Various patterns of retaining trees in indigenous agroforestry practices in the mid-hills of Nepal

Rabindra K. Shrestha[1]

Trees in the farmland have key role in sustaining the mid-hill farming system of Nepal, which is a complex, traditional and highly integrated with its components-forest/tree, livestock and crops. The existing indigenous practice of retaining trees on various places of farmland plays a major role on various functions performed by trees. A survey conducted in 1995 on finding out those practices in two villages from two different agro-ecological zones, revealed that there were five specific different parts of various farmlands used for retaining trees. Most commonly used parts of farmland were middle of Terrace (T) Riser (R) and outside T on T edge. Since they were reported to have good effect on soil conservation and fodder and fuelwood production. In addition, they occupy insignificant space of cultivated land.

Key words: *Bariland*, farming system, fodder tree, indigenous, *Khetland*, terrace riser

The mid-hill region of Nepal is generally rugged mountain topography. This has attributed to extreme differences in elevation within a short horizontal distance resulting into complex climatic conditions. The region covers 43% of the country's total land and supports over 46% of Nepal's population. More than 90% of the people derive their livelihood from farming activity and 80% of them are subsistence farmers.

Here, people are still practising a traditional system of farming which is labour intensive and complex. This has forced them to practise integrated farming system where three distinct components—livestock husbandry, forestry and arable cropping are given equal weightage. Production out-put of one component has direct bearing on the production out-put of other and so; it is virtually impossible to adjust one aspect of the farming without affecting others (Mahat 1987; Yadav 1992). Forest/tree is the foundation upon which the whole sustainability of hill farming is based as it is a major source of biomass for transferring a green material (fodder/forage and leaf litter) to the most needed soil nutrient, and is the only available source of fertiliser in the region. In addition, it also provides over 90% fuel energy for cooking and heating, timber and helps protect against landslides and erosion.

The deforestation indirectly affects soil fertility and has contributed to decline in crop productivity from 4% to 40% on Bariland[1] and 3 to 20% on Khetland[2] (Vaidya *et al.* 1995). Problems such as shortage of forest resources have been reduced to some extent by the mid-hill farmers through retaining or keeping tree in various parts of their farmlands along with crops for centuries despite having limited landholding. Although, the presence of trees on the farmland causes some loss in crop production, the amount of loss is considered less than benefits received (Shrestha 1994). Many authors (Fonzon and Oberholzer 1984; Thapa *et al.* 1989; Thapa 1990; Robinson 1993; Shrestha 1994) mentioned about keeping or retaining trees of various species by mid-hill farmers in their different type of farmland. However, there has merely been any document, which suggests different pattern of retaining or keeping different trees species by farmers on various parts of their land. According to farmers, these different positions of trees on the farmland have direct and indirect impacts on various functions performed by trees in the mid-hill farming systems.

Although, Agroforestry (AF) practice is a newly evolved technology among technicians and extensionists, its many forms have been instrumental in sustaining farming systems of the region for

[1] Senior Programme Officer at Natural Resource Management Sector Assesstance Programme (NARMSAP), Babar Mahal, PO Box 8713, Kathmandu, Tele No. 231218/231219; email: narmsaprabi@mail.com.np

centuries. Such ecological understanding developed by one farming community may be relevant to address the constraints encountered by other communities and so, investigating local knowledge may be a powerful, efficient and rapid means of filling the gaps in scientific understanding of AF (Walker *et al.* 1995). Some of them could be replicable to many parts of world.

This study was conducted in two different villages situated at two separate agro-ecological zones of the mid-hills to identify indigenous knowledge of farmers on retaining trees in different places of farmlands and their impact on soil conservation, and fodder and fuelwood production. Since they are the major processes for conserving nutrients to arrive at an Integrated Plant Nutrient System that is essential for the sustainable agricultural development. The main goal of this paper is to present findings of the study where farmers were applying their indigenous knowledge in practising AF.

