Proc. *Approaches for Increasing Agricultural Productivity in Hill a.id Mountain Ecosystem*
Eds. : B.P. Bhatt, K.M. Bujarbaruah, Y.P. Sharma and Patiram, pp. 129-138
ICAR Research Complex for NEH Region, Umiam, Meghalaya, 2003

2.2

Sustainability through Agroforestry in Himalayas: An Overview

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Mountains and hills have significant role in the socio-economic development of the country by providing some direct benefits such as forest products, non timber products, medicinal plants, plantation crops and agricultural crops etc. as well as indirect benefits such as diverse fauna and flora in the form of biodiversity wealth, control of climate, floods, carbon sequestration etc.

Mountain specificity includes fragility, inaccessibility, marginality, natural instability and human adaptation mechanism and these are to be addressed for hills' sustainable agricultural development (Shah, 1994). As such sustainability can be defined as maintaining an increasing production trend to ensure food security with future dimensions and achieving sustainability is depended on the conservation of the renewable base of our agriculture (Paroda, 2000).

Agroecological Regions

Planning Commission of India (1989) delineated the country into 15 agro-climatic regions considering physiography and climate. This classification divides Himalayan region into two regions, *i.e.*, Western Himalayan Region and Eastern Himalayan Region.

National Bureau of Soil Survey and Land Use Planning (ICAR) delineated the country in 20 agro-ecological regions and 60 agro-ecological sub-regions, considering soil scape, length of growing period and other environmental conditions (Sehgal *et al.* 1992;

Table 1. Agroecological regions, their climate and forest types in Himalayan Hill Region of India

Region No.	Agroecological regions	Sub-regions	Forest types
1	Western Himalaya, cold arid	1.1 Eastern aspects of Ladakh Plateau 1.2 Western aspects of Ladakh Plateau	Snow covered most of the time
14	Western Himalaya, warm subhumid and humid	14.1 South Kashmir and Punjab Himalaya 14.2 South Kashmir and Kumaun Himalaya 14.3 Punjab Himalaya 14.4 Kumaun Himalaya 14.5 Foothills of Kumaun	Moist temperate – 11 Subtropical pine - 9 Sub-alpine forests-14
16	Eastern Himalaya, warm per-humid	16.1 Foot hills of Eastern Himalaya 16.2 Darjiling and Sikkim Himalaya 16.3 Arunachal Pradesh	Subtropical pine-9 Wet temperate-12 Wet evergreen-1 Subalpine forests-14
17	North Eastern Hills (Purv-anchal), warm per-humid	17.1 Meghalaya Plateau and Nagaland Hills 17.2 Purvanchal (Eastern Region)	Wet evergreen-1 Tropical moist deciduous-3 Wet temperate forests-12

Velayutham *et al.* 2000). Agroecological regions of Himalayan region has been given in Table 1

Demographic and Livestock Pressure

Demographic factors play an important role on the existing farming systems. The population density of India is 324 per sq. km according to Census 2001 (Table 2) (Anonymous, 2001), while in the Himalayan Hill States it is comparatively low, *i.e.*, 13, 42, 76 and 99 per sq. km. in Arunachal Pradesh, Mizoram, Sikkim and Jammu and Kashmir respectively. In contrast to low population density, the decadal growth is comparatively higher in the seven hill states (out of 10) than the decadal growth of the country (21.34%). In Meghalaya, Mizoram and Manipur the decadal growth is about 30% but in Nagaland it is very high, *i.e.*, 64.4%. In a study conducted by Dhyani (2000) indicated that the human population density is 43 per sq. km. and livestock density value is 42 per sq. km in north eastern region and both are increasing rapidly. The overall situation indicates that in most of the hill states the population density is comparatively low but due to the high rate of decadal growth, the population pressure on the natural resources especially on lands and forests is going to increase in coming years. Most of the hill states show higher sex ratios than the national level (933 females/1000 males) and this suggests the need to utilize the potential of women in farming activities.

