Range Mgmt. & Agroforestry 39 (2) : 289-295, 2018
ISSN 0971-2070

Socioeconomic characteristics and livelihood of agroforestry practitioners in north-west Himalayas, India

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Received: 16th April, 2018 Accepted: 30th November, 2018

Abstract
This study was conducted to understand socio-economic status and livelihood options of agroforestry practitioners in Sirmaur district of Himachal Pradesh, India. Agroforestry practices and cultivation of crops varied with change in the elevation. Majority of medium farmers were part of joint family, whereas small and marginal farmers were living in nuclear family. Livelihood security of all categories of farmers is reliant on traditional agroforestry practices and orchards. More than 70% farming in the area is rainfed and managed in a traditional way. High literacy rate is the main characteristics features of the study area. Size of land holding owned by farmers in the area varied according to farmers' category. The study revealed that traditional agriculture/agroforestry and employment in service sector were the major sources of income to the people.

Keywords: Agroforestry, Himalaya, Land holding, Livelihood, Socioeconomics

Introduction

Sirmaur is the most south-eastern district of Himachal Pradesh (H.P.), India, where agriculture is the mainstay of economy since around 80% of the population is dependent on the agriculture. The district has about 85% small and marginal farmer families and the land holdings are very small and scattered. Fruits of different varieties depending upon the terrain, climatic conditions and soil, are grown in the district. Presence of forests plays a vital role in shaping the climatic conditions of the area. The forests provide valuable timber, medicinal herbs and raw materials for large and small scale industries, provide employment (Yadav *et al*., 2016) and also play a vital role in conserving the soil (Panwar *et al*., 2018) and ensure timely and sufficient rains.

Mostly district population depends upon agriculture and allied activities like horticulture and cattle rearing for live-lihood security. As a result pressure on natural resources such as forest, land, water etc. is increasing enormously. With every passing day, there is pressure on the local communities to cope up with the changing climatic conditions (Maninder and Singh, 2015). The technology transfer for rural livelihood development had greater impact to protect microclimatic conditions which further affects the favorable soil and environmental conditions (Klett *et al*., 2011) and further helping the local communities to adapt the farming according the changing climatic scenario by adopting new technologies without disturbing the existing environment set up (Kaur, 2002).

The social factors also play roles in land use management decisions including tillage, plant residue management, retention of tree on farming land, manure usage and fertilizer application (Nair *et al*., 2010; Yadav *et al*., 2018), which in turn affect the biomass. Social factors such as farmer's economic and educational status, demography, social connections, culture, and resource availability are important to understand why and how farmers select certain management practices (Seabrook *et al*., 2008; Yadav *et al*., 2016). Availability of resources such as raw materials, labor and domestic animals also influence farmers' decision to adopt specific practices (Williams, 1999). Agricultural decisions made by individuals (or farmers) are often influenced by their economic and livelihood opportunities (Lambin *et al*., 2001; Yadav *et al*., 2016). The magnitude of social factors influence on the land use management practices depends largely on the economic importance of the system. Thus, parameters such as the family structure, social caste, land holding size, livestock rearing, share of income through different sources, patterns of farming and adoption of agroforestry and their link to livelihood of farming community are paramount. Hence, a study was undertaken to understand the socio economic characteristics of people and livelihood aspects of agroforestry practitioners in north-west Himalayas, India.

Materials and Methods

Study area: The study was carried out in 12 panchayats of Sirmaur district of H.P., bounded by latitude 30°22'30" to 31°01'20"N and longitude 77°01'12" to 77°49'40"E having elevation range from <1000 m to >2000 m. The climate of Sirmaur district is sub-tropical to temperate depending upon the elevation. Three major seasons that is the winter season extends from November to February, summer season from March to June followed by the monsoon period extending from July to September end. Maximum precipitation in the form of rain occurs during July to September. Average annual rainfall in the district is about 1405 mm, out of which 90% occurs during monsoon season. In the non-monsoon season precipitation as snowfall also occurs in the higher reaches above 1500 m. During winter period, rainfall also occurs in lower hills and valleys parts. Mean maximum and minimum temperature is 30°C and below 0°C, respectively.

