Contribution of agroforestry for rural livelihoods: A case of Dhading District, Nepal

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SUMMARY

In view of the possible contribution of agroforestry to enhance economic conditions in marginal areas of farmland this article examines the contribution of agroforestry system practiced in Majhitar of Kumpur Village Development Committee (VDC) for meeting the livelihood need of households. This study is based on the complete enumeration of the 42 households engaged in agroforestry activities. The analysis begins with characterising the agroforestry system; institution's intervention; diversity and preference of trees; benefits perceived by the households; resource pattern and the livelihood system. The results indicate that changes in livelihood priorities and opportunities encouraged households to plant more trees on farms. The role of agroforestry in increasing farm income, tree species diversity and women's time saving for collection of fodder and fuel wood is well recognised by the households. But existing government policy undermines the value of protection and marketing of on-farm agroforestry species and products, diverting its efforts to government owned forestland. Although there is a good prospect of agroforestry meeting the livelihood needs of rural households, reducing the pressure on forest resources and conserving biodiversity, this practice also contributed to widen the gap between households with large land holding and those with relatively little land.

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INTRODUCTION

Tree planting was conceived as a potential strategy to meet the needs of local people and protect the environment during 1970s. The worldwide interest in tree planting and management gave birth to several popular terms with "forestry" endings such as social forestry, community forestry and agroforestry (Tamale et al, 1995; Nair, 1993; Foley and Barnard, 1984). Although these terms are new names for age-old practices, specialists maintained the distinctions among them defining a precise technical meaning (Barraclough and Ghimire, 1995). Social forestry as an umbrella term includes the practice of planting or using trees to pursue social objectives through delivery of benefit to the local people. Community forestry, farm forestry and agroforestry are all forms of social forestry (Nair, 1993; Hobley, 1996; Tamale et al, 1995). Community forestry refers either to portion of national forestland handed over to communities or to the use of public or communal land for tree growing which is later handed over to the community for the purpose of management (Nair, 1993; Hobley, 1996; Tamale et al, 1995; MPFS, 1991). Agroforestry is a collective name for land use systems and technologies involving trees combined with crops and/ or animals on the same land management unit (Nair, 1993; Tamale et al, 1995).

Agroforestry practices in Nepal can be described in two broad categories: farm -based and forest-based. The farm-based practices are home gardens, planting trees on and around agriculture fields, tree wood lots and commercial crop under shade trees or agriculture crops inter-cropped with commercial trees. The forest-based practices involve specific agricultural practices associated with forests where farmers collect food, fruits and gums (Tejwani and Lai, 1992). In this study agroforestry is referred to as farm-based practices.

Farming or agriculture is the main source of livelihoods for the people of Nepal. Trees on farmland or in forest form an integral part of the farming system. Nutrients for cropland come from animal manure and leaf material. Timber for construction, firewood as a form of energy, fodder, grass and bedding materials for livestock all come from both the forest and the farmland. Trees are also important for the protection of environment and conservation of biodiversity (Gilmour and Fisher, 1991; Grimble et al, 1994). Nonetheless the food, fuel and fodder requirements of continuously increasing human and livestock population have generated enormous pressure on forest and arable land, leading to depletion of natural resources thereby affecting natural and human environment (MPFS, 1991). Literature indicates that forest resources are dwindling day by day in quantity, quality and diversity. It has been estimated that forest in Nepal in 1964 was more than 45% of the total land area. In 1979, forest cover reduced to 43%. By 1986, forest had been further reduced to 37.4% and by 1998 to 29% of total land area (NPC, 1998). This has a considerable impact on women and girls, who are responsible for fetching water and collecting fuel wood in rural areas (WHO, 2000). In this context agroforestry can play a vital role to meet the need of the growing population in terms of sustaining crop agriculture and livestock, production of commodities for exchange and as a form of energy and providing diverse tree products for sustaining rural livelihoods (Chew, 2001; Arnold, 1997). A review of approaches on farm tree management practices by farmers conclude that trees in farming systems are not seen as a part of forest resource, rather farmers see trees in terms of how they contribute to their livelihood needs and strategies (Arnold and Dewees, 1998). Despite the recognition of value of on-farm

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trees, this practice cannot bring a radical change to the positions of the landless and poor households where inequities in land holding exist. Rather this practice provides higher financial return to land-rich and lower financial return to the land-poor households (Foley and Barnard, 1984; FAO, 1989).