As far as literacy is concerned, it is comparatively high (65.38%) in the most of the hill states for example 88.49% in Mizoram, 77.13% in Himachal Pradesh, 73.66% in Tripura, 72.28% in Uttaranchal. The potentiality of hill farmers to utilize/adopt new farming technologies is quite obvious by the high literacy rate.

Due to increase in population pressure, the land in hills regions are not being used on scientific principles and without necessary conservation measures in most of the cases leading to the degradation of land, water and vegetation resources (Singh and Katoch, 2000). The burgeoning population of human beings and livestock is resulting in the higher demand of food, fodder, fuelwood and timber. This

Table 2. Provisional population of India and Himalayan states in 2001

India/State Union territory	Area (Sq. km)	Area	Persons	Popula tion (%)	Sex ratio (females/ 1000	Density (per sq. km)	Decadal grwoth (%)	Literacy (%)
Jammu & Kashmir	222236	6.8	10069917	1.0	900	99	29.04	54.46
Himachal Pradesh	55673	1.7	6077248	0.6	970	109	17.53	77.13
Uttaranchal	8479562	0.8	964	159	19.2	72.28		
Sikkim	7096	0.2	540493	0.1	875	76	32.98	69.68
Arunachal Pradesh	83743	2.5	1091117	0.1	901	13	26.21	54.74
Nagaland	16569	0.5	1988636	0.2	909	120	64.41	67.11
Manipur	22327	0.7	2388634	0.2	978	107	30.02	68.87
Mizoram	21081	0.6	891058	0.1	938	42	29.18	88.49
Tripura		0.3	3191168	0.3	950	304	15.74	73.66
Meghalaya	22429	0.7	2306069	0.2	975	103	29.94	63.31
India	3287263	100.0	1027015247	100.0	933	324	21.34	65.38

Census of India 2001, Series 1, India, Provisional Population Totals, Paper 1 of 2001. Registrar General & Census Commissioner, India, Year 2001. Pp. 184.

situation is causing increase in land area for agriculture and shrinkage of forests. This is also increasing exploitation, which is resulting in loss of biodiversity along with deterioration of natural resources.

Agroforestry Systems in Himalayan Hill Region

Planning and execution of agroforestry in farmland has a far reaching environmental and ecological effects. Modern concept of agroforestry is for cash, sustained production, environment and ecology with emphasis on rural and urban needs. Agroforestry not only provides higher return per unit area but also contributes for ecological, environmental benefits with biodiversity of plants and animals. In India, systematic research on agroforestry was initiated with the creation of All India Coordinated Research Project in 1983. At present, it is in operation at 35 centres, *i.e.*, 8 centres in ICAR institutes and 27 centres in various State Agricultural Universities. The results indicated that various agroforestry systems such as agrisilviculture, agrihorticulture, silvipasture etc. are being practised by the farmers. The choice of the system depends upon various factors such as agro-climatic, socio-economic, marketing etc. The agroforestry systems being used in Himalayan Hill Region are given in Table 3.

Western Himalayan Cold Arid Agro-ecological Region

Temperate areas of Ladakh have very low rainfall, limited cropping period, high soil erosion and low soil fertility. In Changtang and Rupchu areas of Ladakh, the population

Table 3. Agroforestry interventions proposed for different centres of agroforestry in Himalayan Region

Agroecological regions	Centre of AICRP on AF	Agroforestry systems	Agroforestry interventions proposed
1. Western Himalaya, cold arid	Nil		
14. Western Himalaya, warm subhumid and humid	Srinagar	Agrisilviculture Silvipasture Energy plantation Hortipasture	• Agrisilviculture and silvipasture models are the best answers for the degraded and wastelands of Srinagar district. • *Ulmus wallichiana* with arable crops such as pea and maize followed by oatsmung + beans. • *Melia azedarch, Ailanthus excelsa Aesculus indica, Gliditsia trianthos, Robinia wallichiana* are good tree species at Shuhama centre. • Besides these tree species some tree and grass species e.g. *Cytisus scoporious, Andropogon verginicus* can also be used. • In almond orchards legume crops (red clovers and white clovers) and grasses such as *Festuca pratense* and *Dactylis glomerata* are recommended as horti-pastoral system.
	Solan	Agrisilviculture	• *Grewia optiva, Morus alba, Morus serrata, Acacia catechu, Populus deltoides, Tectona grandis, Toona ciliata* with wheat, paddy, sugarcane, vegetables, maize, barley, upland paddy, pulses potato.
		Hortisilviculture Silvipasture	• *Populus deltoides, Populus ciliata* with *Pyrus malus,* Citrus, *Small* fruits, Kiwi in irrigated areas.