Materials and Methods

The field studies were conducted during 1995. Those selected villages for study were—Thumko village (550masl) of Bandipur Village Development Committe (VDC)[3] from Tanahu district and Tapke village (1350masl) of Keware Bhanjyang VDC of Syanjga district from the Western Development Region of Nepal.

The study used three different perspectives where both direct and proxy indicators were applied to collect information. The direct indicators included group discussions with selected farmers and the direct observation of the farmland. Information on different parts and places of various kinds of farmlands for retaining trees, and their effectiveness in controlling landslides and erosion, and fodder and fuelwood production at different position were collected. A structured questionnaire survey was employed as a proxy indicator to collect indirect information with some individual farmers of study villages. It was carried out through individual farmer interviews, inquiring into similar perspectives as mentioned above but from different aspects. The information obtained from the questionnaire was crosschecked to confirm the findings of group discussions.

Prior to conduct field studies checklists, guidelines and individual questionnaires were tested in other similar villages to examine their potentiality and practicality in collecting right information. For group discussions, households were divided into three categories on the basis of land holding—small farmers with up to 10 *Ropanis* (<0.5ha), big farmer with more than 10 *Ropanis* (>0.5ha) of land and one on gender-women group irrespective of landholding to note any difference in practices according to land holding size and women. A separate group discussion with women was also conducted, as they generally do not express their individual views and knowledge freely in a general mass.

A checklist and guideline was prepared and used informally to carry out group discussion. Each participant participated actively during group discussion. During each group discussion, a careful observation was made to avoid polarisation. For direct observation, on site field visits were made to locate trees in different parts of farmlands and their impacts on soil conservation with naked eyes.

Fifty percent of the households were interviewed in each study villages. The upper village, Tapke and lower village, Thumko has a total of 70 and 82 households respectively. In most cases household heads were interviewed, however when he/she was either absent or unable to respond due to some unavoidable reasons, other responsible members were interviewed. In all perspectives very similar information were collected but from different aspects. The collected data are presented in tabular forms wherever possible, otherwise in the text form.

Results and discussions

Location of trees in different type of farmlands

Most of farmlands have five different locations for retaining trees and they are - Middle of Terrace Riser (TR), Terrace (T), Inside T towards TR, Outside T on T edge and bunds/boundary as shown in Figure 1.

(a) *Bariland*: - it is almost 70% of the total cultivated land in the region. Among different locations the middle of TR and outside T on T edge were the two places of *bariland* that were having the highest number of trees (Table 1). The terrace was least used place for retaining trees since it was the only available cropland for cultivation. Some trees were also retained inside T towards TR. The trees in middle of TR were found bigger in size than trees in outside T on edge.

(b) *Khetland*: - The outcome of group discussion revealed that very small part of *khetland* was used for trees in upper village compared to lower village. It was reported that middle of TR with high Terrace Riser was generally used for trees where as middle of TR with small TR was less used for trees.

