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SUSTAINABLE ENVIRONMENTAL SANITATION AND WATER SERVICES

Non-timber forestry products on marginal lands

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THE INTEREST IN domestication of non-Timber Forest Products (NTFPs) has built up over recent decades in watershed conservation and economic development of rural people (Arnold and Manuel, 1998). Several varieties of wild and domesticated NTFP fulfill subsistence requirements of thousands of hill tribes and other ethnic groups in economically and physically isolated watershed areas in Nepal (Subedi, 1997). Each year Nepal exports about 10,000 to 15,000 tones of NTFPs, comprising of 100 species, to India (Edwards, 1996). Annual sales of a single herbal processing company of Nepal during 1999/2000 was worth about 34.8 million Rupees (Herbal Processing Company, 2000).

In the middle hills of Nepal where nearly 55% of people have less than adequate food (CBS, 1996), NTFP domestication can play a significant role. This problem of food scarcity is likely to aggravate in the future, as the current average land holding size of 0.75 hectare continues to shrink due to population growth and scarce non-farming employment opportunities (Pandit, 1999). Besides outmigration, encroachment of forest, wherever opportunity exists, and land use intensification have been alternative strategies adopted by mountain people to fulfill their subsistence requirements. Despite farmers' land management practices, the cereal-based land use system, requiring regular hoeing and harrowing of land has led to accelerated soil erosion on hill slopes (Thapa and Weber, 1995; Paudel, 2001). Further intensification of the current land use system combined with encroachment of forest would certainly accelerate the pace of environmental degradation, eventually threatening the sustainability of the mountain livelihood system. This will inflict a severe impact particularly on the hill tribes who are poorest of the poor among the poor mountain people. The increasing demand for NTFPs and environmental suitability for their production in the mountains offers a viable alternative opportunity for addressing poverty and watershed degradation problems in the hills.

Study area and research method

This paper has made an attempt to generate much needed information with particular reference to a small watershed, Malekhu Khola divided into two elevational zones, the lower (418-800m) and the upper (801m-2400m) in the middle mountains of Nepal. Data required for this study were collected from both primary and secondary sources. Primary data were collected through a household survey, group discussion and observation. Official reports, journal articles and books were the secondary sources of information. A sample size of 324 households was drawn randomly using a random number table from a total of 3060 households. Sub-samples for two watershed zones were determined proportionately corresponding to the total number of households in respective watershed zone. Sample household was surveyed using a standardized questionnaire

Table 1. Number of NTFP species per household grown on marginal and cultivated uplands

NTFP species	Marginal lands (Kharbari and Khoria)				Cultivated uplands (bari and gharbari and khet)			
	Upper		Lower		Upper		Lower	
	Mean	%	Mean	%	Mean	%	Mean	%
Dendrocalamus species (no)[c]	5.5 #	34	5.9 #	39	1.8*	37	2.5 *	52
Arundinaria intermedia (no)[c]	9.3 *	60	4.4 *	11	2.6*	67	1.4 *	11
Thysanolaena maxima (no)[b]	65.6 *	50	37.8 *	20	37.1*	71	13.4*	27
Bassia butyraceae (no)[t]	8.5 *	17	4.6 *	20	2.4 #	19	2.1 #	26
Terminalia chebula (no)[t]	3.12 #	5	7.4 #	10	1.6 #	03	1.8 #	11
Emblica officinalis (no)[t]	NA	NA	3.8	11	NA	NA	NA	NA
Cinnamomum tamala (no)[t]	NA	NA	NA	NA	3.0	7	4.3	4
Myrica esculenta (no)[t]	16.4	9	NA	NA	4.5	13	NA	NA

Source: Field survey, 2001, NB: [c] = clump type, [b] = bush/grass type, [t] = tree type, % indicates the percentage of household growing NTFP species, * t is significantly different at 0.05 confidence level, # t is not significantly different at 0.05 confidence level

during the month of May –November 2001. There are mainly 5 ethnic groups: Brahmin, Magar, Tamang, Chepang and Artisan in the watershed. Brahmins are skewed to the lower zone. While Tamang and Chepang are concentrated in the upper zone. The other two groups are distributed throughout the watershed. Of the total households, almost two-thirds of the households belong to Tamang and Chepang.