Contd..

Agroecological regions	Centre of AICRP on AF	Agroforestry systems	Agroforestry interventions proposed
			• *Grewia optiva, Morus alba, Populus ciliata Toona ciliata,* with *Pyrus malus, Citrus,* Small fruits, F i in irrigated areas. • *Grewia optiva, Morus alba, Populus ciliata, Toona ciliata, Pyrus malus, Mangifera indica, Citrus* sp., *Prunus persica, Prunus domestica, prunus armeniaca* in rainfed areas. • *Morus alba, Grewia optiva, Robinia pseudoacacia, Popul us ciliata, Acacia catechu, Quercus leucotrichophora* with *Setaria anceps, Chloris guyana,* Hy. Napier, *Dactylis glomerata, Poa* sp., Red clover, White clover, *Stylosanthes hamata, etc.*
	Dehradum	Agrihorticulture	• *Mangifera indica, Litchi chinensis, Citrus* sp. etc. could be grown in systemmatic fasion with field crops. Cash crops (*Curcuma longa, officinale)* are ideal for peachgradens. *Artocarpus integrifolia, integrifolia, Musa paradisiaca* and *Carica papay* can be grown in homesteads.
		Agrisilviculture	• Principal crops (rice, wheat, maize etc.) could be grown with MPTs *Grewia optiva,Bauhinia purpurea, Morus alba, Eucalyptus* etc.) The possible sites for growing trees are field boundaries, terrace risers fields in a scattered fashion.
16. Eastern Himalaya, warm per-humid	Gangtok	Silvipasture	• *Ficus hookerii* + *Thysanoleana maxima* • *Ficus hookerii* + napier.
		Agrisilviculture	• Among 17 fodder trees, *Ficus lacor* gave highest freshfodder (204kg/tree). • Ginger, turmeric, large cardamom and Dinanath grass can be grown successfully (up to 11-15 m distance) and rice, soybean, fingermillet, Nandi setaria and fine stylo (beyond 15 m from bamboo shade. • *Large cardamon (*Amomum subulatum*) with utis (*Alnus nepalensis*).*
17. North Eastern Hills (Purvanchal), warm perhumid	Imphal	Agrisilvipasture	• Napier grass, maize with *Bauhinia variegata, Pinus roxburghii, Schima wallichii,* and *Artocarpus intergrifolia.*
		Agrihoritpasture	• *Citrus rotundifolia,* pineapple with napier. • rice, bean groundnut and soybean.
		Silvipasture	• *Eucalyptus* sp., *L. leucocephala* and *P. pedicellatum.*
	Lembucherra (Tripura)	Agrisilvihorticult ure	• Assam lemon is planted in inter spaces of *Acacia* Turmeric is also grown as inter crop. • Pineapple is planted in the spaces of 12 trees such as *A. auriculiformis, M. alba, Gliricidia sepium* etc. • Til is a compatible oil seed crop under *A. auriculiformis.*
	Barapani (A). High hill slopes (>45%) & soil depth	1. Pure Silviculture (250-400) plants/ha	• *Pinus kesiya, Schima wallichii, Cryptomeria japonica.*

