RESEARCH ARTICLE

TRADITIONAL AGROFORESTRY SYSTEMS AND SOCIOECONOMIC STATUS OF FARMERS IN KANGRA VALLEY OF NORTH WESTERN HIMALAYA, INDIA

Navjot Singh Kaler*, K.S. Pant and Ravinder Sharma

Y.S. Parmar UHF Nauni, Solan- 173230 (H.P.), India
Email: kalernavjot8888@gmail.com

Received-04.05.2017, Revised-17.05.2017

Abstract: The study was conducted to evaluate the existing agroforestry systems and socio-economic status of the farmers in Kangra district of Himachal Pradesh, India. A total number of 220 farmers were selected randomly from four group's viz., marginal, small, medium and large based on landholding capacity by dividing the district into three altitudinal zones namely zone-I (<500 m amsl), zone-II (500-1000 m amsl) and zone –III (>1000 m amsl) for survey and data collection. The main forms of traditional agroforestry systems found in the study area are the agrisilvicultural (AS), agrisilvihorticultural (ASH), agrihorticulture (AH), agrisilvipastoral (ASP), pastoralsilviculture (PS) and silvipastoral (SP) systems. The survey data were collected with a pre-structured questionnaire in personal interviews with household heads and data for family structure, education status of heads of households, literacy rate of family, status of off farm employment, land use statistics was recorded.

Keywords: Agroforestry, Socioeconomic, Farmers, Kangra, Western Himalaya

INTRODUCTION

Forests are cleared mainly into agricultural land as a result of population growth, high dependability of population to agriculture sector and low awareness of forest functions on the environment. The decrease in land area for conserving forest resources and increasing land pressure due to population growth is the major problem faced around the world. Degradation of fertile land puts even more pressure on forests, as additional land needs to be cleared because existing agricultural land is not sufficiently productive anymore due to exhausted soils and water scarcity. These conditions lead into a poverty increase which affects many farmers and damage the natural resources (deforestation, watershed degradation etc.) (Ducoirtieux *et al.,* 2006). Agroforestry serves as multiple functions and able to mitigate these problems through several mechanisms. In turn, practitioners have seen these ecological benefits turn into economic benefits through the increase of agricultural output (Hildreth, 2008). Moreover, in rural areas, agroforestry improves socio-economic conditions by creating job opportunities and provides income, thereby reducing the scarcity of food production and improving financial state (Goudarzian and Yazdani, 2015).

Agroforestry practices in India is old, traditional and practised in various forms (Solanki, 1998 and Sharma, 1996) and is based on the socio-economic, cultural, communication and demographic factors of the population, experiences of farmers and other related factors. Existing agroforestry systems in any area is the result of farmers innovation and experimentation over centuries (Rafiq *et al.,* 2000). Adoption of innovations in agroforestry technology is a complicated process determined by both environmental and socioeconomic factors (Malla, 2000 and Neupane *et al.,* 2002). In most developing countries, the level of participation in any production activity can be linked to the socioeconomic status of households (Agarwal, 1986).

There are different types of agroforestry mixed farming systems are practiced in western Himalayas but, now-a-days few are being replaced and are in danger of disappearing due to socio-economic and demographic conditions. The awakened rural farmer in the hills of district Kangra have witnessed many changes in farming, livestock rearing, traditional agroforestry and in plantations of horticultural crops. Keeping this in mind, the present study was to investigate the existing agroforestry systems in relation to socioeconomic status of the farmers in study area.

MATERIAL AND METHOD

The present study was carried out in the 12 panchayats of Kangra district of Himachal Pradesh, India that lies between 31°41'to 32°28'N latitude and 75°35' to 77°04' E longitude having altitude ranges from 248 to 5861 m amsl (Figure 1). The climate of the district varies from sub-tropical in low hills and valleys to sub-humid in the mid hills and getting temperate in high hills. The average annual rainfall in the district varies from 1500 to 1800 mm. Snowfall is also received in upper ridges of the district. Average minimum and maximum temperature of the district are 3°C and 45°C, respectively.

The entire district was divided into three altitudinal zones viz. Zone I (< 500 m amsl), Zone II (500-1000 m amsl) and Zone III (> 1000 m amsl); in each zone four panchayats were selected and from each selected panchayat as per classification of government of Himachal Pradesh, farmers were divided on the basis of their land holding into four different farmers

*Corresponding Author

categories: Marginal (<1 ha), Small (1-2 ha), Medium (2-5 ha) and 4 Large (>5 ha) and a random sample of five farmers from each category were taken as ultimate unit of the study. Twenty farmers were falling in each category in each altitudinal zone except large category in altitudinal zone III as there was no farmer found in large category in selected panchayats. In total, 220 farmers were surveyed to know about socioeconomic status, livelihood methods and agroforestry systems practised in the area. The relevant information about the study was collected through pre-tested schedule for the purpose through personal interviews with each head of the household. A multistage sampling technique was used to generate the information regarding various variables. Group discussions and direct observations were also considered wherever possible to generate information on general farming and vegetation patterns. Gram pradhans (Heads of the village legislative councils), patwaris (village revenue officers) and block officials were also interviewed to collect precise quantitative data and validated it. The trees and agricultural crops found in the studied area are shown in the Table 1. Agroforestry systems existing in the study area were also identified on the basis of structure (nature and arrangement) and function (role of output) of components.