Research results

NTFP domestication

Growing assorted types of NTFPs on edges and terrace risers of rainfed farm lands including shifting cultivation and permanent fallow plots, locally called khoria and kharbari respectively, for cash earnings as well as for domestic use has been a long established practice of the farmers in the study area. Most people in the upper zone cannot produce enough food because of small landholdings located on steep slopes. Therefore, in particular they have utilized very marginal land and abandoned terraces for growing *Typha angustata*. They have made efficient use of this type of land by growing locationally suitable NTFPs like *Dendrocalamus*, *Arundinaria intermedia* and *Thysanolaena maxima, Bassia butyraceae and Myrica esculenta* (Table 1), because this type of land is not suitable or economically beneficial for growing cereal crops. With the exception of *Emblica officinalis* and *Cinnamomum tamala*, the average number of individual NTFP species is found to be more than double in marginal lands than in cultivated lands (Table 1). Notably, *Emblica officinalis* is grown only on marginal lands in the lower zone. While *Cinnamomum tamala* is grown only on cultivated land in both upper and lower zones.

Bassia butyracea is another important NTFP found mainly in both elevational zones (Table 1). Its seeds contain very high amount of fat, which is traditionally used for cooking food. Nowadays, the fat extracted from *Bassia butyracea* is being utilized as ingredients of several kinds of industrial products, including nectar (Court, 1995).

Reducing poverty through NTFP domestication

NTFPs grown on marginal lands have considerably contributed to farm household economies, as 24% of the annual household income in the upper watershed and 13 % in the lower watershed is accruing from the sales of NTFPs based products (Table 2).

There is a significantly different (P.01) tendency of increasing of NTFPs contribution to the household economy from lower to the upper zones. At the lower watershed, biophysical conditions are relatively more suitable for cereal crop production. Likewise, the location of the area close to the highway has created non-farming income earning opportunities. Therefore, farmers have so far not paid much attention to domestication of NTFPs. Contrarily, in upper elevations biophysical conditions are not much suitable for cereal crop production. Settlers are therefore, growing more NTFPs there. The domestication of NTFPs in the study area has been encouraged by the highway, which connects this area with the capital and regional cities.

Maintaining healthy watershed condition through NTFP domestication

The domestication of NTFPs has reduced local people's dependency on NTFPs as well as other forest resources, as the frequency of visit to forest for fodder and fuel-wood resources is found to be reduced with the increasing NTFP domestication (Table 3). People in the study watershed are earning cash income from the sales of NTFPs without inflicting damage upon forest resources. Growing high value NTFPs on private land is financially more attractive and ecologically beneficial compared to cultivation of cereal crops. Being a non-tillage type of land use, NTFP helps control soil erosion on agricultural lands effectively. Attempts have been made to show how NTFP domestication has helped to save watershed resources in the study area.

The multiple regression analysis (Table 3) reveals that only four independent variables are significant predictors

Table 2. Average annual cash income per family (in Rupees) from various sources

Sources of income	Upper zone	Lower zone
Sale of livestock and livestock products #	2485 (18)	3115 (16)
Cereals (paddy, maize, wheat, millet)*	3585 (25)	5563 (28)
Vegetable and fruit*	819 (06)	4125 (20)
Off-farm (wages, salary and business)*	1781 (13)	4108 (20)
Income from wild NTFPs**	2018 (14)	750 (04)
Income from domesticated NTFPs*	3420 (24)	2542 (13)
Average total annual income per household	14108	20203

Source: Field survey, 2001, 1 USD = 75 Nepali currency Rupee
* t is significant at P<0.05 and ** P<0.01 and # is not significant at P<0.05,
Note: Values in parentheses refer to the percentage of total income

of income from NTFP domestication. They include frequency of visit to forest, shifting cultivation land area, duration of fallow period and skill of making NTFP goods. The computed coefficient of multiple correlation (R) value of both independent and dependent variable is 0.850 and 0.718 (R^2). In other words, 71.8 % of the variation in the model is explained by the combined effect of the four independent variables. By analyzing the share percent of each of the four variables, it is apparent that "frequency of visit to forest" explains the highest variation (47%) followed by shifting cultivation plot (28%), skill of making NTFP goods (19%) and duration of fallow periods (16%) (Table 3). The negative coefficients of the variable, "frequency of visit to forest" indicates that farmers with high domestication of NTFP are visiting forest less times for collection of forest resources like fodder, fuel-wood and leaf litter.