Why this study?

The depletion of forest resources and increasing demand for forest products especially of the rural people who depend on forests for livelihoods have widened the gap between the demand and supply of forest products in Nepal. Finding alternative options to increase the supply of forest products to support rural livelihoods have become a fundamental concern for policy makers and planners. Agroforestry seems to have potential to provide options for rural livelihoods and biodiversity conservation (Gordon and Bently, 1990; Kidd and Pimentel, 1992).

Nepal's current government policy emphasises the need to initiate community and agroforestry programmes (MPFS, 1991; APP, 1995). In light of this policy, in recent years non-government organisations (NGOs) have played a significant role in the facilitation of agroforestry programmes thereby complementing the government programmes (Hegde, 1991; Rao, 1992) to meet livelihood needs of the farming households. In this regard Nepal Agroforestry Foundation (NAF) is a Kathmandu based NGO operating in the middle hill and Terai districts of Nepal. With a particular reference to the NAF-initiated middle hill project area in Majhitar of Dhading District, there is a need to study the effect of agroforestry on different categories of farming households. With this background this study sought to answer the following question.

Is an agroforestry programme, managed by an NGO, able to deliver the benefits suggested in the literature? specifically, did it

- Give improved livelihood opportunities and income?
- Offer poorer households an opportunity to increase income/security?
- Deliver environmental benefits to, and perceived by, the local population?

METHODOLOGY

History and description of the study area

Dhading is one of the least developed hill districts in central Nepal with mean annual rainfall of 1819 mm. The altitude of the district varies from 430 m. to 7409 m. Majhitar is 430 m. above mean sea level. This study was conducted in Majhitar village, ward no. 3 of Kumpur VDC. Majhitar is a low land area, which receives more than 80% rain during June to September (Regmi, 1998). The average household size in Majhitar is 6.00 (Table 1). The area is accessed by the Prithvi highway, which connects Pokhara and Narayangarh, at Gajuri. The soil has medium potential productivity and is suited to all types of crops especially rice and maize. Majhitar by its name is the land of fishermen (Majhis) who originally settled in 1890. Since the 1960s when malaria was eradicated hill people of different ethnicity migrated to Majhitar (Table 1). The main reason for the migration was low productivity of the

farmland, low economic opportunities and landslides. Majhis have sold most of their land to the migrants. External intervention in the area was first felt in 1970s when the government introduced hybrid buffalo, chemical fertiliser and vegetable seeds. Deforestation had already occurred before the entry of development programmes in the study area. Households had to spend approximately 5 hours to collect a load of fodder or firewood (30 kg) from the forest. These households have increasingly faced difficulty especially in getting preferred livestock fodder from the forest. This difficulty created households' interest in farm fodder plantation. But they were lacking technical and material inputs. In 1991 the district women development office contacted NAF to help to solve fodder scarcity in the area. Since then NAF facilitated the agroforestry program.

Table 1. General description

Description	Male	Female	Total
Household size (average)	3.26	3.02	6
Education (%)	43.72	36.68	80.41
Ethnicity			
Description	Brahmin/ Chhetry	Newar/Majhi/Magar/ Bhujel	Other
Ethnicity (%)	57.14	40.48	2.38

Case study

Social science research is based on systematic appraisal and empirical evidence that includes observation of a single or multiple cases (Furze et al, 1996) to understand a particular phenomenon. Case study seeks the answer of why and how questions through multiple sources and perspectives and is flexible to include as many variables as are relevant to the issues being researched (Yin, 1994). Different researchers have used case study method to understand the interrelations between trees and households (Ravindranath and Somashekar, 1995; Scherr, 1997). This study uses case study method for collection and analysis of data. Part of the data comes from a study conducted to examine the program dynamics of the NAF in Majhitar in 1997. The study consisted of 42 households doing agroforestry. The main aim of this study was to understand how agroforestry intervention affected different categories of households, from large to marginal, in a specific community where farmers were already active in agroforestry. In Majhitar agroforestry programme was facilitated by NAF and the households were engaged in agroforestry activities. Therefore, being within the domain of Majhitar, complete enumeration of male and female members of the household was done to gather required information.

