male	2.8 (1)	50.0 (4)	46.2 (6)	12.5 (1)	37.9 (11)	18.5 (12)
		Female	2.8 (1)	25.5 (2)	-	25.0 (2)	13.8 (4)	7.7 (5)
			94.4%	100%	100%	100%	100%	96.9%
9	Cash handling	Both	88.5 (32)	50.0 (4)	69.2 (9)	62.5 (5)	62.1 (18)	76.9 (50)
		Male	8.3 (3)	25.0 (2)	30.0 (4)	12.5 (1)	24.1 (7)	15.4 (10)
		Female	2.8 (1)	25.0 (2)	-	25.0 (2)	13.8 (4)	7.7 (5)
			100%	100%	100%	100%	100%	100%

Figures in parenthesis are the respondent numbers.

4.6 Colony handling

The range of the bee colonies per household, among the respondents was 4 to 250. The colony holding of *A. cerana* was found 4.4 /household ranging from 4 to 12. The human resource involved to manage these colonies was 1.6/household and the range was 1-3. However, human resource engaged in keeping with *A. mellifera* in Terai ranged from 1-9 persons (Average 2.9/HH). It was lower in West Chitwan (1.9 person/HH) than in Bharatpur area (3 person/HH) and in East Chitwan (3.5 person/HH). Moreover, per capita holding of *A. mellifera* colonies in Terai was significantly higher, i.e 50.0 colonies per household, among the respondents. Where, it was extremely higher (88.4 colonies/HH) in Bharatpur fallowed by East Chitwan (43.3 colony/HH) and least in West Chitwan (23.3 colonies/HH) (Table 6).

Table 6 : Manpower involved in beekeeping in Chitwan, 2004

SN	Location	Honeybee colonies (No.)			Human resource involved (No.)		
		Range/hh	Mean/hh	Total	Range/hh	Mean/hh	Total
A	Hills	4-12	4.4	170 (36)	1-3	1.6	57
B	Inner Terai	10-250	50.0	1456 (29)	1-9	2.9	85
1	West Chitwan	10-65	23.1	185 (8)	1-4	1.9	15
2	East Chitwan	10-95	43.3	563 (13)	1-7	3.5	46
3	Bharatpur	10-250	88.4	708 (8)	1-9	3.0	24
	District total	4-250	25.0	1626 (65)	1-9	2.2	142

Figures in parenthesis are the respondent numbers.

4.7 Honey production

The productivity of *A. mellifera* was 254.3% higher (28.7 kg vs 8.1 kg/colony/yr) than *A. cerana* (improved hive 8.6 kg, log hive 7.7 kg, and wall hive 7.4 kg/yr) (Table 7). The beekeepers harvested honey 2 to 7 (mean 3.2) times from *A. cerana* in autumn and spring in the hills, and 3 to 7 times (mean 4.8) from *A. mellifera* in the Terai in winter and spring.

East Chitwan farmers had the highest honey harvesting frequencies (5.3 times/year) with the highest productivity of 34.8 kg per colony per year followed by Bharatpur (4.6 times with 25.1 kg/colony/year) and West Chitwan (4.2 times with 22.2 kg/colony/year). Honey price and mean income was comparatively higher in Terai than hills (honey price: NRs 115.4 vs 104.70/kg, and income NRs 184,474.30 vs 3,794.40 per family/year) (Table 7).

Table 7 : Honey production and household income in Chitwan, 2004

SN	Site/hive type	Colony number		Productivity (kg/hive/yr)		Honey price (Rs)		Income (Rs/year)	
		Range/hh	Total	Range	Mean	Range	Mean	Range	Mean
A	Hills	4-12	170(36)	2-15	8.1	100-150			
1	Improved	2-12	70 (17)	2-14	8.6	100-150			
2	Log hive	1-6	58 (17)	5-15	7.7	100-150	104.7	1200-7200	3794.4
3	Wall hive	1-5	42 (15)	3-15	7.4	100-150			
B	Terai	10-250	1456 (29)	10-60	28.7	100-150	115.4	12000-115000	184474.3
1	West	10-65	185 (8)	10-35	22.2	100-130	109.0	12000-149500	57047.5
2	East	10-95	563 (13)	10-60	34.8	100-120	108.9	13800-627000	173401.9
3	Bharatpur	10-250	708 (8)	10-40	25.1	115-150	132.5	15000-1150000	329893.8
	District total	4-250	1626 (65)	2-60	26.5	100-150	114.3	1200-1150000	83996.8

Figures in parenthesis are the respondent numbers.

Socio-economic problem

Lack of the honey market, poor co-ordination between beekeepers, lack of organizational development, conflicts between beekeepers and crop growers on pasture use, traffic problem on migration / transportation, limited national policy and program, honeybee colony stealing from the newly migrated areas, etc. were the major socio-economic problems faced by the beekeepers in Terai. In hills they lack funds to buy improved hives and necessary feeding arrangements (2.8%). The responses of sample respondents on these issues were : In Terai they lack the sound honey market (31.0%). Lack of co-ordination between beekeepers (20.4%) and lack of their organizational development (17.2%) arose conflicts, specially for pasture use (17.2%) between the farmers of East and West Chitwan, farmers between inter districts, between beekeepers and the crop growers, etc. Traffic problem during colony migration to long distance pasture (13.6% respondents), lack of national policy and program (10.3%), theft (3.1%) and lack of money in Terai (3.4%) and poverty in hills (2.8%) were important (Table 8, Fig. 9).

Table 8 : Socio-economic problems of the beekeepers in Chitwan, 2004

SN	Social-economic attributes	Respondents (%)		Mean
		Hills	Terai	
1.	Lack of money	2.8 (1)	3.4 (1)	3.1 (2)
2.	Theft	-	6.8 (2)	3.1 (2)
3.	Lack of honey market	-	31.0 (9)	13.8 (9)
4.	Lack of national policy /program	-	10.3 (3)	4.6 (3)
5.	Lack of organization development	-	17.2 (5)	7.7 (5)
6.	Lack of co-ordination	-	20.4 (6)	9.2 (6)
7.	Traffic problem on migration	-	13.6 (4)	6.2 (4)
8.	Conflicts for pasture use	-	17.2 (50)	7.7 (5)

Figures in parenthesis are the respondent numbers.
Note: Percentage and number exceeded due to multiple answers.

4.8 Suggestions given by beekeepers

A diagnostic laboratory for problem identification and provision of bee treatment, technical help and follow up support, breed selection, queen rearing and bee research program has been felt necessary in beekeeping. Beekeepers from the hills and Terai have suggested many ways for the promotion of beekeeping in Chitwan. Modification of traditional log and wall hives, training on hive making, swarm capture and hiving, absconding control, better methods of honey harvesting and wax processing training are suggested by the *A. cerana* keepers. They also suggested for the development of low cost honey extractor. *A. cerana* race selection for better productivity and domestication has been felt necessary. However, the commercial *A. mellifera* keepers in Terai suggested for the advance level crop pollination and problem solving training, and demanded a assured honey market and declaration of beekeeping policy and guideline from the government. They demanded a diagnostic laboratory and provision of bee treatment follow up support and technical help from the government side. They are aware on the conflict arbitration on bee migration between beekeepers and bee crop growers and demanded interaction between the crop growers and beekeepers. Traffic problem on bee migration should be solved and government should attempt to control bee poisoning through legislative way. The reponses of the sample respondents on these issues are presented in Table 9.

Table 9 : Suggestions provided by the beekeepers in Chitwan, 2004

SN	Suggestions	Respondents (%)	
		A. cerana	***A. mellifera***
1	Training on hive making and beekeeping	36.1 (13)	31.0 (9)
2	Training on swarm hiving and absconding control	13.9 (5()	
4	Training on harvesting with out comb destroy	13.9 (5)	
5	Training to modify the log/wall hives	11.1 (4()	
6	Training needed for wax processing	2.8 (1)	
7	Advance training on pollination and management		13.8 (4)
8	Mass campaigning for hornet/wasps control	2.8 (1)	
9	Prohibit poison and take precaution	2.8 (1)	13.8 (4)
10	Safety measure needed to developed for harvest	2.8 (1)	
11	Low cost extractor should be developed	2.8 (1)	
12	Difficult to honey harvest from improved hive	2.8 (1)	
13	Honey buying should be granted by HMG/N		41.4 (12)
14	Technical help, diagnostic lab, treatment and fallow up		27.6 (8)
15	Pasture development, management		20.7 (6)
16	Breed selection & maintenance	2.8 (1)	3.4 (1)
17	Re-qeening at proper time		3.4 (1)
18	Interaction between beekeepers and crop growers		24.1 (7)
19	Policy declaration	2.8 (1)	6.8 (2)
20	Tuni wood provision from HMG for hive making		3.4 (1)
21	Traffic problem on migration should be solved		13.8 (4)
22	Establishment of honey processing plant needed		3.4 (1)

Figures in parenthesis are the respondent numbers.