Data collection and analysis: The entire study area was delineated into three elevation zones *viz*., E_1 (<1000 m), E_2 (1001– 2000 m) and E_3 (>2000 m), in each zone, four sites (*Panchayat*) were studied for recording socio-economic status and livelihood methods of inhabitants. In total, 180 households according to farmer's category representing 12 panchayats were surveyed. Out of 180 households, 60 from each marginal (< 1 ha), small (1-2 ha) and medium (2-5 ha) category were selected for surveying. In each household, head of the family was personally interviewed by using interview-schedule, which was in the form of a structured and pretested questionnaire. A Group discussions and direct observations were also considered wherever possible to generate information on general farming and vegetation patterns. Equal representation from all economic classes and family size were given while sampling households for survey and the data were extrapolated based on the total household and population. After completing survey, logical grouping of the quantitative data was done, coded, statistically analyzed and tabulated following standard procedures.

Results and Discussion

***Family size*:** Household size represented the total individuals in household comprising male and female persons (Fig 1). The average household size (persons per household) varied between 4.85 at elevation E_2 and 8.15 at elevation E_3 and the population of males was highest in E_1 while population of female was highest in E_3 followed by E_2. Children's population size ranged between 0.40 and 1.40 at different elevation. Within the farmers' categories, medium farmers have highest family size followed by small and marginal farmers. Similar results regarding family structures were observed by Joshi (2011) who reported average family size of 6.5 persons at Karganoo and 7.0 persons at Katli in Rajgarh and Pacchad block of Sirmaur district. Masoodi (2010) and Sharma (2012) reported average family size of 5 persons in Solan district of Himachal Pradesh.

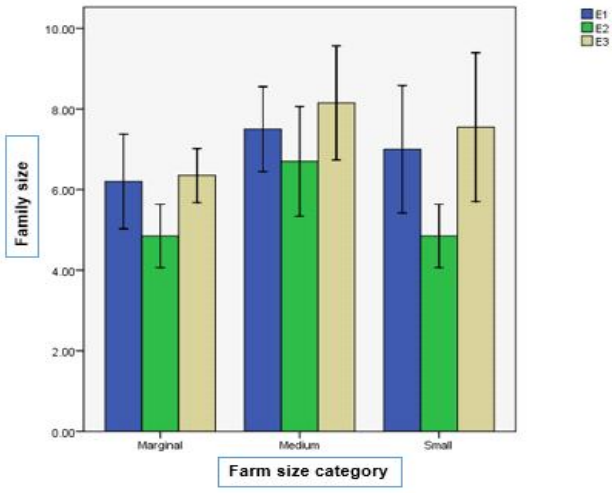

Fig 1. Average family size of farmer's category at different elevations

***Population and sex ratio*:** Household population and sex ratio determine the intensity of dependence of population on natural resources and availability of the family work force on farmers' field (Yadav *et al*., 2016). The sampled household's population ranged from 124 to 150, 97 to 134 and 127 to 163, respectively at different elevations across different category of farmers (Table 1). The sex ratio was recorded more than 700 at all elevations except at elevation E_1 where it was minimum as 687 which is lower than the state (H.P.) and national averages of 972 and 940, respectively (GOI, 2011). The maximum sex ratio was recorded as 961 at elevation E_3 in small farmers' category. Similar observations on sex ratio were also made by Singh (2002).

***Educational status*:** Education plays an important role in farming sector. The decision-making and managerial capability of the family in any households is influenced by the educational status and awareness level of the family. The literacy level was highest (90.41%) at elevation E_1 in medium category of farmers and lowest (77.78%) at the elevation E_2 in the marginal category of farmers (Table 2). Overall literacy rate is around 86.88% in elevation E_1 followed by 85.14% in elevation E_3 and 83.