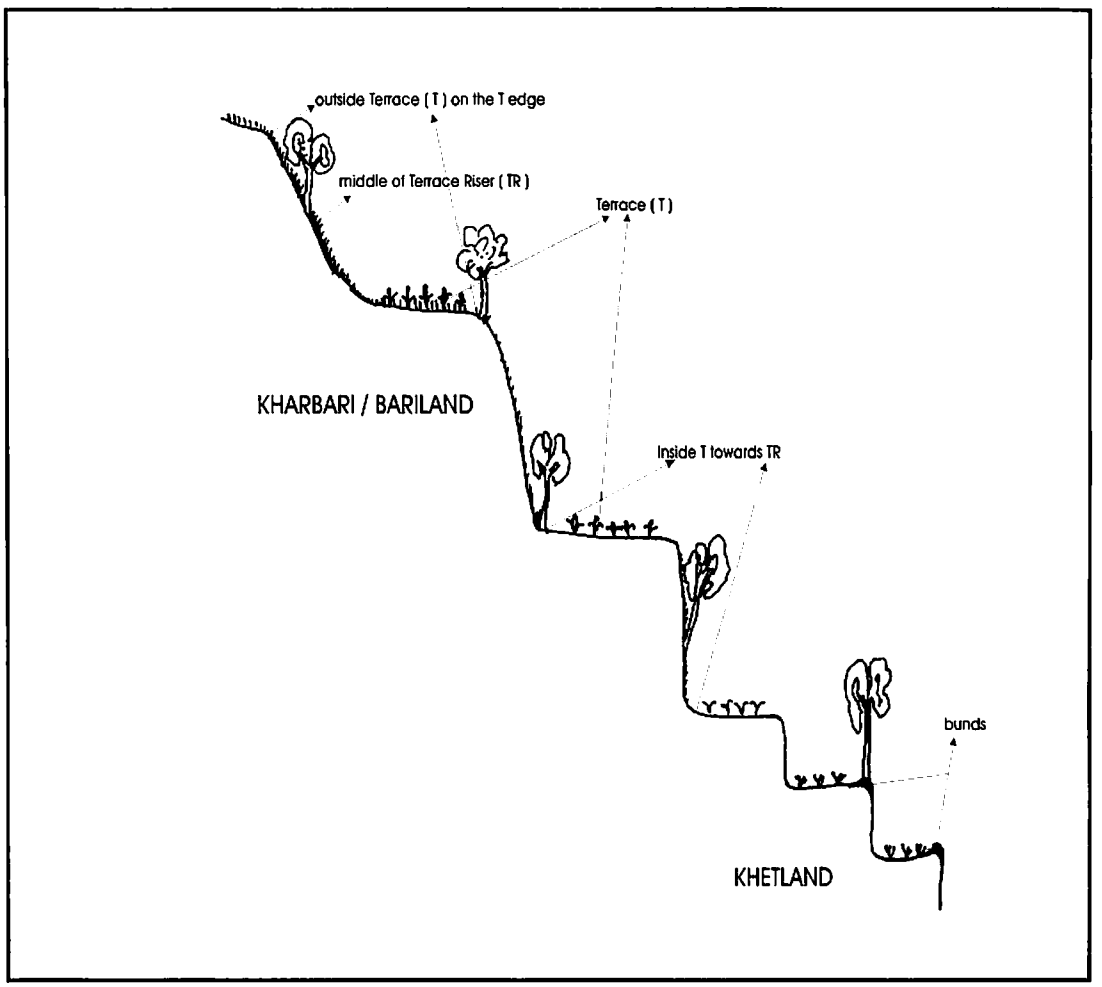

Figure 1: Cross section of Terrace cultivated lands showing their different parts for retaining trees

Table 1: Household responses on retaining trees/shrubs at different places of lands at Thumko (550 m) and Tapke (1350 m) villages

Lands Type	Farmers response (%) at different altitudes (m asl)							
Different parts of land	*Bariland*		*Khetland*		*Kharbariland*		Marginal land	
Altitudes	550m	1350m	550m	1350m	550m	1350m	550m	1350m
Middle of TR	100 (35)	95.1 (39)	54.4 (19)	24.4 (10)	22.9 (8)	31.7 (13)	2.9 (1)	14.6 (6)
Terrace (T)	Nil	2.4 (1)	Nil	Nil	2.9 (1)	Nil	11.5 (4)	14.6 (6)
Inside T towards TR	42.9 (15)	34.1 (14)	Nil	Nil	Nil	4.9 (2)	8.7 (3)	9.7 (4)
Outside T on the T edge (Top of TR)	100 (35)	70.7 (29)	8.6 (3)	19.5 (8)	88.6 (31)	53.6 (22)	65.8 (23)	2.4 (1)
Bunds/Boundary	Nil	Nil	37.2 (13)	12.2 (5)	Nil	Nil	43.0 (15)	19.5 (8)

Note: Numbers in parenthesis are the actual number of households responded.