Agroecological regions	Centre of AICRP on AF	Agroforestry systems	Agroforestry interventions proposed
	(<0.6m) (400 plants/ha)	2. Silvipastoral	• *Alnus nepalensis, Schima* wallichii, Michelia oblonga *Setaria* sp. / Guinea and grasses.
	(B) Upland (30-45%) & soil depth (0.6 - 1m)	3. Agrisilvi cultural (400-500 plants/ha)	• *Alnus nepalensis, Paraserianthes falcataria Michelia champaca, Erythrina indica, Parkia roxhurghii, Prunus cerasoides* and Soybean-linseed, Ginger/ turmericfollowed by groundnut in alternate year.
		4. Sericulture based	
		i) Agrisilviculture	• *Morus alba* (1.80 m x 0.9 m) and groundnut-mushtard.
		ii) Silvihortipasture	• *Morus alba* (0.9x0.9) *Syzyg-ium cumini* + *P. guajava* (6x4 m)/Assam lemon (4x3m) /pear (6x3 m) with pineapple in paired rows with fruit grasses on bunds.
	Slope (15 30%), Soil depth (>1 m)	5. Agrihorticulture	• *P. guajava* (5x2.5 m; 5x5 m; 5x7.5 m) with Ginger/ turmeric or groundnut/soybean or chilies + frenchbean; pineapple in guava rows + groundnut.
	Slope (15-30%), Soil depth (>1 m)	6. Agrihorticulture	• *P. guajava* (5x2.5 m; 5x5 m; 5x7.5 m) with Ginger/ turmeticor groundnut /soybean or chilies+ frenchbean; pine-apple in guava rows + groundnut. • Khasi Mandarin (5x2.5 m, 5x5 m) Assam lemon (4x3 m) with Ginger/turmeric or groundnut/soybean or chilies + frenchbean.
		7. Homesteads and Agriaquaculture	• *P. guajava* and *Musa paradisiaca* on bunds with groundnut/beans and chilies with *P. guajava* on bunds, rice in lowlands vegetables and fish in farm ponds.

Source - Pathak *et al.* 2000, * Venugopal, 1985

growth rate is more than 2.8% resulting into development of new settlements, conversion of new suitable lands into agricultural lands diversion of brooks for irrigation (Pfister, 2001). Substantial number of domestic animals also exits in this area for example in Changtang area livestock population is 1,40,000 of which 90% is of sheep and goat and 10% of zo, which is a crossbred between yak and cow. These animals have to compete with wild ungulates (Tibetan argali, Tibetan wild ass, blue sheep, Tibetan gazelle etc.) of the area, resulting into heavy overgrazing of pasturelands coupled with wind erosion. Therefore pasture management especially around the high altitude wetlands is a priority issue (Pfister, 2001). In this region the conditions are not favourable for the normal agriculture therefore hortipasture is being used on the land having 30 to 50% slope whereas, on more than 50% slope silviculture is in practice.

Western Himalayan, Warm Sub-humid and Humid Agroecological Region

Three AICRP centers, *i.e.*, Solan, Dehradun and Srinagar represent this region and their studies have shown significant results in evolving various agroforestry practices.

Solan

The main agroforestry systems under practice are agrisilviculture, hortisilviculture and silvipasture. *Populus* spp. are being incorporated in all three systems. The other commonly used species are *Grewia optiva, Morus* spp. and *Toona ciliata*. Of the main horticultural tree species are *Pyrus malus, Citrus* spp. The agricultural crops include wheat, paddy, maize barley, sugarcane etc (Sharma, 1997).

In a study on the role of agroforestry systems in total requirement of fodder, fuelwood and cash income at the village level in Himachal Pradesh, it was revealed that 12 tree species were used in indigenous agroforestry system and among these tree species *Grewia oppositifolia,* followed by *Celtis australis, Ficus palmata, Melia azedarach, Olea ferruginea* and *Robinia psuedoacacia. Prunus armeniaca, Prunus persica, Pyrus malus, P. pashia* and *P. communis are important horticultural tree species of the region* (Vishvakarma *et al.*, 1998).

Kachru (1997) has identified eight agroforestry systems among the various categories of the farmers such as marginal, small, medium and large farmers, in the subtemperate and sub-humid region of Himachal Pradesh.