Conclusion and Recommendation

Beekeepers in Chitwan District have been adopted two domesticated honeybee species: *A. cerana* in hills and *A. mellifera* in Terai, with small average colony number (4.4/HH in hills and 50.0 in Terai). The purpose of beekeeping was mainly for honey production. Beekeepers are organizing in different groups, cooperatives and associations in Terai which lacks in hills. The numbers of these oraniizations are not enough. Moreover, strengthening of these groups is necessary. Service delivery system in Terai was stronger than in hills. Both GOs and NGOs were involved on organizing beekeeping trainin and service delivery in Terai which lacks in hills. Gender involvement in beekeeping was very encouraging. Beekeeping seems much effective enterprise for the women and resource

poor farmers both in hills and Terai. The number of clonies kept by beekeepers was very small where the numbers could be increase up to 150 colonies/family for profitable enterprise. There was ample scope of raising honey production through raising productivity and reducing the cost of production. For which, the socio-economic problems of bee keeping should be solved through better co-ordination, organizational development, market promotion, prompt service delivery and considering the issues suggested by the beekeepers in the regular programs both in hills and Terai. Above all maintaining SPS measures are the most important.

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Adoption of Improved Farm Practices in Potato (*Solanum tuberosum* L.) Cultivation in Makwanpur District, Nepal

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The study was conducted to examine the level of adoption of improved farm practices on potato cultivation in Makwanpur district. The study used 105 randomly selected samples from Daman, Palung and Namtar Village Development Committees of Makwanpur District (35 samples from each VDC). It was found that majority of respondents adopted improved farm practices on potato cultivation. Education, training, and extension-contact positively and significantly contributed to the level of adoption.

Key words : Adoption, yield, poverty.

Introduction

Potato is a staple food crop of high hills and as a vegetable in mid hills and terai region of Nepal (NPRP, 2005). It is prioritized as major crop considering it's wider adaptation and potentiality to increase yield per unit area. Potato occupies fifth position in area coverage, second in total production and first in productivity among the field crops grown in Nepal (NPRP, 2006). Shares of potato on agriculture group domestic product (AGDP) is 4.67 percent (ABPSD, 2007). Total area and production of potato in Nepal are 153,534 ha and 1,943,246 mt respectively, where as yield is 12.65 mt/ha (ABPSD, 2007). Total area and production of potato in Makwanpur district are 4,596 ha and 58,900 mt respectively, whereas yield is 12.81 mt/ha (ABPSD, 2007).

Statement of the problem

Food insecurity and poverty are the major problems in the study district. Main focus of the research and extension are to develop improved technology to disseminate potato cultivation to farmers to increase the production and productivity of potato, but per unit yield is quite low in farmers' field as compared to the yield of research station**.** There is large yield gap between research station and farmers field (Pathic *et al.,* 2003). Due to the limited adoption of improved farm practices majority of farmers are less aware of improved cultivation practices and efficient disease and pest management. Late blight and bacterial wilt are the most important diseases reducing crop yield in the mid hill (Dhital *et al.,* 1998). Besides, use of low-quality seed, poor crop management practices, unavailability of storage facilities and marketing network are other factors reducing the

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crop yield. Several technologies have been generated by research to solve the problems of potato growers but, not all have been adopted by farmer. Because the adoption of improved technologies varies from farmer to farmer according to their knowledge, communication methods used, socio-economic factors, extension contact, and availability of resources.

Objectives

General objective of the study is to examine the adoption of improved farm practices in potato cultivation in sample households. However, the specific objectives of the study are as follows:

- To assess the level of adoption of improved farm practices in potato cultivation
- To analyzes the relationship between the level of technology adoption and associated factors
- To examine the factors affecting level of technology adoption
- To identify the major constraints of technology adoption faced by farmer

Review of literature

Adoption of a particular technology is considered as the most critical factor in the success or failure of agricultural production. Adoption process is the mental process through which an individual passes from hearing about an innovation to final adoption. A major difference between the diffusion and adoption process is that diffusion occurs among person while adoption is individual matter (Dongol, 2004). Agriculture is a complex profession in the sense that it is an outcome of the efforts from different types of institutions including farmers. Technology developed by research stations is transferred to the farm community through extension. After technology reaches to the field, the farmers requires integrated services from different technical units as well as necessary inputs and credits, should exist as preconditions for the farmers (Sharma, 2001). Adoption is a long term and dynamic process and hence the success or failure of the approach cannot be judged based on a few seasons experience. More important at this stage to understand the suitability of the participatory approach for varietal selection and dissemination (Paudel *et al.,* 2003).

The educational level of the farmer was relatively higher that could have brought important effect in the adoption of improved technology, while other socio-economic factor did not affect much to the adoption of improved technology (Joshi and Kunwar, 2000). The socio-psychological personal and economic traits i.e. age, education, farm size, socio-economic status, social participation, extension participation and cosmopoliteness etc. had significant positive correlation with adoption. Therefore, extension agencies need to make intensive efforts for providing latest technological information to the farmers and also the training program (Motemed and Singh, 2003). The educational level, land holding size, household income are the most significant socio-economic variables associated with extension effectiveness in term of knowledge acquisition and the degree of adoption

(Joshi, 2001). Number of extension visit per year to the farmers, TV ownership, and training on improved potato cultivation package to the farmers had significant positive impact on the adoption of potato technology (Ghimire, 2005). Frequency of contact between farmers and extension workers facilitated the adoption of new technology (Dhital, 1991). The available agricultural technology delivery and adoption is very low and slow in Nepal due to lack of agricultural inputs, technological knowledge, infrastructure, market, irrigation facility, effective extension and publicity are major limiting factors of agricultural development in the country. Therefore, participatory approach is necessary in the regional and station level (Barakoti, 2000).The general problems such as remoteness, lack of improved seed and fertilizers, lack of technical know how, poor condition of the farming families, lack of extension services, lack of mechanization and lack of collection and storage facilities, marketing etc. have been affecting the use of improved technologies. In addition, the habit of farmers of using traditional practices and decreasing trend of farm manpower during the recent years due to employment opportunities in Gulf countries has created another problem in the community (Barakoti, 2001). Research has to focus to generate cost effective technology on farmers field. Such effort would sustainably contribute to the mass adoption by farmers and ultimately help to enhance the livelihood by reducing poverty (Thakur *et al.,* 2005).

Approach and Methodology

Three Village Development Committees (Palung, Daman and Namtar) were purposively selected for this study because of potential area and accessible for data collection. A total of 105 samples were randomly selected (35 samples from each VDC) from total population. Primary data were collected from sample respondents and secondary data were collected from various published materials of Government offices, Non-government organizations, International Non-government organizations, and internet. The analysis was done with the help of computer software Statistical Package for Social Science (SPSS) and Microsoft Excel. Pearson's correlation coefficient was used to measure relationship between variables and multiple regression model for determining the effects and contribution of explanatory variables on technology adoption. Indexing was used to rank the problem of the respondents.

Finding(s)

Level of adoption of potato technology

Rate of technology adoption was classified into two levels as low and high. Analysis showed that adoption level was distributed in a range from 53-96 percent. Table 1 showed that majority of the respondents (55.24%) had high level of adoption followed by 44.76 percent of respondents had moderate level of adoption.

Table 1 : Level of adoption of potato technology in Makwanpur, Nepal, 2008

Adoption level(%)	VDC			Total
	Namtar	Daman	Palung	
Moderate (<75%)	28 (80.00)	13 (37.14)	6 (17.14)	47 (44.76)
High (>75%)	7 (20.00)	22 (62.86)	29 (82.86)	58 (55.24)
Mean	**75.32**			
S.D	**8.80**			
Range	**53.01 - 95.89**			

Figures in parenthesis indicate percentage

This findings indicates that level of technology adoption of the respondents in the study area was satisfactory. Because level of adoption of more than half (55.24%) of the respondents had above the average.

Relationship between socio-economic factors with adoption of potato technology

Pearson's correlation coefficient (r) analysis was conducted to measure the relationship between socio-economic factors and adoption of potato technology. The factors included age, education, family size, land holding, family income, membership in organization, training, and frequency of extension contact.

Table 2 : Correlation (r) of adoption with socio-economic factors of respondent of Makwanpur, 2008

Factors	r-value	p-value
Age	0.191	0.051
Education	0.327(**)	0.001
Family size	0.178	0.070
Family income	0.235(*)	0.016
Members in organization	0.161	0.101
Training	0.490(**)	0.000
Land holding	0.156	0.112
Extension contact	0.469(**)	0.000

** and * Correlation is significant at the 1% and 5% level, respectively.

The result showed that education, training, and extension contact and family income had significant positive relationship with level of adoption. This indicated that higher the education level, the higher the extent of adoption.

Training had significant positive relationship with level of adoption. This indicates that more the number of training higher the level of adoption of potato technology.

Similarly extension contact had significant positive relationship with adoption of potato technology. This indicated that higher the frequency of extension contact, the higher the level of adoption. Family annual income had significant positive relationship with adoption of potato technology. This indicated that higher the level of income higher the level of technology adoption.

Factors affecting adoption of potato technology

A multivariate regression analysis (MRA) was carried out to examine the factors associated with adoption level. The explanatory variables were age of household head, education, family size, family income, membership in organization, training land holding size, and frequency of extension contact. The R^2 value of 0.55 indicates that all the selected eight variables put together contributed for about 55 percent variation for the adoption of potato technology.