Table 1. Average number of households, population, family size and sex ratio in the study area

Farm size	Sampled households	Total population	Adult/household		Children/household		Sex ratio
			Male	Female	Male	Female	
E_1 (<1000 m)							
Marginal	20	124	2.70	2.20	0.75	0.55	797
Small	20	140	3.15	2.20	1.00	0.65	687
Medium	20	150	3.75	2.60	0.60	0.55	724
Total	60	414	3.20	2.33	0.78	0.58	732
E_2 (1001-2000 m)							
Marginal	20	97	2.00	1.80	0.65	0.40	830
Small	20	109	2.20	1.80	0.90	0.55	758
Medium	20	134	2.65	2.20	1.10	0.75	787
Total	60	340	2.28	1.93	0.88	0.57	789
E_3 (>2000 m)							
Marginal	20	127	2.65	2.35	0.75	0.60	868
Small	20	151	2.75	2.95	1.10	0.75	961
Medium	20	163	3.30	3.00	1.20	0.65	811
Total	60	441	2.90	2.77	1.02	0.67	877

Table 2. Educational status of people depending upon farm size and elevation in study area

Farm size	Educational status						
	Illiterate	Literate	Primary (<5th grade)	Secondary (5-10th grade)	Intermediate and higher (>10th grade)	Non-school going	Literacy (%)
E_1 (<1000 m)							
Marginal	23	97	19	39	39	7	80.83
Small	16	122	19	62	41	4	88.41
Medium	14	132	19	57	56	10	90.41
Total	53	351	57	158	136	21	86.88
E_2 (1001-2000 m)							
Marginal	20	70	22	29	19	7	77.78
Small	14	89	18	51	20	6	86.41
Medium	17	106	22	52	32	13	86.18
Total	51	265	62	132	71	26	83.86
E_3 (>2000 m)							
Marginal	17	101	14	56	31	9	85.59
Small	21	112	24	53	35	19	84.21
Medium	21	125	22	52	51	17	85.62
Total	59	338	60	161	117	45	85.14

86% in E_2. Irrespective of elevation most of the people had secondary (5–10th grade) education followed by the intermediate and higher (>10th grade), primary (<5th grade), uneducated (adults) which majorly comprised of elderly population and least were non-school going (children). Highest primary education was observed in elevation E_2 while highest secondary in elevation E_3 and intermediate and higher educated people were recorded at elevation E_1. Educated farmers are considered to be more aware of the modern farming practices and can be better manager of his/her farm as reported earlier by Rai *et al*. (2001).

***Type of family structure*:** The family, as a primary social institution is changing, both in its composition and structure in India. The family, as in many societies has been not only the center of socio-economic life, but also the primary source of social security and support for the members of the family. The data (Fig 2) revealed that the marginal category of farmers had more number of nuclear families (70%, 90% and 75%) followed by small category of farmers, whereas medium category of farmers in all elevation zones had more number of joint family (65%, 45% and 60%, respectively). Lal (2017) also found similar social structure by conducting a study in Bhota town of Hamirpur district, Himachal Pradesh, India.