Researchers of Dr. Y.S. Parmar Univ. of Horticulture and Forestry has showed that in sub-temperate sub-humid and mid hill region of Himachal Pradesh, agrisilviculture system of *Morus* spp. and wheat was suggested most profitable crop for intercropping that provide about Rs. 29,000 per hactare in comparison to sole crop system which gave Rs. 20000 per hectare (Solanki, 2000).

In a subtropical and submontane low hill regions of Himachal Pradesh, agrihorti-silviculture system of *Citrus reticulata and Leucaena* sp. with wheat and mash (*Vigna mungo*) gave 3.0 q of mash, 7.0 q of wheat, 17.0 q of fuelwood, 22.0 q of tree leaf fodder and fruits providing Rs. 15,000 per annum after seven years of establishment in comparison to 16.0 q of wheat and 20.0 q of maize in a conventional system (Solanki, 2000).

Dehradun

Agrisilviculture system is being practised using tree species like *Grewia optiva, Bauhinia purpurea, Eucalyptus* etc. with crops such as rice, wheat, maize etc. Agrihorticulture system is also in practice with *Mangifera, indica, Litchi chinensis, Citrus* spp. etc.

Srinagar

Agrisilviculture using *Ulmus wallichiana* with pea, maize, oats, mung etc. is being practiced and hortipasture with *Prunus amygdalus* and legume grasses (*Festuca pratense*). Silvipasture system with *Melia azedarach, Ailanthus excelsa* etc. as tree crops and *Cystisus scoporios & Andropogon verinicus*- grass species are popular among the cultivators.

For degraded and wastelands of Srinagar district, silviagriculture and silvipasture models were found suitable (Anonymous, 2000). The suitable tree species for slopes are *Melia azedarach, Aesculus indica, Gliditsia tricanthos, Gliditsia intermis, Ailanthus excelsa, Robinia psuedoacacia* and *Ulmus wallichiana* whereas, *Zea mays* showed better performance among agricultural crops (Anonymous, 2000). *Salix tetrasperma* showed better performance on the areas with high water table (Anonymous, 2000).

In Kumaon hills, lucerne was found most suitable legume for all three altitudes namely lower (<1500m), mid hills (1500-1800 m) and high (>1800 m) under rainfed conditions. Grasses such as hybrid Napier and kikyan grass on terrace risers (bunds) increased the yield of rice-wheat (terrace crop) by more than 60% in addition to forage banks (Singh, 1997). More apple yield was observed with legumes than grasses in hortipasture system (Singh, 1997).

Garhwal hills also have long tradition of Agroforestry practices. As many as 43 multipurpose tree species have been identified, which are integrated in different Agroforestry systems, however, agrisilviculture is most dominant system in rainfed agriculture. *Acacia catechu, Albizia* spp., *Bauhinia* spp., *Boehmeria rugulosa, Celtis australis, Ficus* spp., *Holoptelia integrifolia, Grewia* spp., *Mallotus philipenensis, Ougeinia dalbergioides, Prunus cerasoides, Pyrus pashia, Quercus leucotrichophora* etc. are some of the common MPTs raised by the farmers in or around agricultural fields (Bhatt and Verma, 2002).

Eastern Himalayan Warm Pre-humid Agro-ecological Region

Only one center, *i.e.*, Gangtok is present in this region. Silvipasture of *Ficus hookerii* and *F. lacor* along with *Thysanoleana maxima* has been found

most suitable in terms of profitability and sustainability in the region. Large cardamom is also cultivated in many Agroforestry systems in [illegible] region.

North Eastern Hills (Purvanchal warm per humid) Agro-ecological Region

In this region, there are 3 centres of AICRP on Agroforestry namely ICAR Res. Complex for NEH Region, Barapani, Imphal and Lembucherra, where lot of research work has been undertaken. The major significant achievements from each centre are outlined as follows:

Barapani

At high hill slopes (>45%) with soil depth <0.6 m, silviculture system has been recommended by growing trees like *Pinus Kesia, Schima wallichii, Machilus bombycina, Michelia* spp. etc. Agrisilviculture of trees like *Alnus nepalensis, Michelia champaca, Erythrina indica* with crops, *e.g.*, soybean, linseed, ginger etc. is popular for uplands (30-45%) with soil depth (0.6-1 m). For these uplands silvihortipasture incorporating *Morus alba, Syzygium cumini, Psidium guajava,* pear, pineapple and Congo signal and Guinea grasses have been recommended.