Table 3 : Regression analysis of technology in the sample household in adoption the respondent of Makwanpur, Nepal, 2008

Independent Variable	Coeffi.	Std. Error	t	Sig	R^2
Age (of household head)	0.067	0.056	1.180	0.241	
Education	0.567	0.183	3.108	0.002**	
Family size	0.354	0.217	1.635	0.105	
Family income	0.012	0.011	1.110	0.270	
Members of organization	0.651	1.451	0.449	0.655	
Training	8.004	1.261	6.348	0.000**	0.55
Land holding	0.190	0.115	1.647	0.103	
Extension contact	6.932	1.326	5.227	0.000**	
Intercept	45.47				

Adj. R^2- 0.52

** and * Significant at the 1% and 5% level respectively

The result showed that explanatory variables, education, training and extension contact appeared to be significant at 0.01 level. The result indicated that increase in the level of education contributed positively to the adoption of potato technology. The result indicated that the increase number of training contributed positively to the adoption of potato technology. Likewise, increase the frequency of extension contact contributed positively to the adoption of potato. Increased the number of extension contact encouraged the farmers to cultivate the improved potato cultivation through interaction.

Major constraints faced by farmer

A numbers of constraints are associated with the adoption of potato technologies. This study attempted to find some of the them as perceived by the farmers.

Table 4 : Major constraints faced by farmer, Makwanpur, Nepal, 2008

S.N.	Constraints	Index Value	Rank
1	Quality seed	3.9	I
2	Pest problem	4.3	II
3	Irrigation	4.5	III
4	Chemical fertilizer.	4.8	IV
5	Technical know-how.	5.1	V
6	Market	5.2	VI
7	Storage	5.3	VII
8	Agricultural loan	5.4	VIII
9	Pesticide availability	5.5	IX

It indicates that major constraints of the potato technology were the inadequate quality seed, pest problem, chemical fertilizer, irrigation facility, technical knowhow, market, storage, agricultural loan and pesticide unavailability. Which affects in the adoption of potato technology.

Summary and Conclusion

Summary

Most of the respondents were under the age of 28-53. The major castes and ethnic groups in the study area were Kshetri, Newars, Majority of the respondents were literate because most of the respondents had reached their secondary and primary level of education**.** Agriculture was the main sources of income in the farm communities. However, other sources of income such as business, service, labor and rental were also noted. Majority of respondents had medium level family income, owned middle sized land holding and few had large sized landholding. Majority of the respondents were members in the different organization such as farmers' groups and cooperatives and received training related to potato cultivation. Majority respondents had more frequent contact with extension workers followed by seldom contact. The level of technology adoption of the respondents in the study area is satisfactory because most of the respondents had high level of adoption.

The correlation analysis showed that education, family income, training, and extension contact had significant and positive relationship with the level of adoption. A multivariate regression analysis showed that education, training and extension contact positively and significantly contributing to the level of adoption. The main constraints of the respondents in adopting technology were lack of quality seeds, chemical fertilizers,

irrigation facility , pest problem, technical know how, market, storage, agricultural loan and pesticide unavailability.

On the basis of above findings, it may be concluded that the present level of adoption of improved potato production practices was satisfactory. Because more than half of the farmers had high level of adoption. Education, training and extension contact showed significant and positive contribution to technology adoption. So, these factors could be promoted and incorporated into the other extension programs to enhance the dissemination and promotion of potato technology. The number of extension contact with farmers helps to develop familiarity and confidence to extension worker. The adoption of improved potato technology was largely constrained by lack of quality seed, irrigation facility, pest problem, chemical fertilizer, technical knowhow, market, storage, agriculture loan and pesticide unavailability. It affects the adoption of potato technology. So, agricultural inputs and other necessary requirements for potato production should be managed on time for more production.

Recommendations

Based on the study findings, the following are the recommendation to promote the potato technology**.**

Extension Program

- Education is most important factor in the level of adoption as well as acquiring knowledge by the farmers. So, it should be considered in the program planning.
- Training is also important factor. So, DADO, Makwanpur should conduct the training as per need of the farmer with their active participation .
- Extension contact is also important factor for effective extension program, So, DADO, Makwanpur should prepare the effective action plan for frequent extension contact.
- Provision of Agriculture inputs during the planting time is also necessary and DADO, Makwanpur should focus its attention in this regard.

Research

- Nepal Agriculture Research Council should conduct research on high yielding varieties, by agro climatic conditions.
- Develop disease and insect resistance varieties.

Policy Level

- Ministry of Agriculture and Cooperatives should formulate the policy in favors of the farmers. Policy should be management of agriculture inputs, providing irrigation facility, easy access of loan for effective and efficient program implementation.

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Marketing Information System and Its Role in Value Chain Development

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Market information is an important aspect for commercialization of agricultural system. In addition, it facilitates decisions for production & marketing of agro-products & enhances competitive market processes. Thus, it is vital to minimize information gaps and market uncertainties that exist in the agricultural sector of developing countries. The study found that vegetable producer farmers are more concerned with producing vegetables and selling at higher price without due consideration of value chain process. This resulted into low producers share in consumer's rupee. In this case an efficient marketing information system can help the vegetable farmers optimize their profit by adding more value following the norms of value chain approach. A value chain is a chain of activities where products pass through all activities (cleaning, grading, packaging and transporting) in the chain in a sequence and gains some value at each activity. The existing vegetable marketing information system undertaken by Kalimati Fruits and Vegetable Market Development Board and Market Development Directorate is not found efficient as per the need of the vegetable producer farmers. It is only a wholesale selling price of Kalimati Fruits and Vegetable Wholesale Market of Kathmandu district where farmers need buying and decentralized price (price of local markets) of different vegetables including potato. Based on the findings, a market information system model has been developed which ensures value chain function effectively and efficiently.

Key words : Market information system, value chain, supply response.

Introduction

Vegetables including potatoes are emerging as important commercial crops in Nepal especially in those areas where there are assured market and developed market infrastructures. After the establishment of Kalimati Fruits and Vegetable Wholesale Market (KFVWM) in Kathmandu district, commercial production of vegetable and potatoes in the neighboring districts have been increased rapidly. Potato is the fourth in order of production, fifth in area and first in productivity among major staple food crops of rice, wheat and maize in Nepal (KFVMDB, 2005). It is grown all over the country ranging from tropical climate of Terai to temperate climate of high hills from 65 to 4000 mean sea level. Potato serves as staple food particularly for hilly people whereas it is used either as sole or mixed with other vegetables almost in every meal of Nepalese people (NARC, 2004). KFVMDB has recorded the price and quantity of vegetables and potatoes

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since last decade. Increasing trend in supply of vegetables in KFVWM was found during last eight years. It was highest in Kathmandu district (324%) followed by Bhaktapur (185%), Dhading (182%) and Lalitpur (95%). Similarly, decreasing trend was found in Sarlahi (-96%) followed by Nawalparasi (-93%) and Bara (-91%) (KFVMDB, 2006).

The vegetable production in Nepal is beset with a high degree of uncertainty due to the nature and structure of the production sector, organization of marketing system and natural hazards. Production is characterized by a large number of small & scattered farms and unorganized marketing, with too many middlemen handling small quantities of agricultural produce. Producer farmers are found lacking adequate knowledge of adding values of their product in the competitive situation. In such situation, establishment of market information system is deemed necessary to provide the right signal mainly to the producer farmers. In fact, the existence and transmission of complete and accurate marketing information is the key for achieving both operational and pricing efficiency in the marketing system.

Drawing on nineteen case studies from across Africa, *Chain Empowerment* shows how farmers earn more from what they produce and turn unrewarding 'supply chains' into 'value chains' that offer benefits to all involved in the process of producing and marketing of goods. Vertical integration essentially involves producers playing more roles within the chain, such as processing and other kinds of value-adding. Examples from the case studies include projects to boost fruit juice and honey production among communities in Tanzania and trading and milling of grains in Kenya.

Horizontal integration involves developing better management of the value chain. For example by better use of information & better understanding of the market and co-operation with other actors in the chain. There are numerous examples, some of which have featured in past editions of New Agriculturist, such as finding a niche for Ugandan vanilla and revitalising Mozambique's cashew industry. *Chain empowerment* particularly focuses on how intermediary organizations can work with farmer groups and others to transform supply chains. Information is presented in a well-structured way, emphasizing on practice rather than theory, making this a useful resource for NGOs and others working with farmers and farmer groups (Cutler, 2003).

In developing countries, potatoes are often sold through fragmented marketing chains with little co-ordination and lack of market information, giving rise to supply disruptions and high transactions costs. Many small scale farmers are excluded from markets owing to their low yields and inadequate storage and transport. Inefficient and unfair pricing discourages them from making on-farm investments on production.

Enhancing the value chain requires substantial public and private investments, especially in breeding programmes and infrastructure development to support and co-ordinate activities along the chain (KIT, 2006).

Production initiatives can be strengthened by research focused on specific end uses, rapid multiplication of good quality planting materials, and varieties with pest and disease resistance. Producers of potato seed tubers need to offer yield-improving and

input-saving technologies that boost yields and reduce costs. The formation of producer groups would help farmers share expertise and strengthen their bargaining power. Production would also benefit from improvements in the supply of irrigation water and chemical fertilizers, and in cold storage and transport infrastructure.