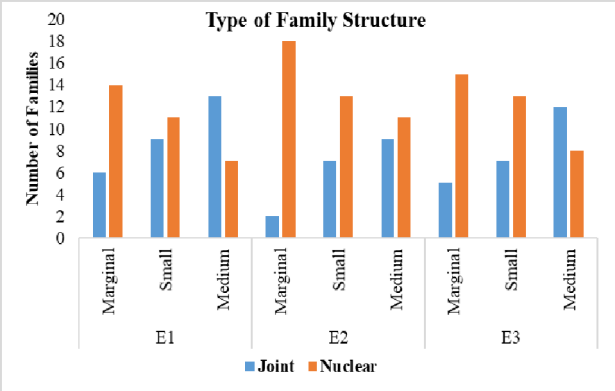

Fig 2. Type of family structure of farmers' category at different elevations

Social category: Social caste is a form of social stratification characterized by endogamy, hereditary transmission of a lifestyle, which often includes an occupation, status in a hierarchy, and customary social interaction and exclusion. It was observed that general category of farmers was dominant in all elevation zones amongst all categories of farmers (Fig 3). At elevation E_3 under medium category of farmers maximum numbers of households (90%) were recorded belonging to general category. Schedule caste (SC) was maximum in elevation E_2 followed by elevation E_1 and E_3. Schedule tribe (ST) and other backward classes (OBC) were less prominent in the study area and households belonging to schedule tribe were only present in elevation E_3, while person belonging to OBC were present in only elevation E_1 and comparatively in lesser number (41.67%). Socio-economic upliftment were based on the capabilities of the respondents and need to increase in education and employment opportunities that directly relates to livelihood improvement as observed by Yadav *et al*. (2016) in central Himalaya and Apparaya (2015) in Kalaburagi district of Karnataka, India.

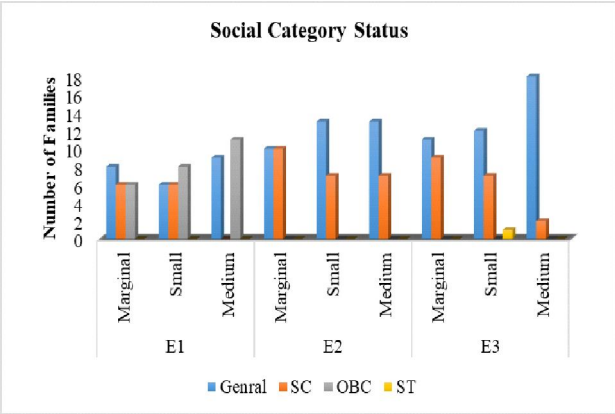

Fig 3. People's social category in different farmers category at different elevations

Livestock population: The population of livestock was also recorded (Fig 4). Livestock was found to play a crucial role in the farming systems of the sampled households. In a tree/crop-livestock system, tree/crop provides green and dry fodders to animals and in return gets manure. Livestock is a source of income to the farmers in terms of milk, wool as well as meat. Perusal of the data (Fig 4) revealed that cow was dominating domesticated species in all categories of farmers of elevation E_1 and E_2 with an average livestock unit of 1.18 and 1.95 followed by other species of animal's *viz*., buffaloes, bullock, goats and sheep. While in elevation E_3 goat was most dominating species in all categories of farmers having an average of 6.78 followed by cow, sheep, bullock and buffaloes. Also at elevation E_3, goat was the major (14.6) domesticated species in medium category of farmers followed by small and marginal categories. Similar trends were also observed in case of cow at elevation E_1 and E_2.

The data indicated that all farmer categories had diversified systems. Cows were the major livestock species except elevation E_3 and reared for the purpose of milk followed by the buffalo. It was also observed that number of bullocks per family were less as land preparation is usually done by owned as well as by hired bullocks in addition to tractors. All the sampled farmers in the study area preferred more of the improved breeds than the local ones among all animal species, which might be ascribed to the reason that improved breeds are more productive and thus leads to higher economic gains. Significant contributions of livestock sector to the economy of Himachal Pradesh were also observed by Kumar and Lal (2012) and Yadav *et al*. (2016) in Central Himalaya.