For slopes (15-30%) with soil depth >1.0 m, agrihorticulture with Khasi mandarin (*Citrus reticulata*), Assam lemon (*Citrus lemon*) and ginger, turmeric, soybean etc. is practiced. *Morus alba* with rice is grown as agrisilviculture for lowlands (<15% slopes). Agroaquaculture agroforestry system has also been recommended for subsistence of the tribal communities (Verma *et al.* 1999; Bhatt *et al.*, 2001).

Large cardamom (*Amomum sublulatum*) can be grown under various nitrogen fixing trees such as *Alnus nepalensis, Albizia* spp., *Terminalia myriocarpa, Schima wallichii* etc., between 500-2000 m amsl rainfall between 1500-2500 mm.

Lembucherra (Tripura)

Agri-silvihorticulture system has been recommended with the tree species like *Acacia* sp, *Morus alba, Gliricidia sepium,* Assam lemon, and turmeric, pineapple and til as agricultural crops.

In Phek district of Nagaland Zabo production system is used which is an indigenous farming system having agriculture, livestock, fisheries and trees components along with water conservation base and well-organized soil (Singh and Katoch, 2000). In Nagaland the main land use system and occupation is agriculture but in low rain fall areas farmers are practising various forms of *jhum* cultivation and often manages up to 60 crops in a single field using a complete array (NEPED and IIRR, 1999).

Priority to Multipurpose Tree Species

Pathak *et al.* (2000) have ascertained the priorities for multipurpose trees based on their growth, uses and economic returns. In the western Himalayan region, they gave first priority to *Grewia optiva* and second to fourth priority to *Populus ciliata, Toona ciliata* and *Celtis australis,* respectively. Whereas *Acacia catechu* and *Robinia pseudoacacia* was given fifth priority. In the eastern Himalayan region first to fifth priority was given to *Michelia champaca, Alnus nepalensis, Gmelina arborea, Morus laevigata* and *Pinus kesia,* respectively

Marketing

Marketing plays an important role in deciding the sustainability of the existing agroforestry systems- besides influencing socio-economic status of the farmers or even landless villagers. Markets for forest products are having many problems such as dominance of cartels, deal in secrecy and existence of legal restrictions (Chambers *et al.*, 1989). In marketing important role is played by the products, price, place and promotion. Thus all these four points should be considered in respect of agroforestry products/ produce in the hill region.

Products

Agroforestry is able to provide a very wide range of products which include timber, grasses, tree fodder, fruits, vegetables, cereals, pulses, oil-seeds, fuelwood, flowers, honey,

minor forest products, medicinal plants, fishes, milk, meat, eggs, silk-thread lac etc. if we consider the range of products which are capable to fulfil the need of various sectors of the market. Another important point is the availability of the one or another products in the whole year, furthermore, the farmers are able to get different products according to altitude and of other agro-climatic factors in the hill regions.

Prices

There is wide variation in the price level of agroforestry products/produce, which ranges from few rupees for green fodder/tree fodder to thousands rupees for a good timber material. All types of consumers small or big have potential to pay the prices, similarly the farmers get money for daily routine life besides having butter money in the form of timber trees. One important aspect is the difference between the prices at farm-gate and at consumer level. This difference should not be wide due to huge profit to the middlemen.

Places

The agroforestry products can be sold at the farm-gate or in the village market or in tehsil or district level mandis or direct to industries. In hill areas transportation facilities are limited and result in the high transportation cost. All these factors decide the benefit to the farmers.