To reflect the status of all the households focus group discussion was held to categorise the households using their own criteria. As given in Box 1 the group prepared a list of criteria and accordingly categorised households into four different categories. The final list of the households from different categories was crosschecked with key informants for further correction.

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Box 1. Criteria used by households to group households in to different categories

Category	Criteria
Large 5 (11.9%)	Food sufficiency for 12 months; large land holding (>20 ropani*) with good quality irrigated and non irrigated land; large size of livestock (>4 livestock) holding and maintains animals also through tenants; low dependency on forest for meeting daily need; lot of trees on private land, more on farm income, large size house with stone slates or tin roof; family members are in secured off farm income; send children to the school and colleges.
Medium 12 (28.57%)	Food sufficiency for 9 months, medium land holding (10-20 ropani) with good quality irrigated and non irrigated land; reasonable number of livestock (about 4 livestock); depend on forest for meeting daily need; several trees on private land; more farm income but has access to off farm income as well; medium size house with stone slates or tin roof; send children to the school and colleges.
Small 19 (45.24%)	Food sufficiency for 6 months, small land holding (4-<10 ropani) usually poor quality land; <4 livestock; depend on forest for meeting daily need; few trees on private land; get income from on farm as well as have access to off farm sources; medium size house with thatch roof; send children to the school.
Marginal 6 (14.29%)	Food sufficiency for 3 months or less, poor quality land holding (<4 ropani); keep few livestock but almost all on tenancy basis, depend on forest for meeting daily need; very few trees on private land; very less farm income depend mostly on off farm activities; small size house with thatch roof; rarely send children to school.

* 1ropani = 1/20 ha.

Semi-structured questions were used to find out the characteristics of different categories of households including the trees and livestock status of the households. Direct field observations and informal group discussions were done to collect data related to agroforestry practices and cropping patterns. Focus group discussion was held to select the preferred fodder trees using their own criteria. Households were asked to brainstorm all the fodder trees that they used to feed their animals. Out of the 15 fodder species used by them, they were asked to select the five most preferred species, which they wanted to grow. Households ranked the selected five species based on the criteria developed by them. Secondary information was collected through official reports.

The data gathered from primary and secondary sources were both qualitative and quantitative. The data on characteristics of the households, livestock and tree statistics were presented using simple descriptive statistical tools such as percentages and mean. The livestock holding was quantified 1 Livestock unit (LSU) = 1Buffalo = 2/3 Cow = 1/10 goat. The farmers' perception of agroforestry practices was measured using a five –level perception scale. In this scale, each item is scored from 5 to 1, with 5 = strongly agree (SA), 4 = agree (AG), 3 = neutral (NT), 2 = disagree, and lowest score 1 = strongly disagree (SD).

Significance and scope of the study

The study is significant in terms of its contribution to both theory and practice. It provides insights into contribution of agroforestry to the livelihoods of large and marginal households. The results of this study can be useful in redirecting, improving and strengthening the existing agroforestry programmes. Since this is a case study of Majhitar, the results of the study may not hold true for other agroforestry projects. However, the information generated may give some guidelines for implementation of

some agroforestry programmes in similar areas. Time and budgetary constraints limited the coverage of the study.

FINDINGS

Agroforestry and farming system

The word agroforestry or *Krishiban* in Nepali is a new word in the farmers' vocabulary but the practice has been in their farming systems for many generations. Farmers have cultivated trees on farm from time immemorial (Gilmour and Nurse, 1991). Agroforestry system in Nepal is diversified and integrated with livestock, trees and crops. Any change in any component of the whole system will have effects on the other components. The agroforestry system in the study area could be classified as an agro-silvo-livestock keeping system. This system in consideration of the study area is further categorised into home garden and tree-crop mix. In home garden households manage a small garden around the house where they grow vegetables and fruits on the farmland while fodder trees are grown around the house. Although home garden covers a small portion of the land, its output is very important for sustaining livelihood of the households. Growing trees with crops or crops with trees depends on the farmers' experience (Shrestha, 1994). Tree-crop mix systems are further categorised as maize-based and rice-based. In the maize-based system maize is the major crop grown while trees are grown along the terrace riser. This system is prevalent in the *bari* (rainfed land) and the most common cropping pattern is maize-vegetable-wheat. Likewise in the rice-based system rice is the major crop grown in the field while trees are grown along the terrace riser of the *khet* (irrigated land). The common cropping pattern here is rice/soybean-wheat-maize or vegetables. Although hill farmers are reluctant to plant trees in the *khet*, introduction of high value species motivated them to plant trees around the *khet* (Hawkins and Malla, 1993). Even though major fear for households is the tree shade effect and root effect on the crops, plantation of deep-rooted leguminous trees that can be managed at a low height motivated them to plant on the bund of the *khet* land.