RESULT AND DISCUSSION

Socioeconomic

a) Family structure

Family structure represented the total number of individuals in a household comprising of adults, children and their male- female population in each group. The family structure and sex ratio of the sampled households given in (Table 2, 3) showed that the average family size of marginal, small, medium and large farmer category in altitudinal zone I was 5.35, 5.25, 8.05 and 6.65 individuals; respectively. However, the overall family size was 6.33. The average family size was reported maximum in medium farmer category followed by large, marginal and small farmer categories. The sex ratio of adults were found maximum in small (953) farmer category, followed by medium (836), large (836) and marginal (804) farmer categories. The overall sex ratio of adults was found 857. The sex ratio of children were found maximum in small (1100) farmer category, followed by marginal (846), medium (810) and large (750) farmer categories. The overall sex ratio of children was found 857. The total sex ratio of adults and children were found highest in small farmer (981) followed by medium (830) and large (822) farmer categories, whereas the lowest total sex ratio of adults and children were found in marginal (814) farmer category. The overall sex ratio was found 853.

The average family size in marginal, small, medium and large farmer category in altitudinal zone II was 5.30, 5.35, 7.25 and 6.35 individuals; respectively. However, the overall family size was 6.06. The average family size was found maximum in medium farmer category followed by large, small and marginal farmer categories. The sex ratio of adults were found to be maximum (849) in large farmer category, followed by medium (841), marginal (778) and small (773) farmer categories. The overall sex ratio of adults was found 815. The sex ratio of children were found maximum in medium (1071) farmer category followed by small (933), large (933) and marginal (857) farmer categories. The overall sex ratio of children was found 948 which were higher than the overall sex ratio of adults 815. Generally, the total sex ratio of adults and children were found maximum in medium (883) farmer category which is followed by large (868), small (814) farmer categories and on the otherhand it was recorded minimum in marginal (797) farmer category. The overall sex ratio was found 844.

The average family size range between 6.10 - 6.30 individuals in marginal, small and medium farmer category, respectively in altitudinal zone III. However, the overall family size was 6.22. The average family size was found maximum in medium farmer category followed by small and marginal farmer categories. The large farmer category was not reported in this zone. The sex ratio of adults were found highest in medium (960) farmer category followed by small (957) and marginal (933) farmer categories. The overall sex ratio of adults was found 950. The sex ratio of children were found maximum in marginal (1056) farmer category, followed by small (737) and medium (647) farmer categories. The overall sex ratio of children was found 815 which were lower than the overall sex ratio of adults (950). The total sex ratio of adults and children were found maximum in marginal (968) farmer category followed by small (894) and medium (881) farmer categories. The overall sex ratio was found 913 which were found highest among all the selected altitudinal zones. Yadav *et al.,* (2016) also found that the average family size lies between 4.3-5.0 at different elevation zones of Kumaon Himalaya, Uttarakhand, India. The overall sex ratio of three altitudinal zone found to be in line with the sex ratio of state and national averages of 968 and 933 respectively (Census, 2011).

b) Educational status of head of families

Educational status of head of family in each category of farmers in different altitudinal zones were having varying levels viz. primary, middle, matric, senior secondary, graduation and post graduation (Table 4). Head of the family having minimum education level even up to primary standard was considered literate. A cursory glance of data of altitudinal I showed that literacy rate was maximum (90.00%) in marginal farmer category which was followed by small (85.00%), medium (80.00%) and large (75.00%) farmer categories. However, the overall literacy rate in altitudinal zone- I was 82.50 percent.

The literacy rate was maximum (85.00%) in medium farmer category which was followed by marginal (80.00%), large (80.00%) and small (75.00%) farmer categories in altitudinal zone II. However, the overall literacy rate (80.00%) was found in altitudinal zone-II which was lower than the literacy rate of heads (82.50%) in altitudinal zone- I.

The literacy rate was found highest in marginal (90.00%) farmer category followed by small (85.00%) and medium (80.00%) farmer categories in altitudinal zone III. The overall literacy rate (85.00%) was found in altitudinal zone- III which was higher than the literacy of heads in altitudinal zone- I (82.50%) and altitudinal zone- II (80.00%). In the study area, irrespective of altitudinal zones and categories, the percentage of literate head of family was found more than illiterate. It is observed that most of the household heads were governed by men in the study area which were found in consistent with the findings of Chen *et al.*, (2006), Demurger and Fournier (2010); Sharma *et al.*, (2012).

c) Sex-wise literacy of family

The role of education is to equip people with the knowledge and to encourage them in their own decision making mechanism. Education imparts confidence and competitiveness in the individual which plays a significant role in transforming his/her society. At the same time, education helps to secure off-farm employment by which it eases the capital constraints. Thus, the analysis of the educational status of households becomes important (Table 5). In altitudinal zone I, the sex-wise educational status of both males and females showed that the literacy rate of males were found maximum in large (98.63%) farmer category, followed by medium (97.70%), small (92.59%) and marginal (86.21%) farmer categories whereas literacy rate of females were found maximum in medium (85.14 %) farmer category, followed by small (82.14%), marginal (79.59%) and large (75.00%) farmer categories. The data also revealed that the literacy rate of males (94.49%) were higher than the literacy rate of females (80.75%) in all the farmer categories. On an average, the highest family literacy rate was observed among the medium (91.93%) farmers category, followed by large (87.97%), small (87.27%) and marginal (83.18%) farmer categories. The overall family literacy in altitudinal zone- I was 87.59 per cent.

The literacy rate of males were found maximum in large (95.59%) farmer category, followed by marginal (88.14%), medium (87.01%) and small (86.44%) farmer categories whereas literacy rate of females were found maximum in large (93.22%) farmer category, followed by medium (79.41%), small (75.00%) and marginal (70.21%) farmer categories in altitudinal zone II. The data also revealed that the literacy rate of males (89.35%) were higher than the literacy rate of females (80.18%) in all the farmer categories. On an average, the highest family literacy rate was observed among the large (94.49%) farmer category, followed by medium (83.45%), small (81.31%) and marginal (80.19%) farmer categories. The overall family literacy in altitudinal zone- II was 84.86 per cent and it was lower than the average family literacy of altitudinal zone- I.