Promotion

This is very important aspect for the agroforestry in hill areas where the supportive role of Central State Governments, NGOs, financial institutes exists. The consumers should be well acquinted about the availability of agroforestry products available in the hill areas. Similarly the farmers should be well informed about the demand of the consumers, which can be fulfilled from agroforestry sector. What will be the trend of demand in the future or possibility of new requirements of the consumers, which can be exploited by the agroforestry by pre-planning Govt. may establish a forecasting system for the help of farmers. The need of technical knowledge, availability of good quality of tree seedlings and crop seeds and financial credit are the main issues to be resolved presently.

Constraints, Issues and Strategies in the Himalayan Hill Farming Systems

Himalayan hills have some characteristic features quite different from the plains such as inaccessibility or difficult accessibility in most of the region due to difficult terrain and high altitudes. There is also wide variation in the climate such as warm per humid, sub-humid, humid or cold arid. Altitudinal changes are also prominent. These factors show a need to develop sustainable and economically profitable agroforestry system according to climate and altitudinal gradient.

Transport and communication facilities are poorly developed. The network of roads is being extended and the use of modern communication technologies such as STD or interconnectivity of telephones among nearby villages/cities is becoming common now a day. These both means of communication are able to assist the agroforester / farmers to adopt good agroforestry systems as well as to fetch good prices for their produce/products. The problem of soil erosion is also severe in the Himalayan hills due to the recent origin of Himalaya, nature of rocks, presence of slopes etc. Agroforestry systems such as silvipasture are able to reduce this problem. Various essential human interference like construction of roads, dams mining, felling of trees for industrial uses are posing threat of loss of bio-diversity. Agroforestry systems have potential to accommodate some locally available useful but endangered plant species. The use of degraded lands of forest area or common lands can also be utilized for developing suitable agroforestry systems such as silvipasture, silviculture, which will also support the fauna for micro fauna of the locality.

The agricultural farming system of Himalayan hill is mostly rainfed, mono cropped and at subsistence level. Clubbed with inadequate infrastructure facilities such as supply and input, marketing, institutional

credit and extension service (Sarma *et al.*, 1997). Many agroforestry systems having animal and or poultry birds aquaculture are self sufficient an reduce economical risk due to wide varieties of products in the form of food, animal feed, fuel, fruit etc. and in the time of emergency they are capable to provide good cash through timber. For more economic returns from agroforestry, marketing and extension actives besides easy credits from banks/cooperatives societies are to be strengthened. Shifting cultivation is still existing in almost all the north eastern States except Sikkim on steep slopes and the fellow cycle has been reduced to two to three years (Sarma *et al.* 1997). Due to this short fallow cycle, the practice is causing more harm to our natural resources. Various agroforestry systems have potential to replace the practice of shifting cultivation. Employment opportunities may increase by adopting agroforestry practices as they provide alternative labour opportunities in forestry work (Tewari, 1995).

Agroforestry systems also generate about 10-20 times more employment at the secondary or tertiary level in wood based such as agricultural implements, wood furniture, can and bamboo furniture, pulp, paper, packing boxes etc. (Tewari, 1995).

During the recent years, there is tremendous pressure on Mountain farming systems and crop yield is declining constantly in spite of increase in land area under agriculture (Pratap and Watson, 1994).

Various underutilized plant species are having actual or potential economic importance as well as key role in sustainable agriculture (Anonymous, 1999). For Himalyan hill region, underutilized crops like amaranths buckwheat, finger millet, rice bean, horsegram etc. have great potential and need to be incorporated in the agroforestry systems for the region.

National Agricultural Policy (2000) aims to attain growth rate in excess of 4% per annum in the agricultural sector, which is based on efficient use of resources and conservation of water, soil and biodiversity. Achieving growth that is technologically, environmentally and economically sustainable has also been aimed in the policy. Special emphasis will be given on conservation of soils and enrichment of soil fertility, while special attention will be given on the management of land resources on watershed basis and shifting cultivation will be given particular attention for the sustainable development in this policy. Considering the aims of National Agricultural Policy (2000), it is evident that agroforestry systems have great potential to fulfil these aims even in Himalayan hill regions. The combination of poultry, milching animals, aquaculture etc. on watershed basis will further increase the benefits of agroforestry systems.

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