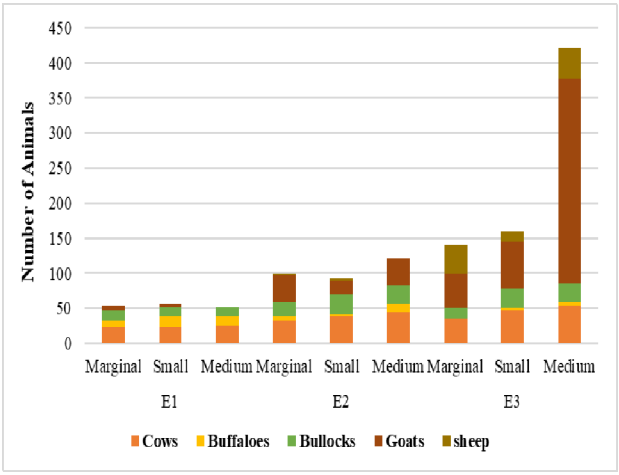

Fig 4. Livestock inventory at different elevations

Table 3. Animal husbandry and management practices of households in the study area

Particulars	Elevation (E)								
	E_1			E_2			E_3		
	Marginal	Small	Medium	Marginal	Small	Medium	Marginal	Small	Medium
	Percentage of households								
Family involved	80.0	95.0	85.0	80.0	95.0	100.0	95.0	100.0	100.0
Milking method									
a. Traditional	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Livestock health management									
a. Regular deworming	62.5	57.8	64.7	6.20	31.5	25.0	31.5	50.0	35.0
b. Disease pest management	56.2	52.6	76.4	6.25	31.5	30.0	42.1	60.0	45.0
c. Both	56.2	42.1	58.8	6.25	26.3	20.0	31.5	50.0	35.0
Breeding method									
a. Scientific	50.0	57.8	76.4	6.25	15.7	20.0	47.3	35.0	50.0
b. Traditional	50.0	42.1	23.5	93.7	84.2	80.0	47.3	60.0	50.0
Animal dung utilization									
a. Direct spreading	12.5	10.5	0.00	56.2	36.8	25.0	31.5	20.0	10.0
b. Fuel	81.2	68.4	82.3	75.0	84.2	95.0	84.2	75.0	75.0
c. Composting in pit	81.2	78.9	76.4	43.7	47.3	40.0	68.4	60.0	80.0
Cleaning of animals	43.7	63.1	76.4	25.0	47.3	55.0	42.1	50.0	60.0
Sanitation/ disinfection	62.5	52.6	88.2	6.25	36.8	30.0	42.1	55.0	55.0

Where E_1, E_2 and E_3 are elevations

***Animal husbandry and management practices*:** The different farmers of the studied area (Table 3) adopted the different management practices for animal husbandry. The farmers of different elevation zones and all categories follow traditional methods of milking as they did not possess big dairy farm. Majority of the farmers go for regular deworming and disease-pest management practices in elevation E_1 making overall percentage of 61.54 followed by elevation E_3 and E_2. The data also revealed that scientific breeding method was preferred more against traditional method in elevation E_1, due to increasing awareness and accessibility of veterinary technicians and services. But in elevation E_2 and E_3 traditional method was preferred more because of lack of facilities and unawareness. General observation was that green and dry fodders were the major feed resources for the feeding of animals; however, share of concentrate feeds in feeding was negligible. Moreover, the farmers were paying good attention toward animal management. Animal husbandry practices adopted in the study area was similar to the finding of Massingue (2007) who confirmed the traditional method of milking and farmers awareness about the regular washing/cleaning of animals and other improved practices of animal management.

***Farming area and land holding size*:** Land is a basic resource in the agrarian economy. Size of the land holding is an important variable that is directly linked to household income, consumption and savings. Land holding size showed a significantly positive relationship with category of farmers in all elevation zones (Fig 5). There was increase in land holding in medium category of farmers followed by small and marginal category of farmers. Average area available for farming was highest (2.80 ha) under medium category of farmers in elevation E_3, while lowest (0.66 ha) at elevation E_2 under marginal category. Singh (2007) and Das (2003) also reported that large percentage of respondents had either small or medium land holding size with more number of assets and facilities when compared to marginal land holders.