Cleaning of small TR is an annual practice for avoiding rodent damage to rice crop and so, nothing is allowed to grow in TR during the cropping period. Bund was the next common place for trees after middle of TR. Trees retained in bunds was found in dense form during field observation. Compared with *Bariland*, small number of trees was found on *Khetland*. 54% and 24% of interviewed farmers respectively have trees in the middle of TR in Thumko and Tapke villages. The bund was (37% and 12% respondents of Thumko and Tapke village respectively) the next location after middle of TR. The terrace was rarely used for retaining trees. It is noteworthy that terrace of *Khetland* is the only place where the most important crop, rice is grown.

(c) *Kharbariland*[4]: - It is commonly a sloping terrace to steep slope land (more than 30%) or abandoned *Bariland* due to poor fertility. Some *Kharbarilands* can have similar parts like that of *Bariland*. Here, more trees were retained but in scattered form and along the contour of slope which is outside T on T edge. 89% and 54% of respondents from both the villages respectively have more trees in outside T on T edge (Table 1). Only 23% and 32% of households from Thumko and Tapke village however, reported of retaining trees in the middle of TR.

(d) Marginal land[5]: - It is an abandoned part of farmland (gullies or badly degraded land) due to landslides and erosion, generally found distributed in between cultivated lands, but is not common in all farmlands. This type of land can have different parts like other. The group discussion from both villages concluded that although outside T on T edge has largest number of trees, they were more confined to either side of gullies with few trees scattered here and there. The group also said to have trees in boundary but less than in outside T on T edge. Farmers were more interested to retain more trees in such land since it is unfit for crop production. The trees retained on such land were in a dense form. Over 65% of farmers from Thumko mentioned that trees were retained in outside T on T edge but almost no farmer from Tapke responded in that respect. Similarly 43% and 20% of farmers from lower and upper villages respectively mentioned that they have trees on bunds/boundary.

Impact of trees on soil conservation and fodder and fuelwood production

Group discussion and respondents from both villages reported that trees retained in the middle of TR and outside T on the T edge were ranked first and second respectively for soil conservation, and fodder and fuelwood production (Table 2). Most of terraces of farmlands with trees in the middle of TR and outside T on T edge were found more intact with very little damage caused by water. However, terraces of some farmlands with big trees grown outside T on T edge were seen collapsed during the field observation. It was also reported that terraces with trees on such locations need very little or no annual maintenance than terraces without trees or with trees inside T towards TR and other places. Groups also reported

Table 2: Farmer's response on impacts of trees on soil conservation and fodder and fuelwood production

Impacts altitude places	Impacts of trees on soil conservation and fodder & fuelwood production											
	Soil conservation				Fodder production				Fuelwood production			
	550m		1350m		550m		1350m		550m		1350 m	
Rank	**	*	**	*	**	*	**	*	**	*	**	*
Middle of TR	94.3	5.7	82.9	14.6	94.3	5.7	68.3	29.2	82.9	17.1	65.9	29.3
Terrace(T)	nil	nil	2.4	2.4	nil	nil	4.9	nil	nil	nil	2.4	nil
Inside T towards TR	8.6	34.3	19.5	14.6	19.9	22.9	17.1	17.1	22.8	20.0	19.5	9.8
outside T on T edge	94.3	5.7	41.5	36.6	82.9	17.1	56.1	22.0	85.8	14.3	43.9	31.7
Bunds & boundary	25.7	5.7	48.8	9.8	17.2	14.3	26.9	19.5	22.8	8.6	29.3	24.4

Note: - ** Good; * Not so good

that trees in the middle of TR and outside T on T edge produce more fodder and fuelwood than any other places. Nevertheless, it was mentioned that if trees were grown in terraces they would have produced more fodder and fuelwood than any other places. However, it was rarely used for retaining trees. It was reported that collection of fodder and fuelwood from trees retained in middle of TR were much easier than trees grown in any other locations, which was put more strongly by the women groups of both villages. Trees inside T towards TR were said to be less effective for soil conservation than trees in bund/boundary. It was reported that bunds were effective in protection of *Khetland* form river/ stream cutting. Furthermore, it was reported that trees in outside T on T edge protect terraces from damages caused during ploughing.