Tree species on the farmland: intervention, diversity and preference

On-farm tree management strategies of the household are influenced by access and availability of forest resources. As the resource base diminishes households respond to scarcity either by protecting the naturally regenerated seedlings on farm or supplementing the existing stock of naturally grown trees by planting more trees on farm (Arnold, 1991; Gilmour, 1997). To respond to the growing scarcity of forest resources especially fuelwood and fodder, households have protected an average of 137 naturally grown trees on their farmland. But these trees alone were not the only solution to meet the daily demand of the household. NAF organised cross visit for households interested in agroforestry, provided training, technical and material support, encouraged farmers especially women farmers to form a saving group to meet regularly and to assist one another in producing plants and protecting trees on farm (Regmi, 1998).

Households keep different types of animals for meeting their livelihood needs. Considering the species in the herd, goats constituted the highest average number of animals per household followed by buffalo and cattle. However in terms of livestock

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units buffalo holding was highest followed by cattle and goat (Table 2). Households planted fodder trees on the under utilised land such as terrace riser and these trees were lopped at low height in order to prevent shading of crops and to provide fodder in short interval for the animals mentioned above. The average fresh fodder requirement for each household is 73.68-kg/day. After NAF's intervention the average number of trees increased to 442 per household. Although most of the respondents recognised the increasing contribution of farm trees for meeting the need of fodder and fuelwood, average supply of fodder (including cut grasses) from the farmland was found to be adequate for only 8.3 months. The gap of 3.7 months was met by other sources such as concentrates (maize flour, rice bran etc.), rice straw, maize stalk and wheat stover and grazing at common land areas. The increased number of fodder trees on farm enabled one third of the households to practice stall-feeding (Table 3). However the rest of the households still practice both stall feeding and grazing mainly because of lack of land to produce sufficient fodder from the farm and to maintain health and soundness of the animals especially the oxen.

Table 2. Average livestock holding in livestock unit (LSU)

Type of animal	Animal per HH	Livestock Unit (LSU)/HH
Cattle	1.98	1.32
Buffalo	2.69	2.69
Goat	3.26	0.33
Total	7.93	4.33

Table 3. Fodder sufficiency from the farmland, by months

Fodder sufficiency	Number of respondents
<4 months	5 (11.91)
4-7 months	10 (23.81)
8-<12 months	13(30.95)
12 months	14 (33.33)

Note: Figure in parentheses is percentage

Firewood is the main source of fuel. The average firewood requirement for each household is 8.77 kg per day. Majority of the households (95%) are dependent on firewood and crop residues for the fuel while about 5% use alternatives such as biogas. Majority of the respondents (79%) reported improvement in firewood supply; however only one fourth (25%) are self sufficient from the farm trees while others still partially depend on the forest for meeting their firewood need.

As the number of on-farm trees increased, households took the initiative to protect the deteriorating forest and common land areas. They requested the district forest office to hand over those areas (about 3.5 ha) in the form of community forestry. The district forest office handed over the land to the community. A forest user group management committee has been formed but the committee restricted the access of grazing to the whole community for the purpose of tree plantation and management. This has brought a negative impact mainly to those small and marginal households who relied on common land for feeding their animals. Despite the role of on farm agroforestry to

protect the deforested forest and common land areas, this has contributed negatively to the livelihood of the small and marginal farmers.