Statement of the Problem

Vegetable and potato producer farmers are facing not only post production management problem but also increased intra-farmers competition for price. As a result, producer farmers have not been able to obtain proper price of their product despite substantial increase in production. Though price collection and dissemination activities has been undertaken by the Government of Nepal, Ministry of Agriculture and Cooperatives through its line agencies since long, but how far this information is relevant to producer farmers, traders and consumers has not been assessed yet. Past efforts in studying the relevancy of price information system could not tell about how effectively price information is being used in various decisions related to production and marketing of vegetable crops like potatoes to increase their income from their enterprises.. Thus lack of efficient Marketing Information System (MIS) has been considered one of the bottlenecks for commercial vegetable production in general and for potato in particular. Therefore, this paper attempts to answer certain questions :what are the ways to increase efficiency in the market and to what extent adoption of efficient marketing information system to gain more profit to the farmers, traders and consumers by understanding the role of MIS in each and every marketing activities.

Objectives

The main objective of this paper is to analyze the marketing information on potato regarding its supply responses to price and marketing channel. Specifically, the research intends to:

a) identify the major marketing channels and actors and compare marketing margins;
b) assess the satisfaction of farmers, traders and consumers towards existing marketing information system of KFVMDB.
c) analyze the supply response of potato growers to the price; and
d) design an appropriate marketing information system for improving the potato marketing in Nepal.

Review of literature

Pudjihastuti **(**2002**)** presented that agriculture market information system is a major need for government, producers, consumers, distributors and every marketing stakeholder in Indonesia. The agriculture market information system include information on producers area, volume, quality, price, demography structure, consumers' social economic condition,

market institutions, economy infrastructure, manpower capacity and publication. But most concerns are on price information.

Aragon**,** et.al. (1991) reported that agricultural marketing information system provides a basis for farmers to make production and marketing decisions. The marketing information system is a mechanism through which collection, analysis and dissemination of information needed to help farmers in making marketing decisions are organized and systematized.

Kohls (1990) defined that marketing information is an important facilitating function in a marketing system. It facilitates marketing decisions, regulates the competitive market processes and facilitates marketing mechanisms.

Beals (1966) reported that market information is vital to minimize information gaps and uncertainties that exist in the agricultural sector of a developing economy such as that of Malaysia. It is much needed by farmers in planning production and marketing and equally needed by other market participants in arriving at optimal trading decisions. The agricultural sector in Malaysia is beset with a high degree of uncertainty due to the nature and structure of the production sector, organization of the marketing system and natural hazards.

Approach and Methodology

This paper is based on a case study with the potato producer farmers of Kavrepalanchok and Rautahat districts and potato wholesale traders and consumers of KFVWM of Kathmandu district. Both the primary and secondary sources of information were used. Primary information was collected from potato producer farm households, traders and consumers whereas secondary information as collected from different sources.

The primary data on potato marketing by farm households and traders such as market prices, availability of market price information and their uses, and problems faced by Potato Producer Farm Households(PPFHs) and Potato Wholesale Traders regarding the marketing of potato were collected through face to face interview method using pre-tested interview schedule. Similarly, issues related to consumers satisfaction towards availability of market information such as potato price and availability as their choice were collected from the Potato Consumers through face to face interview during the visit at KFVWM. The data for production were collected through PPFHs survey. In addition, information were also collected through Key Informant Survey (KIS) and researcher's own observation and discussions with PPFHs.

The Supply Response of Potato was estimated using cobweb model. This is a simple dynamic model of cyclical demand and supply which is used when there is a time lag between the responses of producers to a change in price. Hence, Cobweb Model was fitted to analyze the supply response of potato area, production and yield with wholesale price in this study. The district level data during 1996/97 to 2004/05 was separately used for Kavrepalanchok and Rautahat districts..

The mathematical model is:

$Y_{et} = \beta + \beta_1 P_{t-1} + \varepsilon$

Where:
Y_t = Dependent variable - area (ha), production (mt) and yield (mt/ha) separately in year t
P_{t-1} = Independent variable - Potato Price (Rs/mt) in year t-1
β, β_1 = Coefficients
ε = Error term

Findings

1. Major marketing channel and Actors

In marketing of potato, different types of marketing intermediaries were involved. Major intermediaries involved were collector, wholesaler and retailer. The potato produced in the study area ultimately reached to the consumer through these intermediaries in different ways. Based on this, mainly five types of marketing channels were found in the study area. Different types of marketing intermediaries were involved in potato marketing and major actors were local traders (collectors wholesalers and retailers). Based on these following were some common marketing channels prevalent in potato marketing in Nepal in general.

i) **Producer-Consumer** : farmers take their product directly to the nearest market. Small potato producer farmers located in the countryside usually have small capacity that only fulfils local demand. They perform retailing activities directly. This is mostly seen in local haat bazaar of Rautahat district.

ii) **Producer- Assembler-Consumer :** relatively larger investor involves in assembling in the down stream of the channel and in retailing activities in upstream. Intermediaries at country towns lead this channel.

iii) **Producer-Wholesaler-Consumer :** type of marketing channel is also found in Kalimati market. In this channel wholesalers have direct contract with potato producer farmers in advance booking of potato. Some of them have contract type of potato farming.

iv) **Producer-Wholesaler- Retailer-Consumer** : is quite common in Kalimati market. Potato producer farmers have made contract with wholesalers in advance for their crop selling. It causes low bargaining power of potato producer farmers.

v) **Producer-Assembler-Wholesaler-Retailer-Consumer** : This is the most common marketing channel connected with the wholesale markets having very large consumer base and infrastructure capacity. These markets are located around the big cities, like KFVWM which serves the people of the capital. Therefore, individual farmers do not have easy access to these markets. Local traders undertake the exchange function to these markets. The wholesalers and retailers perform upstream distribution. A commission agent, who has dominance power because of his relational advantage, is also involved frequently within this channel.

It was found that long marketing channel possesses less producer's share to consumers' rupee and vice versa. In potato marketing role of middlemen was found higher in

distance production area of Kalimati market, it is because small farmers are unable to afford transportation cost and other marketing costs to dispatch their product in distance market.

Potato producer farmers were found involved in business activities within the farm yard and haat bazaars where they can dispose their product without paying transportation costs. On the other hand traders were involved in buying, assembling and transporting of potatoes. The result showed that farmers of the study area are using mainly the above five types of marketing channels to dispose their produce in Kalimati market.

Considering the overall result it can be concluded that the wholesalers are the most important actor in the marketing of Potatoes.

2. Main Actors in Potato Marketing

Potato producer farmers and traders were the main actors in potato marketing. Intermediaries like local traders, middlemen, wholesalers and retailers were also found active in potato marketing. The potato produced in the study area ultimately reached to the hands of consumer through these intermediaries in different ways. It was found that the producers, share to consumer's rupee was found very low, due to o excessive involvement of these intermediaries in potato marketing.

3. Producers Response towards Market and Price Information

Potato producer farmers were asked for the usefulness of price information disseminated by KFVMDB, as every year government of Nepal is spending a lot of money for this purpose. Responses of potato producer farmers are described hereunder in different subheadings.

3.1 Availability of Market Price Information

Market price information plays an important role in the farmer's decision about the production and marketing of potato . Market and price are the prime factors of potato production. Timely and desired form of market information may perform farmer's activities effectively and efficiently leading to proper allocation of resources through increased competition on the market. In this regard availability of market price information is most crucial. If farmer get information about market price, they perform their activities effectively and efficiently leading to proper allocation of resources through increased competition in the market.

Table 6.1 : Availability of Market Price Information by Farmers in the Study Area

Availability	Rautahat	Kavrepalanchok	Total	Per cent
Available	59	68	127	57.73
Not Available	51	42	93	42.27
Total	**110**	**110**	**220**	**100**

Source : Field Survey, 2004.

In this regard, the availability of market price information is most crucial. The result showed that about almost all of the respondent farmers get information about the market price (Table 6.1). The result showed that 57.73 per cent of respondent farmers get information about the market price, though various sources of information like radio, newspapers and other means of communication. But only the availability of the market price information is not important, from the point of its usefulness, it should be reliable, efficient and target group oriented. It should be effective on aiding to the farmers decision on different aspects related to production and marketing.

3.2 Satisfaction on Market Price Information

The effectiveness of the market price information is reflected in farmers' satisfaction level towards available information. Most of the potato producer farmers, traders and consumers in the study area were not satisfied towards the availability of the market price information and the effectiveness of the wholesale market price information of KFVWM disseminated by Radio Nepal. Potato producer farmers argue that KFVWMDB disseminates wholesale price of Kalimati market whereas farmers need buying price information and it should also include local market price information. Similarly traders and consumers were also not satisfied with this price information, because it is not accurate.

Satisfaction index was calculated to indicate the satisfaction level of the farmers. A three-point scale of satisfaction i.e. satisfaction, neutral, dissatisfaction was used to compute the satisfaction level of farmers and traders with the market price, market information and marketing facilities available in the existing market. Similarly, Satisfaction Index (SI) was used to compute availability of potato in Kathmandu Valley as per the preference of consumers.

$$SI = \frac{\Sigma F_i X_i}{N}$$

Where,

SI = Satisfaction Index

F = Frequency

X = Value of satisfaction level measured in terms of satisfaction, neutral and dissatisfaction.

I = Frequency and value of satisfaction level of ith potato consumer ranging from 1to n.

The satisfaction index was -0.49 and -0.32 in Rautahat and Kavrepalanchok districts, respectively (Table 6.2). Overall, farmers were not satisfied (-0.40) with the availability of market price information.