In altitudinal zone- III, the literacy rate of males were found 98.39, 93.94 and 90.91 per cent in marginal, small and medium farmer categories, respectively. Whereas, the literacy rate of females were 78.33, 81.36 and 90.00 percent in marginal, small and medium farmer categories, respectively. Thus, maximum literacy of males (98.39%) and females (90.00%) were found in marginal and medium farmer categories, respectively. The literacy rate of males (94.33%) were found higher than the literacy rate of females (83.24%) in all farmer categories. On an average, the highest family literacy rate was observed among the medium (90.48%) farmer category, followed by marginal (88.52%) and small (88.00%) farmer categories. The overall family literacy in altitudinal zone- III was 89.00 per cent which was found higher than the literacy rate in altitudinal zone- I (87.59%) and II (84.86%). It is evident from the results that the percentages of illiterate females were found higher than that of males in all the altitudinal zones, irrespective of the farmer categories. The results also conclude that overall family literacy rate was found maximum in altitudinal zone- III, followed by I and II. Our present findings, exhibited that overall literacy rate of different altitudinal zones of study area were found higher than the literacy rate (82.80%) of H.P. (Census, 2011). Yadav *et al.*, (2016) also founded the overall literacy rate as 83.0% in Kumaon Himalaya, Uttarakhand, India.

d) Status of off-farm employment

Off-farm employment is not only an additional source of income to the farmers but also an alternative medium of economic gain during crop failure. In the present study (Table 6), the sampled farmers met their livelihood through government employment/pension, grocery shop-keeping, carpentry, family trade, tailoring, vegetable vendor, private transport, industries, etc. were the sources of off-farm income. Males were found dominating in employment in government as well as private services in all the altitudinal zones. Similar studies on off farm employment were done by Sharma *et al.*, (2009) and Yadav *et al.*, (2016). Among different farmer categories, in altitudinal zone- I, the income of individuals from government services were found maximum in small (70.88%) farmer category followed by medium (55.97%) and large (55.39%) farmer categories, whereas minimum income of individuals from government services was recorded in marginal (41.58%) farmer category. The income of individuals from private services were found highest in marginal (58.42%) farmer category,

followed by large (44.61%) and medium (44.03%) farmer categories, while the lowest income of individuals from private services was observed in small (29.12%) farmer category. Moreover in the total population of altitudinal zone- I, the income of individuals from private services (53.81%) were found maximum than the income of individuals from government services (46.19%).

The income of individuals from government services were found highest in large (68.33%) farmer category followed by marginal (61.54%) and small (56.24%) farmer categories, whereas lowest income of individuals from government services was recorded in medium (53.83%) farmer category in altitudinal zone II. The income of individuals from private services were found maximum in medium (46.17%) farmer category, followed by small (43.76%) and marginal (38.46%) farmer categories, while the lowest income of individuals from private services was observed in large (31.67%) farmer category. However in the total population of altitudinal zone- II, the income of individuals from government services (66.83%) were found maximum than the income of individuals from private services (33.17%).

The income of individuals from government services were found maximum in medium (63.66%) farmer category followed by marginal (56.00%) farmer category, whereas minimum income of individuals from government services was observed in small (55.61%) farmer category in altitudinal zone III. The income of individuals from private services were found highest in small (44.39%) farmer category, followed by marginal (44.00%) farmer category, while lowest income of individuals from private services was recorded in medium (36.34%) farmer category. In the total population of altitudinal zone- III, the income of individuals from government services (64.45%) were found higher than the income of individuals from private services (35.55%).

e) Land use statistics

Land is a basic requirement for farming. The size of the land holding is directly related to household income, consumption and savings. Land use statistics presented in table 7 revealed that agriculture was the major land use system prevalent in the study area. In altitudinal zone I, the irrigated and unirrigated lands under all the farmer categories were found 13.52 and 69.82 per cent. Data further showed that maximum land area under agriculture was recorded in marginal (88.24%) farmer category, followed by medium (86.82%) and small (84.05%) farmer categories, whereas minimum land area under agriculture was observed in large (79.65%) farmer category. Further in case of land area under pasture, the maximum area was found under small (15.23%) farmer category followed by large (14.52%) and medium (11.05%) farmer categories, while minimum area was recorded under marginal (10.12%) farmer categories. Average land holding was found maximum in large (5.99 ha) farmer category, followed by medium (2.99 ha), small (1.38 ha) and marginal (0.70 ha) farmer categories. The overall land holding per household for this zone was found 2.76 ha.

The total irrigated and unirrigated land under all the farmer categories were found 2.17 and 78.33 per cent, respectively in altitudinal zone II. The maximum proportion of total agriculture land was found in large (81.64%) farmer category, followed by marginal (81.37%) and small (79.76%) farmer categories, while minimum proportion of total agriculture land was found in medium (78.58%) farmer category. Maximum land area under pasture was found in medium (18.81%) farmer category followed by small (17.51%), large (15.84%) and marginal (15.11%) farmer categories. Average land holding was found in the following order: large (5.49 ha) > medium (3.03 ha) > small (1.37 ha) > marginal (0.63 ha) farmer category. Data also reflect that average land holding per household for this zone was 2.63 ha.