Households in the study area have maintained diverse on-farm trees. As shown in Table 4 they are cultivating and using at least 32 species. Out of those 37.5% comprised fruit, 15.5% comprised fuel and 47% comprised fodder trees. These include both exotic and indigenous species. Among them about 16% were exotic while rest of the cultivated species (84%) were of indigenous origin. These species, commonly grown on the farmland, have substantially contributed to meet the daily need of households, supplying mainly fodder, fuel, timber and fruit. Some of these species have medicinal value and also play an important role in soil conservation. Over the years trees diversity slightly increased in the study area contributing towards the conservation of biodiversity. Households are interested to add more fodder trees in their farmland as long as their land can accommodate the trees.

Table 4. Tree and crops grown in Majhitar

Local name	Scientific Name	*Native/**Exotic to the village	Uses
Fodder			
Badahar	*Artocarpus lakoocha*	*	Fodder, fuel, fruit
Bhatmase	*Flemingia congesta*	**	Fodder, fuel, soil conservation
Dabdabe	*Garuga Pinnata*	*	Fodder, fuel
Gajuma	*Guazuma ulmifolia*	**	Fodder, fuel
Gayo	*Bridelia retusa*	*	Fodder, fuel
Ginderi	*Premna latifolia*	*	Fodder, fuel
Ipil Ipil	*Leucaena spp.*	**	Fodder, fuel, soil conservation
Kabro	*Ficus lacor*	*	Fodder, fuel, soil conservation, pickle
Khanyu	*Ficus semicordata*	*	Fodder, fuel, fruit
Khasreto	*Ficus hispida*	*	Fodder, fuel
Kimbu	*Morus alba*	**	Fodder, fuel, sericulture
Koiralo	*Bauhinia variegata*	*	Fodder, fuel, pickle
Rahar	*Cajanus cajan*	*	Fodder, fuel, food
Kutmero	*Litsea monopetala*	*	Fodder, fuel
Tanki	*Bauhinia purpurea*	*	Fodder, fuel
Fuelwood/Timber trees			
Bakaino	*Melia azedarach*	*	Timber, fuel, fodder, medicinal
Boddhairo	*Lagerstroemia parviflora*	*	Timber, fuel
Sal	*Shorea robusta*	*	Timber, fuel, fodder
Sissoo	*Dalbergia sissoo*	*	Timber, fuel
Tuni	*Toona ciliata*	*	Timber, fuel
Fruit trees			
Amba	*Psidium guajava*	*	Fruit, fuel
Amp	*Mangifera indica*	*	Fruit, fuel
Anar	*Punica granatum*	*	Fruit, fuel
Aru	*Prunus persica*	*	Fruit, fuel
Bhui-katahar	*Ananus sativus*	*	Fruit, soil conservation

Kagati	*Citrus aurantifolia*	*	Fruit, fuel
Kera	*Musa sapientum*	*	Fruit
Lichi	*Litchi chinensis*	**	Fruit, fuel
Mewa	*Carica papaya*	*	Fruit
Naspati	*Prunus communis*	*	Fruit, fuel
Nibuwa	*Citrus lemon*	*	Fruit, fuel
Rukh-katahar	*Artocarpus integrifolia*	*	Fruit, fuel, fodder, medicinal

Households are knowledgeable on the use of different trees they have grown on the farmland and have developed their own set of criteria for choosing what fodder species to plant. The focus group discussion revealed that they could formulate their own criteria to assess the fodder species. Out of 15 currently grown fodder species they have selected five preferred species based on palatability of the species, followed by its contribution to milk production and availability of fodder in the dry season. As shown in Table 5, the overall response of the farmers' group showed that *Artocarpus lakoocha* was highly preferred by the households, followed by *Morus alba, Leucaena spp., Bauhinia purpurea* and *Ficus hispida*. The active involvement of household in agroforestry shows that they are aware of the importance of on-farm trees. Although they are not familiar with the term biodiversity, they are knowledgeable of the value of on-farm tree diversity for the sustenance of their livelihood. But their major concern is how can they access the trees they prefer to grow on the farmland when outside support is terminated. This situation calls for exploration of other alternative means. One of the nearest sources for accessing seedlings is the government run nursery. But these nurseries mainly produce forest-based trees especially the timber species that are not the preference of the farmers. The group discussion revealed that government officials do not consult with them before the production of the seedlings. On the one hand these households perceive that officials' duty is just to manage government owned forestland; on the other government officials focus their job to accomplish just their target oriented forestry development plan. This indicates that district forest office has not given any attention towards on-farm agroforestry development. Similarly Nepaune et al. (2001) argued that extension department has not given any attention towards agroforestry in their extension program, which is why extension workers are not knowledgeable in agroforestry and are therefore unable to deliver appropriate agroforestry technology to the farmers. Although Agricultural Perspective Plan and the Master plan for the Forestry Sector emphasise agroforestry development (APP, 1995; MPFS, 1991), the practice of officials puts agroforestry in shadow creating communication gap with households. This is hindering households to access technical and material support of their choice from government on agroforestry development. Households realise a need to build capacity of current women saving groups, which could develop marketing system for the sale of their products and enable them to access and use opportunities available for agroforestry development.