Among five identified locations of different farmlands, middle of TR and outside T on T edge were revealed to retain maximum number of trees in either altitude. Middle of TR was ranked first and outside T on the T edge was classified second. In addition, trees on those parts were reported to have more effect on the protection of terraces from landslides and erosion apart from providing good production of fodder and fuelwood than trees from any other parts of farmland. Similarly it was reported that terrace was used least for retaining trees. Among different farmlands, middle of TR and outside T on T edge of Bariland were found having highest number of trees.

According to farmers, trees protect the cultivated terraces from failures caused by rain, water and river cutting as they act like a retaining wall and provide anchorage to them. In addition, they have very little competition with arable crops for nutrient and sunlight. Furthermore, farmers have had easy access for harvesting fodder and fuelwood and has saved significant amount of time for collecting fodder and fuelwood. It was reported that on an average of 9.9 trips/household/week are made to collect fodder and each trip takes up to 15 hours in the Eastern hills of Nepal (Abell 1981). It has thus allowed farmers to have some additional time to earn extra cash and is a substantial contribution in the daily life of women, especially, as they are the main member of the family responsible for collecting fodder and fuelwood.

Above all, trees in the middle of TR and outside T on T edge do not occupy any part of arable cropping land. Therefore, they address problems related to increasing population call for greater production from a fixed land base. But if, trees grown outside T on T edge were allowed to grow very big, they some time cause failure of farmland terraces and therefore, should not be allowed to grow very big. Such trees do not compete much with crops for nutrient and sunlight but in compare to trees on middle of TR they compete more for sunlight and nutrient. Above all, trees from these two locations make maximum use of available nutrients, which would have been lost due to leaking in deep layer of soil for nothing. Terrace is rarely used for retaining trees since it is the only land available to grow their staple food. Nevertheless, some fruit trees were seen planted or retained on terrace but in very small number and very few farmers have this practice. Trees grown in terrace definitely would have much better growth than any other parts. Trees inside T towards TR compete more with crop for nutrient and sunlight and have little protection function. Furthermore, roots of these trees create problems while ploughing the terrace since roots spread along the terrace disturb the

cultivation. Apart from all they occupy good portion of farmland reducing actual area of cropping.

Very little or no difference was found in parts of farmland for retaining trees at both altitudes. This has revealed that the practice of retaining trees at both villages are subjected to the same objectives and up to this range, the altitude has little effect in retaining number of trees in different types of farmlands. Nevertheless, number of trees retained in different places was found decreased at Tapke than Thumko village. This reveals that number of trees retained decrease with increase in altitude.

Conclusion

The study revealed that there are five different parts of various farmlands, which have been used for retaining trees. Out of which two locations, middle of TR and outside T on T edge were mostly used as they are good for soil conservation, fodder and fuelwood production. These two practices of retaining trees do not occupy the actual cultivated land, an advantage to the region where it is very scarce. This pattern of putting trees with crop may not have implication on losing crop production. Therefore, resource poor farmers, who have problem with limited land, will be benefited by such tree retaining practices as they can get without loosing crop productions.

Identified indigenous practices of retaining trees can be applied in other similar domains of the country as well as to other parts of world. The study has further provided some benchmark information necessary to conduct a more detail investigation on identifying other patterns of AF practices that exist at higher altitudes. The indigenous practices at these two altitudes revealed that the number of trees decrease with increase in altitude. Therefore, the complex climatic variation within short horizontal distance in the mid-hills of Nepal can attribute to many other different important practices, the information on which can help farmers of similar domains in sustaining their farming system.

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Notes

1. *Bariland* is an unirrigated rain fed terraced land occupying largest portion of hill farmland with high TR.
2. *Khetland* is the only irrigated land available for paddy cultivation which occupies smallest portion of farmland in the mid-hills with low TR.
3. VDC is the lowest level of political and administrative unit consisting of few to many small hamlets.
4. *Kharbariland* is generally unterraced steep to sloping terraced land with poor fertility and is used for growing thatch grass
5. Marginal land is an abandoned parts of cultivated land due to landslide, erosion and poor fertility.

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