In altitudinal zone III, the irrigated and unirrigated lands under all the farmer categories were found 1.67 and 73.34 per cent. The marginal category of farmers had 76.51 per cent land area under agriculture and 20.32 per cent under pasture. Small category of farmers had 70.65 per cent of land area under agriculture and 27.55 per cent under pasture. Likewise, 77.23 per cent land area among medium category of farmers was under agriculture and 21.25 per cent of area under pasture. Data further reflect that the average land-holding per household was maximum in medium (2.59 ha) farmer category followed by small (1.52 ha) and marginal (0.60 ha) farmer categories. The average land holding per household for this altitudinal zone was 1.57 ha.

Identification and comparison status of agroforestry systems

Irrespective of different categories of farmers and altitudinal zones, a total of six agroforestry systems types existed in the studied area. The agroforestry systems predominant in Kangra district were Agrisilviculture (AS), Agrisilvihorticulture (ASH), Agrihorticulture (AH), Agrisilvipastoral (ASP), Pastoralsilviculture (PS) and Silvipastoral (SP) and there comparative status among different categories were shown in table 8. These systems may be attributed to agroclimatic conditions of the area and need of the farmers i.e. food, fodder, fuel wood and timber etc. Anita *et al.,* (2008) also reported that the traditional agroforestry practices helped the peoples to fulfil their basic needs i.e. food, fodder, fuel wood and timber and identified prevalent agroforestry systems viz. AH, AS, ASP, PS, PH in Lahaul and Kinnaur District (H.P.).

CONCLUSION

From the present study it was found that the overall sex ratio of three altitudinal zones found to be in line with the sex ratio of state and national averages of 968 and 933 respectively which shows that there was no gender biasness in the study area. Adult population constituted 79.45, 76.70 and 73.73 per cent of the total population among three altitudinal zones suggesting, thereby, greater availability of the family labour. The average family size was 6.33, 6.06 and 6.22 in three altitudinal zones, respectively. The majority of the family heads were found literate among three altitudinal zones. In terms of educational status, males were found to be more literate in comparison to females in all farmers categories of three altitudinal zones. Among various identified agroforestry systems agrisilviculture (AS) and pastoralsilviculture (PS) systems were most prevalent agroforestry systems in Kangra District. Hence, the study represents the clear picture of socioeconomic status of farmers and existing agroforestry systems which will help the researchers to understand the agroforestry system of study area in order to make improvement and develop technologies that will help local people/farmers to fulfil basic needs and overcome the existing constraints.

Figure 1. Location map of the study area

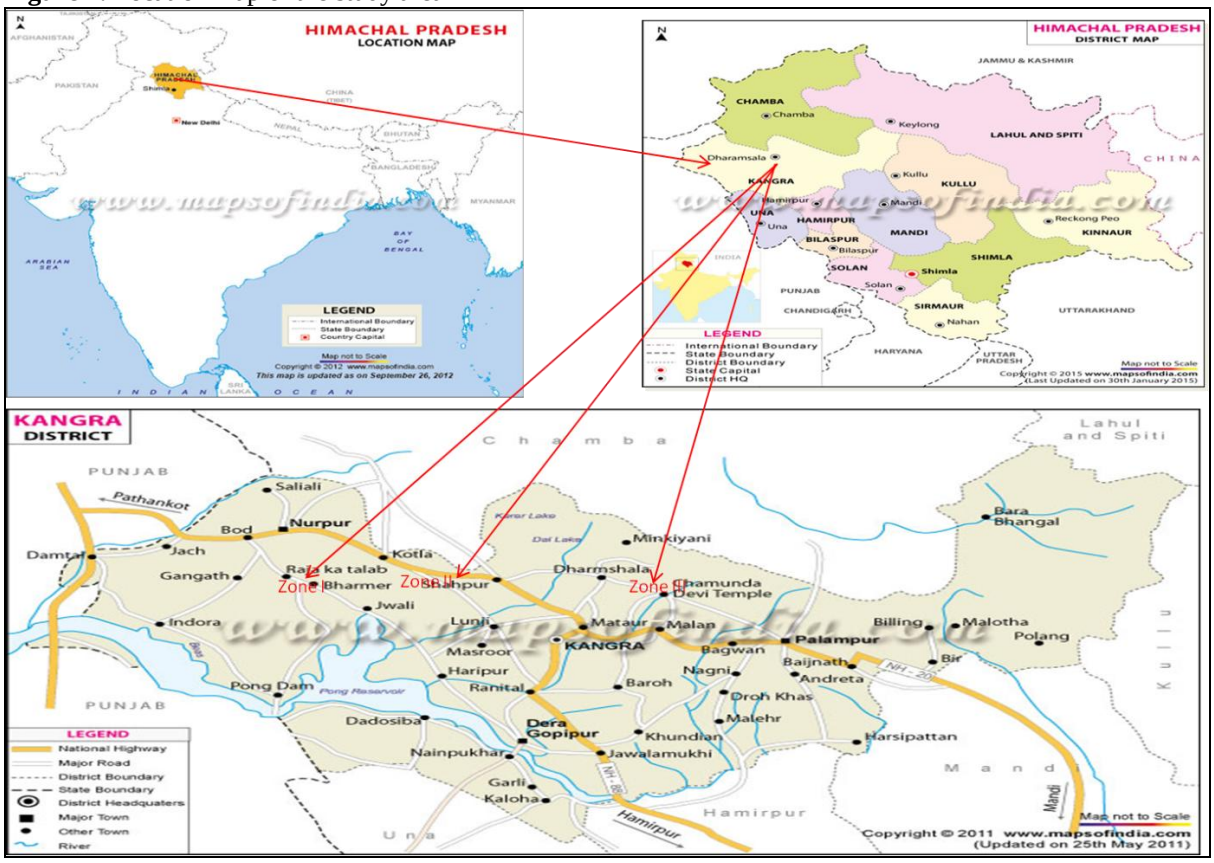

Table 1. Trees and agricultural crops present in the existing agroforestry systems of study area