Table 5. Farmer's preference for fodder trees

Criterion	Fodder tree species				
	Ipil	Kimbu	Tanki	Badahar	Khasreto
Palatability	2	2	2	1	2
Milk production	1	3	1	1	4
Dry season fodder	1	1	1	2	5
Biomass production	5	2	4	1	1
Easy to propagate	3	1	3	3	5
Fast growth	1	2	2	4	2
Multiple use	3	3	4	1	2
Total	16	14	17	13	21

Note: Ranking 1 for most preferred and 5 for least preferred

Perception of agroforestry

The respondents were aware of the economic and environmental benefits of agroforestry practices and had favourable attitude towards those practices. It may be due to the fact that significant portions of male and female household members are literate in the study area (Table 1). Most of the respondents agreed that agro-forestry practices increased soil fertility, increased farm income and reduced the chances of complete crop failure (Table 6). These households realised that plantation of trees on the under utilised portion of the farmland has not decreased in the overall output of the farmland. Sequential or simultaneous production of fodder and grass, crop and vegetable and livestock contributed to increases in the overall household income. Maintenance of mixed trees on the farmland made households resilient to cope with uncertainty and risks. At the time of insect or disease outbreak in one species they can meet their need from other species. Thus this practice has reduced the chances of complete crop failure. The respondents strongly agreed that agroforestry practices maintained/improved surrounding condition of the forest and saved time on collecting fodder and firewood from the forest. The saved time opened up avenues for other farming activities such as vegetable farming. It is noteworthy that these households have experienced improved greenery and saw increased role of farm trees to meet their need of fodder and firewood. However they disagreed on the statement that it takes long time to get income from agroforestry practices. This is due to the fact that households have cultivated fast growing trees that were able to give benefit especially fodder in short period of time.

Table 6. Respondents' individual rating for agroforestry practices

Statement	Responses*				
	1	2	3	4	5
Agroforestry practices					
Increased soil fertility	-	6 (14.28)	8 (19.05)	21 (50.00)	7 (16.67)
Increased farm income	1 (2.38)	2 (4.76)	5 (11.91)	31 (73.81)	3 (7.14)
Conserved soil and water	-	-	-	6 (14.29)	36 (85.71)
Reduced chances of complete crop failure	-	-	5 (11.91)	20 (47.62)	17 (40.48)
Saved time on collecting fodder and fuel wood from the forest	-	-	-	5 (11.91)	37 (88.09)
Took a long time to get income	-	20 (47.62)	6 (14.29)	10 (23.81)	6 (14.29)
Maintained/improved surrounding condition	-	-	-	3 (7.14)	39 (92.86)

Note: Figure in parentheses is percentage.

*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Pattern of distribution of resources

Majority of the respondents had a small land holding (Table 7) and this range reflects a skewed distribution of land from 1 to 45 ropani. The pattern of distribution of resources show that average numbers of livestock unit, fodder trees and income are positively correlated with the increase in land holding size (Table 8). But these resources did not increase in the same ratio. Average land holding size increased by five times, while number of livestock, fodder trees and income increased by about four times, fourteen times and three times respectively. This indicates that agroforestry has mainly benefited farmers with larger landholdings. As the landholding size decreases, the off-farm earning activities increase. The marginal farmers obtained about two-thirds of their income from off farm sources, while large farmers derived about the same proportion of their income from farm sources.