Table 6.2 : Satisfaction Level on Market Price Information by potato producer farmers

Satisfaction Level	District		Total	Satisfaction Index		
	Rautahat	Kavrepalanchok		Rautahat	Kavrepalanchok	Total
Satisfied	12	16	28			
Indifferent	18	20	38	- 0.49	- 0.32	- 0.40
Dissatisfied	29	32	61			

Source : Field Survey, 2004

3.3 Listening of Market Price Bulletin of Radio Nepal

The wholesale price of some important vegetables in the morning at Kalimati Wholesale Market are being broadcasted by Radio Nepal in national broadcasting services from 6.35 pm to 6.40 pm after the local news since August 1999. This was initiated with the aim of providing market price information to the farmers and traders as well. The result showed that 76 percent of the farmers were not listening price bulletin aired by radio Nepal. In district-wise, farmers of Kavrepalanchok listen more (32%) than Rautahat (16%) and ethnicity/castwise, Brahmin Chhetri listen more (38% and 22% in Kavrepalanchok and Rautahat respectively) than other castes (23% and 14% in Kavrepalanchok and Rautahat respectively).

6.4 Supply Response of Potato Growers to Price

Cobweb Model was used to measure the effect of wholesale price on area allocation of potato The notion of cobweb theorem explains the dynamic process whereby farmers increase their supply of a commodity in the following year due to price in the previous year. Accordingly, following null and alternate hypotheses were formulated.

Null hypothesis H_o: wholesale price does not affect the area, production and yield of potato. Cobweb Model is used.

Alternative hypothesis H_1: wholesale price positively affects the area production and yield of potato.

The hypotheses were tested using time series data of area allocation and wholesale price of potato for nine years at the district level. The result of hypothesis test is as follows:

Area = 704+0.37 price,
Adjusted R^2 = 0.63,
P-value = 0.01

The relationship is significant at 1% level of significant. Thus, the null hypothesis is rejected and the alternate hypothesis prevails. The result is consistent with the Cobweb Theorem. Therefore, it can be inferred that per rupee increase in the wholesale price of potato increases the allocation of potato area by 0.37 ha of Kavrepalanchok district.

Similarly result was obtained for Rautahat district.

Area = 193+0.18 price,

Adjusted R^2 = 0.43,
P-value = 0.03.

The relationship is significant at 5% level of significant. Thus, the null hypothesis is rejected and the alternate hypothesis prevails. Therefore, it can be inferred that per rupee increase in the wholesale price of potato increases the allocation of potato area by 0.18 ha of Rautahat district.

Regression of district level of potato area, production and yield lagged wholesale price indicated that price has significant positive response to area, production and yield in both Kavrepalanchok and Rautahat Districts (Table 6.3). The area coefficient of Kavrepalanchok District is higher than that of Rautahat district. This implies that the farmers of Kavrepalanchok are more responsive to the price and they adjust area allocation under potato cultivation according to wholesale price.

Table 6.3 : Cobweb Model Fitted for Area, Production and Yield Response to Price

District		Model	Adjusted R^2	P-Value
Kavrepalanchok	Area Response	= 704 + 0.37 P ***	0.63	0.01
	Production Response	= (-) 27247 + 9.62 P***	0.75	0.00
	Yield Response	= 6.17 + 0.001 P***	0.64	0.01
Rautahat	Area Response	= 193 + 0.18 P* *	0.43	0.03
	Production Response	= (-) 16362 + 4.16 P***	0.56	0.01
	Yield Response	= 1.64 + 0.001 P * *	0.53	0.02

* * * significant at 1% level, * * significant at 5% level.
Note: time series data was used for calculation .

The elasticity of area, production and yield shows that production is highly elastic followed by area and yield in Kavrepalanchok district (Table 6.3). The scenario in Kavrepalanchok district shows that area contributes more to the production than what the yield contributed. Similarly, in Rautahat district, production is highly elastic followed by area and yield. But in this case, the contribution to production seems equal by area and yield. Comparing these two districts in potato production, the technology adopted by farmers of Kavrepalanchok is highly improved and they are harvesting higher yield for last decade. However, most of the farmers of Rautahat district are still following traditional technology only 30 out of 110 farmers are progressive and shifting to improved technology. Therefore, the contribution of yield and area to production seems equal in Rautahat district.

Recommended Model for Potato Marketing Information System

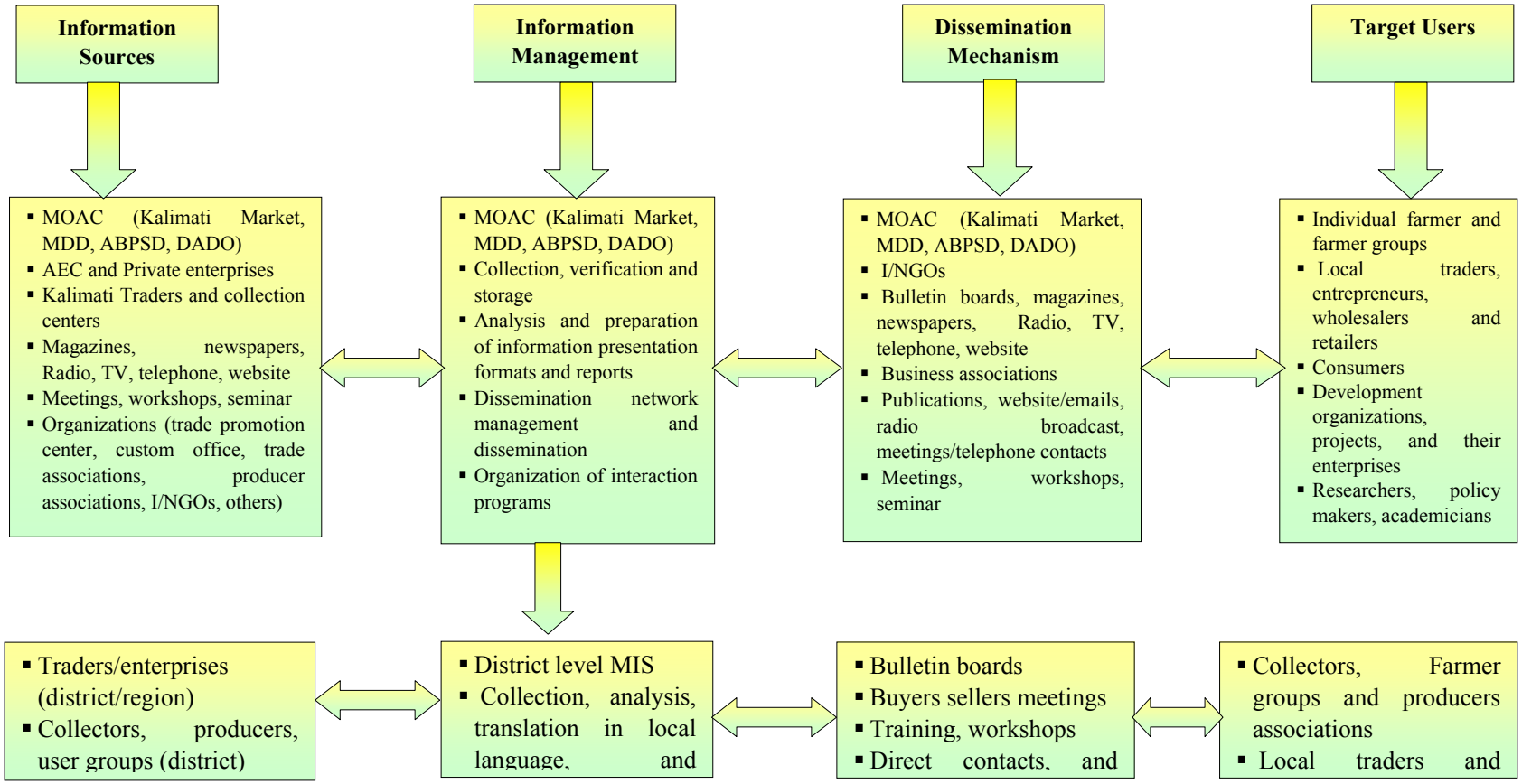
The general agriculture marketing policy of the Government of Nepal is to allow free play of the market forces in determining the price and encourage larger participation of the private sector. One of the reasons for low price received by growers, particularly small

farmers is the lack of market information, which also results in wide inter market price variation. Improvement in agricultural market information services is a necessary condition both for domestic market efficiency and to integrate domestic agricultural market with regional and international market for sustainable development of agricultural sector, as well as to ensue country's long run food security. Therefore, a model (Fig 7.1) is designed for long run agricultural development in the country. Ministry of Agriculture and Cooperatives (MOAC) has the sole responsibility to develop marketing information-collection, management and dissemination. It is, thus recommended that the ministry develop a marketing information wing in its regional, district, service center level offices so that farmers can get accurate and timely information which ultimately help farmers take decision on farming.

Mostly the small producer farmers fully depended on the information disseminated by the town area traders who have direct linkages with big and small consumers in the area. Neither the producer farmers nor the consumers were found benefited by the existing marketing information disseminated byMOAC.

Different countries of Asia and around the world have developed efficient marketing information system to increase the farmers' income by reducing the profit margin of the middleman.

Fig 7.1 Potato Market Information System



Conclusion and Recommendations

Potato is not only an important vegetable crop but also a staple food in high hills. It has great potential to attain food security in Nepal. Due to the involvement of middlemen and long marketing channel farmers were found dissatisfied with their business.