Forest trees
Morus alba, *Acacia catechu*, *Dalbergia sissoo*, *Toona ciliata*, *Albizia chinensis Populus deltiodes*, *Celtis australis*, *Bombax ceiba*, *Melia azedarach*, *Terminalia bellerica*, *Cassia fistula*, *Ficus palmata*, *Bauhinia variegata Grewia optiva*, *Leucaena leucocephala*, *Salix alba*, *Syzygium cumini and Zizyphus mauritiana*
Fruit trees
Mangifera indica, *Psidium guajava*, *Litchi chinensis*, Prunus persica, Prunus domestica, *Citrus limon*, *Citrus aurantifolia* and *Citrus sinensis*
Agricultural Crops
Cereals
Triticum astivum (Wheat), *Zea mays* (Maize), *Oryza sativa* (Paddy) and *Hordeum vulgare* (Barley)
Oilseed crops and Pulses
Brassica nigra (Mustard), *Sesamum indicum* (Till), *Vigna mungo* (Maash) and *Phaseolus vulgaris* (Rajmash)
Vegetables

Curcuma longa (Turmeric), *Solanum lycopersicum* (Tomato), *Brassica oleracea* (Cabbage), *Brassica oleracea* (Cauliflower), *Solanum melongena* (Brinjal), *Capsicum annuum* (Capsicum), *Abelmoschus esculentus* (Ladies finger), *Momordica charantia* (Karela), *Cucurbita maxima* (Pumpkin), *Raphanus sativus* (Radish), *Allium cepa* (Onion), *Allium sativum* (Garlic) and *Capsicum frutescens* (Chilli)

Table 2. Family structure of four farmers category in three altitudinal zones of Kangra District

Category	Adult (A)			Children (C)			Grand Total (A+C)	Average Family Size
	Male	Female	Total	Male	Female	Total		
Altitudinal zone- I								
Marginal	46 (42.99)	37 (34.58)	83 (77.57)	13 (12.15)	11 (10.28)	24 (22.43)	107 (100)	5.35
Small	43 (40.95)	41 (39.05)	84 (80.00)	10 (9.52)	11 (10.48)	21 (20.00)	105 (100)	5.25
Medium	67 (41.61)	56 (34.78)	123 (76.40)	21 (13.04)	17 (10.56)	38 (23.60)	161 (100)	8.05
Large	61 (45.86)	51 (38.35)	112 (84.21)	12 (9.02)	9 (6.77)	21 (15.79)	133 (100)	6.65
Total	217 (42.89)	185 (36.56)	402 (79.45)	56 (11.07)	48 (9.49)	104 (20.55)	506 (100)	6.33
Altitudinal zone- II								
Marginal	45 (42.45)	35 (33.02)	80 (75.47)	14 (13.21)	12 (11.32)	26 (24.53)	106 (100)	5.30
Small	44 (41.12)	34 (31.78)	78 (72.90)	15 (14.02)	14 (13.08)	29 (27.10)	107 (100)	5.35
Medium	63 (43.45)	53 (36.55)	116 (80.00)	14 (9.66)	15 (10.34)	29 (20.00)	145 (100)	7.25
Large	53 (41.73)	45 (35.43)	98 (77.17)	15 (11.81)	14 (11.02)	29 (22.83)	127 (100)	6.35
Total	205 (42.27)	167 (34.43)	372 (76.70)	58 (11.96)	55 (11.34)	113 (23.30)	485 (100)	6.06
Altitudinal zone- III								
Marginal	44 (36.07)	41 (33.61)	85 (69.67)	18 (14.75)	19 (15.57)	37 (30.33)	122 (100)	6.10
Small	47 (37.60)	45 (36.00)	92 (73.60)	19 (15.20)	14 (11.20)	33 (26.40)	125 (100)	6.25
Medium	50 (39.68)	48 (38.10)	98 (77.78)	17 (13.49)	11 (8.73)	28 (22.22)	126 (100)	6.30
Large	-	-	-	-	-	-	-	-
Total	141 (37.80)	134 (35.92)	275 (73.73)	54 (14.48)	44 (11.80)	98 (26.27)	373 (100)	6.22

(Values in parenthesis are the percentages)

Table 3. Sex ratio of adults and children of four farmers category in three altitudinal zones of Kangra District

Category	Adult (A)			Children (C)			Grand Total Sex ratio (A+C) (Per 1000 male)
	Male	Female	Sex ratio (Per 1000 male)	Male	Female	Sex ratio (Per 1000 male)	
Altitudinal zone- I							
Marginal	2.30 (42.99)	1.85 (34.58)	804	0.65 (12.15)	0.55 (10.28)	846	814
Small	2.15 (40.95)	2.05 (39.05)	953	0.50 (9.52)	0.55 (10.48)	1100	981
Medium	3.35 (41.61)	2.80 (34.78)	836	1.05 (13.04)	0.85 (10.56)	810	830
Large	3.05 (45.86)	2.55 (38.35)	836	0.60 (9.02)	0.45 (6.77)	750	822
Total	2.71 (42.89)	2.31 (36.56)	857	0.70 (11.07)	0.60 (9.49)	857	853