Table 7. Land holding

Land holding category	Percentage (%)
Marginal (<4 ropani)	14.29
Small (4-<10 ropani)	45.24
Medium (10-20 ropani)	28.57
Large (>20 ropani)	11.90

Table 8. Distribution of different resources by farm size

Farm size	Average/ Household (HH)				
	HH No	LSU	Fodder trees	Farm income	Off-farm income (%)
Marginal (<4 ropani)	6	2.4	73.17	17,388.33	62.08
Small (4-<10 ropani)	19	3.47	410.68	17,812.42	50.38
Medium (10-20 ropani)	12	4.94	439.33	23,318.00	22.51
Large (>20 ropani)	5	8.49	1013.20	50,048.60	35.33
Total	42	4.33	442.38	23,162.50	39.61

Livelihood system

Most of the households are not self sufficient in food production. This is due to the fact that the small and marginal households cannot produce sufficient food for the livelihood of their family members. Practice of agroforestry one-way or the other served farmers as a source of food and cash. The predominant farm based economic activities in the study area are vegetable production, tree crop production and livestock keeping. The introduction of the chemical fertiliser and irrigation facilities have resulted in more intensive use of land in growing different types of crop and vegetables that supply food for the households. Trees on farmland contributed fuelwood for cooking and fodder to the livestock, fruit as a source of food. In addition to this trees play important role for preparation of local medicine and soil conservation.

Livestock and livestock products have indispensable roles in generating cash, nutrition and maintaining the productivity of the farmland. Location of the area close to Gajuri opened up avenue for selling mainly vegetables and livestock products. The transport facility gave farmers easy access to regional markets (Kathmandu or Narayangarh). Livestock products, vegetables and fruits that are not sold at Gajuri are brought to those regional markets. These products are sold through middlemen or farmers themselves in Kathmandu or Narayangarh. Although farmers are aware of the markets, an organised marketing mechanism does not exist in the study area. In the continuum from marginal to large households, marginal and small farmers depend mostly on off- farm sources compared to medium and the large farmers. Income from farm sources contributed highest proportion (60%) of the total farm income (Table 9). This income includes the sale of vegetables, fruits, livestock, milk, fodder seed and

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crop. Beside the on-farm income, being close to the highway mainly small and marginal households access seasonal off farm employment opportunities in the form of labour. Average 40% of the total household income is derived from off-farm employment opportunities (Table 9) mainly from service/teaching, business trade and labour. The income generated is used to maintain or improve living conditions especially to purchase household materials, crop seed, and agricultural tools and cover health, education and festival costs.

Table 9. Household income by sources in Majhitar in NRs

Income sources	Average income/HH	Income (%)	Total income (%)
Farm income			
Fodder seed/slip sold	330.36*	2.36	1.43
Crop	2721.52	19.46	11.75
Livestock/milk	4027.38	28.79	17.39
Vegetable/fruit	6909.43	49.39	29.83
Sub total	13988.69	100.00	60.39
Off-farm income			
Business/trade	714.29	7.79	3.08
Wage/labour	1845.24	20.11	7.97
Service/teaching	6614.29	72.10	28.56
Subtotal	9173.81	100.00	39.61
Total	23162.50		

(* NR 330.36 = US Dollar 5.64)

DISCUSSION

This case study indicates a number of patterns in the study area. The history shows that as the resource become scarce farmers change their survival strategy either by migrating to productive areas or by diversifying their current practices. The hill farmers who have experienced low productivity and the lack of economic opportunities migrated to the Majhitar, which was an ideal place for growing different types of crops. But Majhis who were originally from Majhitar have shifted from fishing to farming when fishing alone no longer supported their livelihood. The agro-silvo-livestock keeping system practiced in the study area helped farmers to produce a wide variety of products such as fodder, fuel wood, livestock and crops. The combination of different trees balanced the environment and helped to protect and manage the forest and common land area. But the conversion of forest and common land areas in the form of community forest restricted the access of households for grazing. This was especially detrimental to the small and marginal farmers who depend on it for their livelihood. Mixed plantation of indigenous and exotic trees in the terrace riser and home garden strengthened the existing agroforestry practices. Households maintained diverse trees because of their specific values, which contributed towards biodiversity conservation. These households were found to be