1. Conclusion

It is urged that accurate and timely marketing information help increase the existing income of potato producer farmers by providing the knowledge of value adding technique. Farmers harvest their crop without knowing the market demand. This has resulted into low price of their products, due to excess supply in the market. Therefore, quantity and type of market information are needed to get better price for their product. Farmers need information about buying and assured price of their product. Efficient marketing information can help provide accurate and timely information to the potato producer farmers.

Potato producer farmers invest a lot of money for potato cultivation, but due to the lack of appropriate market information they are not benefited by their business. One remarkable observation among potato producer farmers was that most of them never assessed the market demand of their product. They send potato to the market immediately after harvesting. It has resulted into over supply in the market. Thus, the farmers were bound to sell at low price. Sometimes the price is lower than the cost of potato production. Therefore the farmers prefer marketing information of local market rather that of Kalimati market. potato producer farmers expect information such as timely, accurate and reliable buying price, transportation cost and value adding mechanism.

2. Recommendations

The study has brought out much information related to vegetable marketing information system with reference to potato. On this background the following recommendations have been made.

(i) The most efficient channel in terms of producers share in consumers rupee was channel number 1, but in this channel the movement of potato was found less than that of channel no. 5. In channel no. 5, producers share is comparatively less. In this situation if marketing cost will be reduced the long channel will also enhance potato production and add income generation to the farmers. If it can not be solved the problems affect both the producers and the consumers in terms of low prices received by the producers and high prices paid by the consumers. The ultimate beneficiary is the middleman. Therefore, a detail study is needed to cope with existing problem by developing a reliable marketing information system which will help reduce the marketing cost and encourage potato producer farmers.

(ii) Farmers, traders and consumers were not found satisfied with the price information delivered by KFVMDB. From farmers point of view buying price of traders is important. However KFVMDB broadcasts the selling price of traders which is not

important for the seller farmers. Therefore, it is difficult to access to the farmers valuing the price of their product. Similarly, traders and consumers were also not satisfied with this delivered time as well as price information system. Such information includes volume, quality and quantity of the product. To improve the existing situation of price information delivered by KFVMDB a detail study is needed.

(iii) Potato producer farmers were found traditional and they don't have much more idea to increase. potato production commercially. Therefore, activities should be developed to increase potato production by expanding area & increasing productivity.

(iv) Modern advanced information technologies can make it more feasible to provide small-scale farmers with the marketing information they need. However, farmers may not benefit from sophisticated facilities, if the system is poorly managed or not designed for their needs. Therefore, marketing information must be disseminated in a form accessible to farmers and adapted to their needs.

(v) Advanced information technology is suited to government collection and analysis of large quantities of data. It is of little relevance in terms of a direct information service for farmers, although it might be valuable if suitable intermediaries are used. Farmers benefit more from simple technology with communicates information in a lucid and relevant way. It should be noted that farmers are interested not only in current price information, but also in marketing issues, news, and demand forecasts.

(vi) There is wide price variation according to quality. Fruit and vegetable prices including potato are particularly influenced by quality including size. The lack of a uniform national grading system is a major constraint to the development of an efficient national marketing information service.

(vii) Farmers must be able to seek out and compare the information available for different outlets if they are to sell to best advantage. Price information is less useful if there is only a single market outlet, or if farmers are price takers rather than price seekers. Where there is a very wide gap between the farm gate price and the price paid in wholesale markets.

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Alternative Practices to Minimize the Use of Chemical Fertilizers in Remote Areas of Western Hills

E.M. Bhattarai and Y.R. Pandey*

Experiments on quality improvement methods of farmyard manure (FYM) were conducted in different agro-ecological zones of western hills of Nepal during 2003-07 to find out the alternative practices of minimizing the use of chemical fertilizers in remote areas of hills. FYM samples from different methods of FYM preparations were collected and analyzed for nutrient content (N%, P% and K%) from farmers field. Nitrogen content was found 2.08% in urine soaked FYM against 1.56% in farmers' practice, Effective Microorganism treated FYM 2.05% against 1.62% in farmers' practice, FYM covered with black polythene sheet 2.21% as compared to 1.65% farmers' practice, and FYM covered with thatch roof was 1.59% contrary to 1.47% in farmers' practice. The increment of nitrogen content over farmers' practice was 23.08%, 26.54%, 33.94% and 8.16% higher respectively. Similar results were found for potassium content, 23.7%, 17.2%, 31.19% and 13.79% higher respectively over the traditional practice of farmers. Decomposition period of FYM was reduced under EM treated FYM. Similarly, decomposition process was hastened by FYM covered with black polythene sheet. Grass, newspaper, black and white polythene sheets were used as mulching materials. Among the tested mulching materials, mulching with grass gave the highest potato tuber yield (31,340 kg/ha). Application of 20 ton FYM/ha + Multiplex spray at 15 and 30 days after emergence gave the highest potato tuber yield (29,080 kg/ha). Use of Azotobactor 2 kg mixing with 20 ton FYM/ha gave the highest potato tuber yield (25,880 kg/ha). Green manuring with Berseem (sown 15 days before rice harvest) gave the highest potato tuber yield (30,840 kg/ha) against farmers' practice (24,440 kg/ha)

Keywords : Quality FYM, alternative practices, micronutrient, mulching, hills

Introduction

Nitrogen (N) is the most limiting nutrients for crop production. Therefore, it is necessary to utilize N efficiency because N is lost through different ways from the soil such as denitrification, run-off and leaching during rainy season. Likewise, farmers do not apply organic and inorganic fertilizers in proper combination. Farmyard manure (FYM), prepared by farmers in open heaps is generally of poor quality not only because nutrients are lost due to volatilization and leaching but from less decomposition (Tripathi et al., 2001/02). Application of quality FYM (covered by black polythene sheet) 20 ton/ha improved soil fertility status of soil in both sites (Chambas, Tanahun district and Pakuwa of Parbat district), in comparison to normal (uncovered) FYM. Plant height and grain yield

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of maize were significant both at Chambas and Pakuwa with application of quality FYM. Grain yield was found highest (7,530 kg/ha) at Pakuwa and Chambas (6,002 kg/ha) with application of quality FYM (black polythene sheet covered) (Bhattarai, 2004).

Statement of the Problem

The remoteness, marginality and fragility features of hills and variation in altitude, steepness, aspect, temperature, rainfall etc. limit the developmental option in the hills and offers a comparative advantage for cultivation of crops. Chemical fertilizers are expensive as well as they are less available in remote areas because of its transportation cost is very high. FYM prepared by farmers in open heaps is generally of poor quality not only because nutrients are lost due to volatilization and leaching but from less decomposition (Tripathi et al., 2001/02).

Objectives

- To find out low cost technologies for disadvantaged groups of western hills.
- To verify and select the technologies to minimize the use of chemical fertilizers in remote areas of western hills
- To improve quality of FYM
- To verify and demonstrate the sustainable soil management technologies in remote hills

Review of Literature

Residue of the previous crop, weeds and additional mulching materials from outside the field can be used (leaves, twigs from bushes, hedges, straw, wood cutting and organic household wastes like peelings, shells and husks). Several forms of plastic foils are used in intensive agriculture and gardening to protect the soil, reduce evaporation and suppress weed growth. However, these mulches play a marginal role in small-scale agriculture (Nill et. al., 1996). Newspapers help regulate the soil temperature and conserve moisture, save the time and water (Erik et. al., 1996). Mulch should be applied 3.3-4.5 ton/ha. Hay versus straw as a mulch material can be used in potato production (Deltaan Ron, 1996). The rice straw (or grass) mulch which has a higher C:N ratio enhanced tuber yields by 24% as compared to legumes leaf mulch in the long term tuber crop (Sangakkara et. al., 2004).

The concept of EM (Effective Microorganism) was developed by Dr. Teruo Higa, in 1980s. About 500 kg compost can be prepared which is called Bokasi with the use of one litre of EM. Experiment conducted at Kakani area showed that traditionally prepared FYM/compost took six to eight months to decompose whereas FYM/compost prepared by using EM was ready to apply in the field within fifteen days (CWDS, 2053 BS). Both organic and inorganic sources of plant nutrients are becoming scarce and expensive. In such a situation, it has become necessary to look alternative sources of plant nutrients that are locally available and economically and environmentally friendly. Several studies have

been reported that EM and non-symbiotic rhizobia such as Azotobacter can enhance the crop productivity (Samy et. al., 1995, Lee and Cho, 1993, Primavesi, 1993). Azotobactor and Arbuscular mycorrhhizal fungi are also used to improve soil structure and enhance productivity of potato in India (Vignes et. al., 2005). The two-year study indicated that EM applied in combination with chemical fertilizer gave 32-38% moe yield (Sherchand, 1999). About 3-29% yield increase is expected from its use but it was found ineffective in combination with mineral fertilizers (Pandey 1995). Response of Azotobactor inoculation in combination with FYM was found positive in wheat at Jumla (Shrestha et. al., 2000).

Approaches and Methodology

For urine collection small pit was prepared using locally available material (plastic bucket). Number of participating farmers in each experiment was eight as replication. Bedding materials and FYM was soaked with collected urine. After two hours of its preparation, bedding materials and FYM were soaked with EM solution (2 ml. EM mixed with two gram molasses per liter of water). Bedding materials and FYM were kept under the thatch roof. Farmers' practice was compared with FYM kept under the thatch roof mainly by nutrient content and visual appearance. FYM was covered with black polythene sheet to compare with farmers' traditionally prepared FYM (open method). The experiments were conducted with eight replications in different sites; Chambas of Tanahun district, Tulsibhanyang of Syangja district, Pala, Baglung and Ratnechaur of Myagdi district. Response of quality FYM was tested in maize crops. The plot size for each treatment was $45m^2$ (12 rows of 5m long) for maize. FYM was applied @20 ton per ha in each treatment. Farmers' practice was compared with improved practice mainly by nutrient content analysis and visual appearance.