Altitudinal zone- II							
Marginal	2.25 (42.45)	1.75 (33.02)	778	0.70 (13.21)	0.60 (11.32)	857	797
Small	2.20 (41.12)	1.70 (31.78)	773	0.75 (14.02)	0.70 (13.08)	933	814
Medium	3.15 (43.45)	2.65 (36.55)	841	0.70 (9.66)	0.75 (10.34)	1071	883
Large	2.65 (41.73)	2.25 (35.43)	849	0.75 (11.81)	0.70 (11.02)	933	868
Total	2.56 (42.27)	2.09 (34.43)	815	0.73 (11.96)	0.69 (11.34)	948	844
Altitudinal zone- III							
Marginal	2.20 (36.07)	2.05 (33.61)	933	0.90 (14.75)	0.95 (15.57)	1056	968
Small	2.35 (37.60)	2.25 (36.00)	957	0.95 (15.20)	0.70 (11.20)	737	894
Medium	2.50 (39.68)	2.40 (38.10)	960	0.85 (13.49)	0.55 (8.73)	647	881
Large	-	-	-	-	-	-	-
Total	2.35 (37.80)	2.23 (35.92)	950	0.90 (14.48)	0.73 (11.80)	815	913

(Values in parenthesis are the percentages)

Table 4. Educational status of head of family of four farmers category in three altitudinal zones of Kangra District

Education Level										
Category	**Primary**	**Middle**	**Matric**	**Secondary**	**Graduate**	**PG**	**Literate**	**Illiterate**	**Total**	**Literacy (%)**
Altitudinal zone- I										
Marginal	3 (15.00)	2 (10.00)	4 (20.00)	2 (10.00)	7 (35.00)	-	18 (90.00)	2 (10.00)	20(100)	90.00
Small	2 (10.00)	1 (5.00)	7 (35.00)	4 (20.00)	3 (15.00)	-	17 (85.00)	3 (15.00)	20 (100)	85.00
Medium	4 (20.00)	2 (10.00)	5 (25.00)	2 (10.00)	3 (15.00)	-	16 (80.0)	4 (20.00)	20 (100)	80.00
Large	1 (5.00)	2 (10.00)	6 (30.00)	4 (20.00)	2 (10.00)	-	15 (75.00)	5 (25.00)	20 (100)	75.00
Total	10 (12.50)	7 (8.75)	22 (27.50)	12 (15.00)	15 (18.75)	-	66 (82.50)	14 (17.50)	80 (100)	82.50
Altitudinal zone- II										
Marginal	4 (20.00)	5 (25.00)	5 (25.00)	2 (10.00)	-	-	16 (80.00)	4 (20.00)	20 (100)	80.00
Small	3 (15.00)	2 (10.00)	7 (35.00)	2 (10.00)	1 (5.00)	-	15 (75.00)	5 (25.00)	20 (100)	75.00
Medium	1 (5.00)	6 (30.00)	6 (30.00)	4 (20.00)	-	-	17 (85.00)	3 (15.00)	20 (100)	85.00
Large	3 (15.00)	6 (30.00)	3 (15.00)	4 (20.00)	-	-	16 (80.00)	4 (20.00)	20 (100)	80.00
Total	11 (13.75)	19 (23.75)	21 (26.25)	12 (15.00)	1 (1.25)	-	64 (80.00)	16 (20.00)	80 (100)	80.00
Altitudinal zone- III										
Marginal	1 (5.00)	3 (15.00)	9 (45.00)	4 (20.00)	1 (5.00)	-	18 (90.00)	2 (10.00)	20 (100)	90.00
Small	-	3 (15.00)	9 (45.00)	3 (15.00)	1 (5.00)	1 (5.00)	17 (85.00)	3 (15.00)	20 (100)	85.00
Medium	1 (5.00)	2 (10.00)	6 (30.00)	2 (10.00)	5 (25.00)	-	16 (80.00)	4 (20.00)	20 (100)	80.00
Large	-	-	-	-	-	-	-	-	-	-
Total	2 (3.33)	8 (13.00)	24 (40.00)	9 (15.00)	7 (11.67)	1 (1.67)	51 (85.00)	9 (15.00)	60 (100)	85.00

(Values in parenthesis are the percentages)

Table 5. Sex-wise literacy of family of four farmers category in three altitudinal zones of Kangra District

Category	Literate		Illiterate		Total		Total (Literate + Illiterate)	Family literacy (%)
	Male	Female	Male	Female	Literate	Illiterate		
Altitudinal zone- I								
Marginal	50 (86.21)	39 (79.59)	8 (13.79)	10 (20.41)	89 (83.18)	18 (16.82)	107	83.18
Small	50 (92.59)	46 (82.14)	4 (7.41)	10 (17.86)	96 (87.27)	14 (12.73)	110	87.27
Medium	85 (97.70)	63 (85.14)	2 (2.30)	11 (14.86)	148 (91.93)	13 (8.07)	161	91.93
Large	72 (98.63)	45 (75.00)	1 (1.37)	15 (25.00)	117 (87.97)	16 (12.03)	133	87.97
Total	257 (94.49)	193 (80.75)	15 (5.51)	46 (19.25)	450 (88.06)	61 (11.94)	511	87.59
Altitudinal zone- II								
Marginal	52 (88.14)	33 (70.21)	7 (11.86)	14 (29.79)	85 (80.19)	21 (19.81)	106	80.19
Small	51 (86.44)	36 (75.00)	8 (13.56)	12 (25.00)	87 (81.31)	20 (18.69)	107	81.31
Medium	67 (87.01)	54 (79.41)	10(12.99)	14 (20.59)	121 (83.45)	24 (16.55)	145	83.45
Large	65 (95.59)	55 (93.22)	3 (4.41)	4 (6.78)	120 (94.49)	7 (5.51)	127	94.49
Total	235 (89.35)	178 (80.18)	28 (10.65)	44 (19.82)	413 (85.15)	72 (14.85)	485	84.86
Altitudinal zone- III								
Marginal	61 (98.39)	47 (78.33)	1 (1.61)	13 (21.67)	108 (88.52)	14 (11.48)	122	88.52
Small	62 (93.94)	48 (81.36)	4 (6.06)	11 (18.64)	110 (88.00)	15 (12.00)	125	88.00
Medium	60 (90.91)	54 (90.00)	6 (9.09)	6 (10.00)	114 (90.48)	12 (9.52)	126	90.48
Large	-	-	-	-	-	-	-	-
Total	183 (94.33)	149 (83.24)	11 (5.67)	30 (16.76)	332 (89.01)	41 (10.99)	373	89.00