interested to increase number of trees on the farmland as long as their farm accommodates and they get preferred species. The policy in rhetoric emphasises agroforestry development but in reality the practice of officials puts national forest land development in priority. This practice has created a communication gap between forest officials and households that raises question for the future sustenance of agroforestry system in Majhitar. The pattern of land holding size, fodder trees and livestock shows that the rate of adoption of agroforestry could be higher with large farmers as compared with marginal farmers. Although NAF aimed to uplift the poor and marginal farmers through agroforestry, in realities the program has not contributed to uplift those farmers. Thus the agroforestry programme rather contributed to widen the gap between large and the marginal farmers. This suggests the need for other alternatives such as non-land-based activities that would create employment opportunities to augment the income of marginal farmers. The pattern of social inequity raises questions to the whole agroforestry discipline on how agroforestry contributes to poverty alleviation. Even though programmes are facilitated with good intentions for alleviating poverty, they produce negative results. Agroforestry development brought changes in the whole spectrum of the farming households: however it did not attain social equity. Therefore development and equity do not go together in a community where there are large and marginal households.

The pattern of income sources show that marginal farmers depend on off farm income sources while large farmers depend on farm income sources for their survival. Mainly male members from marginal land holding households migrate far distance for off farm work while male members from large landholding households have enough incentive to stay on their land. Since male members from marginal landholding households are compelled to go out of home for earning, female members of these households have to maintain both the on-farm and off-farm activities. This means they become more independent in making decisions about domestic expenses. Large land holding households are male dominated and their female members do not engage so much in decision-making. These patterns in terms of gender suggest that female farmers with marginal land holding are more empowered and independent than those with large land holdings. This raises questions about how agroforestry programmes contribute to women empowerment. Likewise increasing investment of household income in education significantly contributed to increase in the numbers of educated young people. However the educated youth are tending to avoid farming, which is challenging the future of subsistence farming.

The increasing access to the market has gradually created more opportunities for off-farm activities and intensification of cropping pattern to produce more market-valued livestock products and vegetables. Quick profit obtained from these products especially vegetables motivated households to increase the intensity of use of agro-chemicals. This pattern indicates that as the cash demand increases farmers tend to increase the intensity of agrochemical use, which in the long run pollutes soil and water and impacts on the health of the household. This calls for the use of alternative technologies such as integrated nutrients and pest management. The changing farming pattern suggests that market based farming is gradually replacing subsistence farming. But the sale of agroforestry products through middlemen or on individual basis does not contribute to households fetching optimum price for their products. Strengthening of women's savings groups in parallel with the development of the agroforestry programme may facilitate the establishment of a sustainable source of funds for group

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members' income generating activities. Converting women farmer groups into savings and credit cooperative can represent the common interests of a larger proportion and can be a means to market agroforestry products in an organized way. Such institution not only raises income but also strengthens the group capacity to mobilise community resources (Pandit et al., 2001).

CONCLUSION

The degradation of the forest resources and population pressure posed great challenges towards land intensification and diversification of income sources for the livelihood of the Majhitar farmers. The formation of women saving group to solve the common problem of fodder shortage and trees cultivated in the farm land contributed towards generating income of the households and reduced pressure on the national forest land. The greater awareness of households towards economic and environmental benefits of agroforestry could be attributed to the higher rate of education of households and external intervention. The hill agroforestry system contributed to biodiversity conservation and production of diverse products to maintain the livelihood of the farming households. However the system has not contributed to the economic improvement of the small and marginal farmers that posed challenges to maintain social equity in a community. The system has rather widened gap between large and the marginal farmers. The influence of external organisation, increasing access to market, road and transport made farmers shift from subsistence to the market based farming. Gradual increase in the production of crops and animals for cash contributed towards the commercialisation of the agroforestry system. Development of organised marketing mechanism could help these households to cope with the changing agroforestry system and outside market outlets. The increased access to road and transport created opportunities especially for small and marginal households to engage in off-farm activities for the sustenance of their livelihoods. Different categories of households from large to marginal adopted different strategies for meeting their livelihood need. Households have developed their own preferences towards fodder trees. Extension organisation in their extension programmes need to give priority to the households' preferred fodder trees based on their own experience and that fit to their specific local condition. This necessitates participation of households in planning and implementation of agroforestry programmes. Policy makers need to draw their attention to understand first households' need and knowledge and their strategies in the development of agroforestry policies for the sustenance of rural livelihood.

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