Field experiments were conducted at Phalebas, Mudikuwa, Devisthan and Khanigaun VDCs of Parbat district in mid hill condition in two years (2006/07-2007/08) during winter season on sandy loam soil. Treatment combinations consisting of different organic, inorganic fertilizer sources and micronutrient fertilizer (Multiplex) viz. Farmers practice/control (T1), 20 tones FYM/ha + Multiplex spray (@2.5ml/liter) at 15 days after emergence (T2), 20 tones FYM/ha +Multiplex spray at 15 and 30 days after emergence (T3) and 20 tones FYM/ha + Multiplex spray at 15, 30 and 45 days after emergence (T4) were replicated five times in randomized complete block design.

Field experiments were conducted during winter season of 2006/07-2007/08. The sites were at Khurkot VDC of Parbat district. Treatment consisting of two bio-fertilizers, Azotobacter 2 kg/ha and EM. 2 lit/ha in combination with organic manures and chemical fertilizers were applied. Treatments were replicated six times in randomized complete block design. Azotobacter and EM were mixed with FYM and spread before planting. Field experiments were conducted at Mudikuwa, Devisthan and Khanigaun VDCs of Parbat district in mid hill condition in two years (2006/07-2007/08) during winter season on sandy loam soil. Treatment combinations consisting of different organic and inorganic sources of mulches viz. mulching with grass (T1), mulching with Newspaper (T2)

Mulching with black polythene sheet (T3), mulching with white polythene sheet (T4), farmers practice/control/without mulching (T5). These were replicated five times in randomized complete block design on both years, potato was planted during the second week of November. Seed tubers of variety Janak Dev were planted at 60X25 cm spacing of plot size 3X3 m. In polythene and newspaper mulches, holes were punched for planting tubers of potato and sides were sealed with earth. The crop was grown under partially irrigated conditions. Economic analysis for each treatment was worked out using Incremental Benefit Cost Ratio (IBCR) on prevailing market prices using following formula.

$$\text{IBCR} = \frac{\text{Additional return over control}}{\text{Additional cost over control}}$$

Green manuring before the plantation of potato crop was done with berseem before 20 days of rice harvesting and compared with non-green manuring plot of farmers. Maize-ginger strip cropping was compared with sole maize in Aryabhanjyang. Strip of maize ginger was 2 m each alternately. Ten farmers were participated in both experiments.

Findings

i) Effect of Covering FYM Heap/Pit with Black Plastic Sheet on FYM Quality

It was observed that the decomposition period of FYM was reduced (visual observation). Nutrient content was increased in black polythene sheet covered FYM as compared to farmers' practice (Tables 1, 2 and 3). Nitrogen, phosphorous and potassium content in black polythene sheet covered FYM was found 1.70-1.99%, 0.37-63% and 1.4-2.8% over 1.27-1.42%, 0.35-0.54% and 1.4-2.1% respectively in FYM without covering (farmers' practice). Mean nitrogen contents of different locations were found FYM covered with black polythene sheet 2.21% (farmers' practice 1.65%) Similar types of results were found in potassium contents in FYM, covered with black polythene sheet 2.21%. It was 31.19% higher than farmers practice.

Table1 : Nitrogen percentage of black polythene sheet covered FYM in different districts

Treatment	Chambas, *Tanahun*	Tulsibhanjyang, *Syangja*	Ratnechaur, *Myagdi*	Pakuwa, *Parbat*	Deurali, *Palpa*	Bhakimli, *Myagdi*
Covered	1.73	1.85	1.84	2.1	1.95	1.99
Uncovered	1.37	1.39	1.42	1.5	1.41	1.27
Mean	1.55	1.62	1.63	2.3	1.68	1.63
P Value	<0.01	0.01	0.007	0.007	0.01	0.001
LSD05	0.16	0.14	0.13	0.13	0.18	0.12
CV%	5.6	7.8	9.8	7.5	7.8	13.1

Table 2 : Phosphorous percentage of black polythene sheet covered FYM in different sites

Treatment	Chambas, *Tanahun*	Tulsibhanjyang, *Syangja*	Ratnechaur, *Myagdi*	Pakuwa, *Parbat*	Deurali, *Palpa*	Bhakimli, *Myagdi*
Covered	0.45	0.41	0.37	0.39	0.42	0.63
Uncovered	0.35	0.38	0.36	0.37	0.39	0.54
Mean	0.40	0.40	0.37	0.38	0.41	0.58
P Value	<0.01	0.09	0.078	0.16	0.12	0.07
LSD05	0.066	0.21	0.24	0.19	0.24	0.17
CV%	7.8	9.1	8.7	11.9	9.2	6.2

Table3 : Potassium percentage of black polythene sheet covered FYM in different sites

Treatment	Chambas, *Tanahun*	Tulsibhanjyang, *Syangja*	Ratnechaur, *Myagdi*	Pakuwa, *Parbat*	Deurali, *Palpa*	Bhakimli, *Myagdi*
Covered	2.1	2.7	2.1	2.0	2.2	2.1
Uncovered	1.8	2.1	1.5	1.4	1.6	1.6
Mean	1.96	2.4	2.3	1.9	1.9	1.85
P Value	0.022	0.008	0.007	0.021	0.01	0.012
LSD05	0.26	0.17	0.13	0.348	0.12	0.31
CV%	8.3	10.3	7.5	5.9	8.6	22.3

ii) Effect of Urine Application on FYM Quality

Nutrient content was increased in urine soaked FYM as compared to farmers' practice (Table 4). Nitrogen, phosphorous and potassium content in urine soaked FYM was found 1.86-2.16%, 0.40-042% and 2.0-2.22% against 1.45-1.84%, 0.30-0.38% and 1.30-1.83% respectively in FYM farmers' practice. It was observed that the decomposition period of FYM was also reduced (visual observation). N, P and K content percentage was highly significant in urine soaked FYM in comparison with traditional FYM. Mean Nitrogen content was found 2.08% in urine soaked FYM (farmers' practice 1.69%). It was 23.08% higher than conventional practice. Similar types of results were found in potassium content in FYM, urine soaked FYM 2.4% (farmers' practice 1.94%), potassium content was found 23.7% higher over the traditional practice of farmers.

Table 4 : Effect of Urine on FYM quality (2006-2007)

Treatment	Chambas, Tanahun			Tulsibhanjyang, Syangja			Pala/ Baglung		
	N %	P%	K%	N %	P%	K%	N %	P%	K%
Urine soaked	1.86	0.40	2.0	2.16	0.40	2.08	2.21	0.42	2.11
Non soaked	1.45	0.30	1.3	1.84	0.32	1.70	1.75	0.38	1.83
Mean	**1.66**	**0.35**	**1.6**	**2.00**	**0.36**	**1.89**	**1.98**	**0.40**	**1.97**

P value	<0.01	0.016	<0.01	0.01	0.08	0.001	0.007	0.12	0.01
CV %	12.3	7.9	9.6	8.5	11.4	10.1	9.1	5.9	9.8
LSD	0.138	0.07	0.39	0.201	0.23	0.31	0.01	0.29	0.12

iii) Effect of Effective Microorganisms (EM) Application on FYM Quality

Nutrient content was increased in EM treated FYM as compared to farmers' practice (Table 5). Nitrogen, phosphorous and potassium content in EM treated FYM was found 1.94-2.18%, 0.38- 0.41% and 1.85-2.8% against 1.50-1.79%, 0.33-0.38% and 1.63-1.79% respectively in FYM without EM (farmers' practice). It was observed that the decomposition period of FYM was also reduced (visual observation). N, P and K content percentage was highly significant in EM treated FYM in comparison with traditional FYM. Mean nitrogen content in EM treated FYM was found 2.05% (farmers' practice 1.62%). It was 26.54% higher than the farmers' practices. Similar results were obtained in potassium content. Potassium content was found 17.2% higher over the traditional practice of farmers. However, there was no significant difference in phosphorous content between FYM prepared through treatment and without treatment i.e. farmers' practice.

Table 5 : Effect of Effective Microorganism (EM) on FYM quality (2004/05-05/06)

Treatment	Chambas, Tanahun			Tulsibhanjyang, Syangja			Ratnechaur, Myagdi			Pala/Bhimpokhara,		
	N %	P%	K%	N %	P%	K%	N%	P%	K%	N%	P%	K%
EM treated	1.95	0.41	2.8	2.18	0.38	1.97	2.12	0.41	2.10	1.94	0.38	1.85
Non treated	1.50	0.33	2.4	1.79	0.37	1.73	1.65	0.38	1.69	1.53	0.36	1.63
Mean	1.73	0.37	2.6	1.99	0.38	1.85	1.89	0.40	2.40	1.74	0.37	1.74
P value	<0.01	<0.01	<0.01	<0.01	0.08	<0.01	<0.01	0.085	<0.01	<0.01	0.09	<0.01
CV %	9.8	7.5	6.6	11.1	9.7	6.8	7.3	8.5	7.9	10.1	8.7	7.9
LSD 05	0.218	0.026	0.22	0.12	0.11	0.09	0.12	0.21	0.13	0.10	0.19	0.11

iv) Effect of Covering FYM Heap/Pit with Thatch Roof on FYM Quality

Potassium content was high in FYM heap/pit covered with thatch roof as compared to farmers' practice (Table 6). Nitrogen content in FYM kept under the thatch roof was found highly significant against farmers' practice. Nitrogen, phosphorous and potassium content in FYM heap/pit covered with thatch roof was found 1.59%, 0.46% and 2.3% against 1.47%, 0.37% and 1.9% respectively in FYM without EM (farmers' practice). Nitrogen content was 8.16% higher over the farmers' practices. Similar results were obtained in potassium content. It was 13.79% higher than the traditional practice of farmers.