(Values in parenthesis are the percentages)

Table 6. Status of off-farm employment of four farmers category in three altitudinal zones of Kangra District

Category	Government services					Private Services					Grand Total
	Male	Income/month (Rs)	Female	Income/month (Rs)	Total	Male	Income/month (Rs)	Female	Income/month (Rs)	Total	
Altitude- I											
Marginal	10	19300.00 (28.69)	3	8666.67 (12.88)	27966.67 (41.58)	10	15300.00 (22.75)	2	24000.00 (35.68)	39300.00 (58.42)	67266.67 (100)
Small	10	20200.00 (33.93)	1	22000.00 (36.95)	42200.00 (70.88)	3	17333.33 (29.12)	-	-	17333.33 (29.12)	59533.33 (100)
Medium	12	19166.67 (42.62)	1	6000.00 (13.34)	25166.67 (55.97)	15	19800.00 (44.03)	-	-	19800.00 (44.03)	44966.67 (100)
Large	16	24187.50 (24.73)	1	30000.00 (30.67)	54187.50 (55.39)	11	23636.36 (24.16)	4	20000.00 (20.44)	43636.36 (44.61)	97823.86 (100)
Total	48	21083.33 (27.76)	6	14000.00 (18.43)	35083.33(46.19)	39	19538.46 (25.72)	6	21333.33 (28.09)	40871.79 (53.81)	75955.13 (100)
Altitude- II											
Marginal	15	19800.00 (61.54)	-	-	19800.00 (61.54)	8	12375.00 (38.46)	-	-	12375.00 (38.46)	32175.00 (100)
Small	12	18916.67 (41.05)	2	7000.00 (15.19)	25916.67 (56.24)	6	20166.67 (43.76)	-	-	20166.67 (43.76)	46083.33 (100)
Medium	19	21684.21 (53.83)	-	-	21684.21 (53.83)	15	18600.00 (46.17)	-	-	18600.00 (46.17)	40284.21 (100)
Large	14	19500.00 (29.94)	2	25000.00 (38.39)	44500.00 (68.33)	8	20625.00 (31.67)	-	-	20625.00 (31.67)	65125.00 (100)
Total	60	20150.00 (37.25)	4	16000.00 (29.58)	36150.00 (66.83)	37	17945.95 (33.17)	-	-	17945.95 (33.17)	54095.95 (100)
Altitude- III											
Marginal	17	21000 (56.00)	-	-	21000.00 (56.00)	12	16500.00 (44.00)	-	-	16500.00 (44.00)	37500.00 (100)
Small	16	20562.5 (43.05)	1	6000.00 (12.56)	26562.50 (55.61)	15	21200.00 (44.39)	-	-	21200.00 (44.39)	47762.5 (100)
Medium	21	22428.58 (34.75)	3	18666.67 (28.92)	41095.24 (63.66)	11	23454.55 (36.34)	-	-	23454.55 (36.34)	64549.78 (100)
Large	-	-	-	-	-	-	-	-	-	-	-
Total	54	21425.92 (37.40)	4	15500.00 (27.05)	36925.93 (64.45)	38	20368.42 (35.55)	-	-	20368.42 (35.55)	57294.34 (100)

(Values in parenthesis are the percentages)

Table 7. Farmers category wise land use statistics (per ha) in three altitudinal zones of Kangra District

Category	Agriculture			Pasture	Orchard	Average land holding
	Irrigated	Unirrigated	Sub total			
Altitudinal Zone I						
Marginal	0.09 (13.41)	0.53 (74.83)	0.62 (88.24)	0.07 (10.12)	0.01 (1.64)	0.70 (100)
Small	0.24 (17.06)	0.92 (66.99)	1.16 (84.05)	0.21 (15.23)	0.01 (0.70)	1.38 (100)
Medium	0.43 (14.28)	2.24 (74.98)	2.59 (86.82)	0.33 (11.05)	0.07 (2.19)	2.99 (100)
Large	0.74 (12.34)	4.03 (67.31)	4.77 (79.65)	0.87 (14.52)	0.35 (5.87)	5.99 (100)
Total	0.37 (13.52)	1.93 (69.82)	2.29 (82.68)	0.37 (13.39)	0.11 (3.96)	2.76
Altitudinal Zone II						
Marginal	0.004 (0.61)	0.51 (80.76)	0.51 (81.37)	0.10 (15.11)	0.02 (3.51)	0.63 (100)
Small	0.03 (2.10)	1.06 (77.66)	1.09 (79.76)	0.24 (17.51)	0.04 (2.80)	1.37 (100)
Medium	0.06 (2.03)	2.32 (76.55)	2.38 (78.58)	0.57 (18.81)	0.08 (2.60)	3.03 (100)
Large	0.13 (2.45)	4.35 (79.20)	4.48 (81.64)	0.87 (15.84)	0.14 (2.59)	5.49 (100)
Total	0.06 (2.17)	2.06 (78.33)	2.12 (80.50)	0.44 (16.87)	0.07 (2.67)	2.63
Altitudinal Zone III						
Marginal	0.01 (2.22)	0.45 (74.29)	0.46 (76.51)	0.12 (20.32)	0.02 (3.17)	0.60 (100)
Small	0.04 (2.39)	1.04 (68.26)	1.08 (70.65)	0.42 (27.55)	0.03 (1.89)	1.52 (100)
Medium	0.03 (1.11)	1.97 (76.11)	2.00 (77.23)	0.55 (21.25)	0.04 (1.48)	2.59 (100)
Large	-	-	-	-	-	-
Total	0.03 (1.67)	1.15 (73.34)	1.18 (75.01)	0.36 (23.17)	0.03 (1.83)	1.57