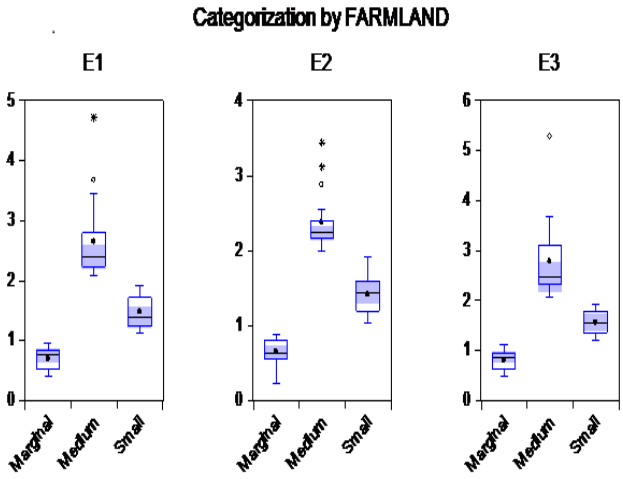

Fig 5. Average land holding size of different farmers' category at different elevations

Table 4. Pearson's correlation coefficients between various parameters of the study area

Variables	1	2	3	4	5	6	7	8
Family size	1.000							
Type of family	0.750**	1.000						
Sex ratio	0.018NS	0.058NS	1.000					
Male literacy rate	-0.211**	-0.230**	-0.038NS	1.000				
Female literacy rate	-0.043NS	0.003NS	0.073NS	0.237**	1.000			
Land holding	0.226**	0.268**	0.022NS	0.064NS	0.183*	1.000		
No. of livestock	0.083NS	0.150*	0.154*	-0.148*	0.024NS	0.216**	1.000	
EIA	0.734**	0.486**	-0.181*	-0.082NS	-0.065NS	0.218**	0.029NS	1.000

** (P<0.05); *(P<0.10); NS: Non-significant

***Employment and income sources*:** There were four different employment avenues in the study area. The sampled farmers met their livelihood through service, wage labour, self-business and agriculture. Major source of income is agriculture in all elevation zones and all categories of households followed by the service, labour employment and self-business. Agriculture contributed 77.60%, 84.26% and 84.36% in total household income at elevation E_1, E_2 and E_3, respectively. This share decreased along the rise of category of farmers and attained highest value as 86.02% under medium category at elevation E_2. Share of service employment as a source of income was second largest which varied from 7.71% at elevation E_3 to 16.40% at elevation E_1. Public sector and private sector services are the main source for service employment.

***Agroforestry in the study area*:** The major agroforestry systems of the study area were agrisilviculture (crops+forest trees), agrihorticulture (crops + fruit trees) and agrisilvihorticulrure (crops + forest trees + fruit trees). Under pastoral system, agrisilvipastoral (crops + forest trees + pastures) and silvipastoral (forest trees + pastures) were main agroforestry systems in elevation E_1, while pastoralsilviculture (pastures + forest trees) and pastoralsilvihorticulture (pastures + forest trees + fruit trees) were important agroforestry systems in elevation E_2 and E_3. Singh *et al*. (2018) also reported similar type of agroforestry systems in Himachal Pradesh. Share of income from agriculture (through adoption of agroforestry) was significantly related to family size, type of family and land holding size and sex ratio, while male and female literacy rate and number of livestock were not significantly related (Table 4). Philip *et al*. (2013) reported that adoption of agroforestry system was significantly affected by farmers' level of education.

Conclusion

Study indicated that in all the elevation zones, major source of income was agriculture irrespective of farmers categories followed by the service, labour employment and self-business. Cow is the major source of milk for the household's and majority of the households own livestock. Land holding size also showed a significantly positive relationship with category of farmers at all the elevation zones. In the study area agrisilviculture, agrihorticulture, agrisilvihorticulrure, agrisilvipastoral, silvipastoral, pastoral-silviculture and pastoral-silvi-horticulture were found as important agroforestry systems. However, appropriate knowledge on suitable species of crops and trees, adoption of scientific agroforestry practices and government supports etc. are required for sustainable income with minimum risk leading to improvement in livelihood.

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