The "shifting cultivation landholding" is the variable with the second highest correlation coefficient and is positively and highly significant to dependent variable (P<.01). The highest positive coefficient indicates a very strong tendency of increasing income from domesticated NTFPs with increasing size of shifting cultivation landholding. As mentioned above, this type of lands are not suitable for field crop cultivation, they are therefore being utilized for growing NTFPs. It is important to leave the shifting cultivation plots fallow for longer duration as this practice not only protects the soil from erosion but also increases income from NTFPs grown in such lands. The usual practice of farming in these lands is that farmers leave some important NTFP producing trees such as *Myrica esculenta,* bushes (broom grass) or clumps (bamboo) to grow on longer fallow shifting cultivation plots while removing other unwanted plants in the next cycle of shifting cultivation. This practice has increased the income from domesticated NTFPs and hence has positive relationship with the dependent variable with third highest coefficient. It implies that longer the fallow period of shifting cultivation land the better the condition of watershed and the more income from perennial NTFPs.

By virtue of their traditional skill, Chepang and Tamang particularly at high elevational zone make assorted types of mats and baskets from bamboo grown on marginal as well as cultivated rainfed uplands lands and sell these products in cash as well as in kind. Likewise, villagers have been increasingly growing *Thysanolaena maxima* on marginal lands as well as on terrace risers in view of high demand for brooms made from this species. Besides enabling these hill people to acquire supplementary income to fulfill their daily needs, growing bamboo and other NTFPs on very steep lands has contributed to control erosion and maintain the watershed condition. The skill of rural tribal group has become an important indicator for increasing the income from domesticated NTFPs and for improving the condition of watershed. This has been explained by at least 19% of variations in the regression model (Table 3).

Conclusions

Growing NTFPs grown on farmlands to fulfill basic household needs have been a long established tradition in the mountains of Nepal. With the gradual market integration of some of the watersheds, NTFPs have been important sources of cash income particularly for very poor groups of people, with small landholdings. In the study area, tribal groups like *Chepang* and *Tamang,* living mainly in the higher elevations, have benefited considerably by selling raw and processed NTFP species grown particularly on marginal watershed areas, which are not suitable for cereal crop cultivation. In virtue of their inherited skills, these people are earning substantial amounts of income from the sale of NTFP based products. However, in the middle and lower elevations, with the majority of ethnic groups belonging to the higher caste, NTFPs have played a relatively small role in the household economy because of lack of NTFP based handicrafts making skill and higher amounts of cereal crop production. Domestication of NTFPs has reduced population pressure on forests. But due to open access to forests particularly in the upper watershed, local people have still continued collecting economically valuable NTFPs from forests without care of their sustainable availability. Despite this, forests in the upper elevations have not degraded so far, as the local population is still very small. In view of the steadily growing population, on the one side and free access to forests, on the other, the

Table 3. Stepwise multiple regression: NTFP domestication by selected independent variables

Step	Variable included	Multiple R	R^2	Standardized coefficients Beta
1	Frequency of visit to forest	0.793	0.629	-.47
2	Shifting cultivation land	0.829	0.688	.28
4	Duration of fallow period	0.846	0.716	.16
5	Skill of making NTFP goods	0.850	0.722	.19

Source: Field survey, 2001

condition of forests is likely to degrade in the future. Therefore, there is need to promote community forestry as well as NTFP domestication program particularly in the upper elevations in order to ensure sustainable conservation of watershed and enable local people to improve their economic condition.

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