(Values in parenthesis are the percentages)

Table 8. Comparative status of various agroforestry system types in different altitudinal zones and farmers category of Kangra District

AFS types	Altitudinal Zone- I				Altitudinal Zone- II				Altitudinal Zone- III			
	Marginal	Small	Medium	Large	Marginal	Small	Medium	Large	Marginal	Small	Medium	Large
AS	5	7	9	5	6	5	8	5	6	7	5	-
ASH	3	4	5	3	4	3	-	3	4	5	3	-
AH	-	-	-	3	-	-	3	4	-	-	-	-
ASP	-	5	6	-	4	6	4	-	5	4	6	-
PS	4	6	5	6	5	5	6	4	4	6	5	-
SP	-	-	3	4	-	2	4	3	-	3	4	-

ACKNOWLEDGEMENT

Authors are thankful to the Prof. B. Gupta, Head of Department, Department of Silviculture and Forestry, College of Forestry, Dr. YS Parmar University of Horticulture and Forestry Nauni (Solan) for providing necessary support. The authors also thank to the line department officials and villagers in the study area for their cooperation during the survey.

REFFERENCES

Agarwal, B. (1986). Of social forestry and other tree-planting schemes. In Agarwal B. (Ed.), Cold Hearths and Barren Slopes: The Woodfuel Crisis in the Third World. London, United Kingdom: Zed Books, pp 106-139.

Anita, Kumari., Sehgal, R.N. and Shailender, Kumar. (2008). Traditional agroforestry systems practiced in Lahaul (Lahaul and Spiti) and Kinnaur Districts of Himachal Pradesh. *Ind. For*., 1003-1010.

Census. (2011). Office of the registrar general and census commissioner, India. Ministry ofhome affairs, Government of India, New Delhi. Av ailable from: http://www.censusindia. gov.in/.

Chen, L., Heerink, N. and Berg, Mvanden. (2006). Energy consumption in rural China: household model for three villages in Jiangxi Province. *Ecol. Econ.*, 58(2): 407-420.

Demurger, S. and Fournier, M. (2010). Poverty and firewood consumption: case study of rural households in northern China. Paper provided by Groupe d'Analyse et de Théorie Economique (GATE), Centre national de la recherche scientifique (CNRS), Université Lyon 2, Ecole Normale Supérieure in its series Working Papers with number 1020: 1-32. Available from: http://www.gate.cnrs.fr/.

Ducoirtieux, O., Visonnavong, P. and Rossard, J. (2006). Introducing cash crops in shifting cultivation regions-the experience with cardamom in Laos. *Agrofor. Syst.*, 66: 65-76.

Hildreth, L.A. (2008). The economic impacts of agroforestry in the Northern Plains of China. *Agrofor Syst.*, 72: 119-126.

Goudarzian, P. and Yazdani, M.R. (2015). Climate diversity in line with agroforestry systems: studying technicalities of agroforestry systems and allied components in two diverse climatic regions (Warm climate vs. cold climate) (Case study: Kazeroun & Sepidan in Fars Province, I.R.Iran). *Desert.*, 20 (2): 157-166.

Malla, Y.B. (2000). Farmers tree management strategies in a changing rural economy and factors influencing decisions on tree growing in Nepal. *Int. Tree Crop J.*, 10: 247-266.

Neupane, R.P., Sharma, K.R. and Thapa, G.B. (2002). Adoption of agroforestry in the hills of Nepal: A logistic regression analysis. *Agric. Syst.*, 72: 177-196.

Sharma, C.M., Gairola, S., Ghildiyal, S.K. and Suyal, S. (2009). Forest resource use patterns in relation to socio-economic status. *Mt. Res. Dev.*, 29: 308-319.

Sharma, J., Gairola, S., Gaur, R.D. and Painuli, R.M. (2012). Forest utilization patterns and socio-economic status of the Van Gujjar tribe in sub-Himalayan tracts of Uttarakhand, India. *For. Stud. China.*, 14: 36-46.

Sharma, K.K. (1996). Agroforestry in farming system development. *Ind. For.*,122(6): 547-559.

Solanki, K.R. (1998). Agroforestry research in India. Special issue. *Ind. J. Agric. Sci.*, 68(8): 559-566.

Rafiq, M., Amacher, G.S. and Hyde, W.F. (2000). Innovation and adoption in Pakistan's Northwest Frontier Province. In Hyde WF and Amacher GS, (Eds.). Economics of Forestry and Rural Development. An Empirical Introduction from Asia. Ann Arbor, MI: University of Michigan Press, pp 87-100.

Yadav, R.P., Gupta, B., Bhutia, P.L. and Bisht, J.K. (2016). Socioeconomics and sources of livelihood security in Central Himalaya, India: a case study. *Int. J. Sust. Dev. World.*, 23: 1-9