Table 6 : Effect of FYM heap/pit covering with thatch roof on FYM quality

Treatment	Nutrient content in FYM		
	Nitrogen (N%)	Phosphorous (P%)	Potassium (K%)
FYM heap/pit covering with thatch roof	1.59	0.46	2.3
FYM heap/pit without thatch roof	1.47	0.37	1.9
Mean	1.54	0.42	2.1
LSD05	0.075	0.066	0.35
P value	<0.01	0.023	0.019
CV %	7.5	6.4	8.1

Economy of Quality Farm Yard Manure on Maize

Similar result in yield increment of 20% and 35% was found in potato with the application of FYM treated with EM and urine soaked with FYM respectively (Table7). The highest (8.29) Value Cost Ratio (VCR) was found with the application of EM treated FYM followed by application of FYM covered with black polythene sheet (7.52) in maize crop.

Table 7 : Economy of quality FYM on maize yield, return, cost and VCR

Location	Treatments	Grain yield (Kg/ha)	Additional yield over farmers' practice	Gross return (NRs)	Additional cost (NRs)	Net return (NRs)	VCR
Chambas	Urine soaked FYM	5868	833	12495	3000	9495	3.17
	Farmers' practice	4985	0	0	0	0	0
Chambas	EM treated FYM	6012	658	9870	2000	7870	3.94
	Farmers' practice	5354	0	0	0	0	0
Ratnechaur	EM treated FYM	6411	1238	18570	2000	16570	8.29
	Farmers' practice	5173	0	0	0	0	0
Tulsibhanjyang	EM treated FYM	6549	1005	15075	2000	13075	6.54
	Farmers' practice	5544	0	0	0	0	0
Chambas	FYM covering with black polythene sheet	6370	839	12585	1500	11085	7.39
	Farmers' practice	5531	0	0	0	0	0
Ratnechaur	FYM covering with black polythene sheet	6156	852	12780	1500	11280	**7.52**
	Farmers' practice	5304	0	0	0	0	0
Tulsibhanjyang	FYM covering with black polythene sheet	6183	794	11910	1500	10410	6.94
	Farmers' practice	5389	0	0	0	0	

Note:

Cost of 1 bottle EM =NRs100 (which is sufficient for making 500 kg FYM/Ropani)
Cost of 0.5 kg black polythene sheet =NRs75, for making 500 kg FYM
Cost of urine collection=NRs 150 for making 500 kg FYM
Price of maize grain per kg= NRs 15

Effect of Biofertilizer on Potato

Among the tested treatments, application of Azotobater 2kg + FYM 20 t/ha +100:100:60 kg $N.P_2O_5K_2O$/ha gave the highest potato tuber yield (25.88 t/ha) followed (21.36 t/ha) by the application of EM 2liters + 20t FYM+100:100:60 kg $N.P_2O_5K_2O$/ha. Response of bio-fertilizers on potato was found highly significant (Table 8). The tuber yield of potato was increased by 21.3-25.5% by the application of biofertilizer (Azotobacter and EM) alone or combination of both in combination of FYM. Azotobacter and EM alone or combination of both was found at par in tuber yield and tuber numbers.

Table 8 : Incremental benefits cost ratio analysis of biofertilizer use in potato crop

Treatments	Tuber yield, kg/ha	Additional tuber yield, kg/ha	Value of additional tuber yield, NRs/ha	Additional cost of fertilizers, NRS	Benefit Cost ratio
Azotobactor 2kg + FYM 20 t/ha	18208	3195	47925	1550	30.91
Azotobactor 2kg + FYM 20 t/ha +100: 100:60 kg $N.P_2O_5K_2O$/ha	25880	10867	163005	13486.29	12.08
.EM 2Lit. + FYM 20 t/ha	18511	3498	52470	1600	32.79
EM 2Lit+ FYM 20 t/ha +100:100:60 kg $N.P_2O_5K_2O$kg/ha	21360	6347	95205	13436.29	7.08
.Azotobactor 2kg+EM 2Lit + FYM 20 t/ha	18842	3829	57435	1850	31.04
Control farmers' practice	15013	0	0	0	0
Mean	19.64				
LSD05	4.178				
P-value	0.006				

Note: Potato, Rs 15 /kg, EM Rs 100/ Lit, Azotobactor Rs 125 /kg, Labour charge Rs100/8 hrs, Urea Rs 22/kg, DAP Rs 30/kg, Muriate of Potash (MOP) Rs 22/kg, FYM Rs 1/kg

Effect of Mulching in Potato

Among the tested treatments, mulching with grass gave the highest potato tuber yield (31340 kg/ha) followed by mulching with black polythene sheet (28,404 kg/ha)). Effect of different types of mulching practice was found significant in potato tuber yield (Table 9) Lowest yield (17m260 kg/ha) of potato tuber was found in control plot with no mulching. Incremental benefit cost ratio was found highest (5.7) in grass/straw mulching.

Table 9 : Incremental Benefits Cost Ratio analysis of Mulching

Treatments	Tuber yield kg/ha	Additional tuber yield kg/ha	Value of additional tuber yield Rs/ha	Additional cost of mulching	Incremental Benefits Cost Ratio (IBCR)
Mulching with grass	31340	14080	211200	37000	5.7
Mulching with paper	25449	8189	122835	35000	3.5
Mulching with black polythene sheet	28404	11144	167160	106000	1.6
Mulching with white polythene sheet	27718	10458	156870	106000	1.5
Farmers' practice	17260	0	0	0	0
Mean	26034				
LSD05	5998				
P-value	0.004				

Note: Potato Rs 15 /kg, Labour charge Rs100/ 8hrs, Black polythene sheet Rs 150/ kg, White polythene sheet Rs 150/ kg, Paper Rs 5/kg, Grass/straw Rs 3/kg

Area and quantity of mulching materials

- 600 kg news paper/ha
- 667 kg polythene sheet/ha
- 10,000 kg straw/dry grass /ha

The data revealed that application of 20 t FYM +two spraying of Multiplex (at 15 and 30 days after emergence) gave the highest potato tuber yield (29,080 kg/ha) followed by application 20 t FYM+ + three spraying of Multiplex at 15, 30 and 45 days after emergence (28,500kg/ha) which were significantly better than without application of micronutrient and control (Table 10).

Table 10 : IBCR analysis in potato

Treatments	Tuber yield, kg/ha	Additional tuber yield kg/ha	Value of additional tuber yield NRs/ha	Additional cost of fertilizers, NRS	IBCR
T1. Farmers practice/ control	12667	0	0.0	0.0	--
T2 20 tones FYM + Multiplex spray @.5ml/liter at 15 days after emergence	24520	11853	177795	27136.29	6.55
T3. 20 tones FYM +Multiplex spray at 15 and 30 days after emergence	29080	16413	246195	30636.29	8.04
T4. 20 tones FYM +Multiplex spray at 15, 30 and 45 days after emergence	28500	15833	237495	34136.29	6.95
Mean					
LSD05	7596				
P-value	0.009				

Note: Potato tubers Rs. 15 /kg, Urea Rs 22 / kg, DAP Rs 30 /kg, MOP Rs22 /kg, Multiplex Rs 50 /100ml, FYM Rs 1 /kg, Labour charge Rs100/ 8hrs

Demonstration and Dissemination of green Manuring before Potato Crop

Yield increment was found about 20% (green manuring 1564kg/Ropani and 1308kg/Ropani without green manuring) in green manuring treatment against farmers' practice (no green manuring).

Summary, Conclusion and Recommendation

- If farmers apply more than 10 ton quality FYM/ha, nitrogenous fertilizer top dressing twice is sufficient instead of adding phosphorous and potassium fertilizer.
- Nutrient uptake is more in pipeline varieties (population 45 and ZM 621) than in farmers' local ones.
- Application of urine and EM in FYM and FYM covered with black polythene sheet increased the nutrient contents (mainly organic matter, nitrogen and potassium) and its quality.
- Use of EM treated, urine soaked and FYM covered with black polythene sheet increased the maize grain yield by 35.6%, 34.49% and 24.99% respectively in improved maize variety against farmers' practices.
- The most effective things felt by the farmers for above technologies are to take less duration for decomposition, easy for carrying, quickly taken by crops, increased yield and reduced women's drudgery**.**
- Improvement of cattle shed and urine collection is not only to improve FYM quality but farmers are using urine as a bio-pesticide (Gitimal) and at the same time as fertilizer (foliar spray and surface application).
- Hill farmers are reducing the use of chemical fertilizers and adopting the technologies of FYM quality improvement for sustainable soil management.

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