RESEARCH ARTICLE :

Independent household and farm factors in adoption of different agroforestry types: Experience from Haridwar district, North India

■ HIMSHIKHA AND CHARAN SINGH

SUMMARY : This study accesses the individual, house hold and farm factors that are not associated with adoption of four major kinds of agroforestry practices in Haridwar district, India. Random sampling technique was used for the purpose. All three tehsils were selected and 12 villages were randomly selected from each of the tehsils. 12 farmers' households were randomly selected from each of the village. Primary data were collected through semi structured questionnaire with 426 farmers out of which 365 farmers were agroforestry adaptors. Data from agroforestry adopters only is analyzed in this study. The results of the study shows that there were a number of determinants which although being a part of household conditions, did not influence an agroforestry adopter's decision on what types of agroforestry he should practice his field. Chi^2 test (p=0.05) shoes that there is no significant association between different household conditions determinants and a farmers choice on types of agroforestry practices in all three tehsils of the studied district. The adopted agroforestry practices in the study area include agri-silvi and pastoral based practices, horticulture tree species based like orchard plantation or home gardens; multipurpose tree species woodlots and live fences in form of planting trees on farm boundaries.

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BACKGROUND AND OBJECTIVES

Adoption is a decision to make full use of and agroforestry technology at the best course of action (Rogers, 2003). If we review available literature on agroforestry practice types, many agroforestry practices are categorized like improved fallows, Taungya farming, home gardens, alley cropping, multipurpose tree species on farmlands (Nair, 1993) as well as boundary planting (Sinclair,

1999). Many researchers have discussed the attributes of the users, stackholders (Kant and Lehrer, 2004) in agroforestry context. Sinclair even proposed a new scheme that used 'Practice' rather than 'system' as the unit of classification. A wealth of literature confirms that agroforestry may contribute to the welfare and livelihoods of farmers. Several studies have perceived agroforestry practices in different ways and most research on agroforestry has been conducted from the bio-

Author for correspondence :

HIMSHIKHA
Extension Division,
Forest Research
Institute, DEHRADUN
(UTTARAKHAND) INDIA
Email:bhhimshikha654
@gmail.com

See end of the article for
authors' affiliations

physical perspective only (Adedayo and Sobola, 2014). Agroforestry solutions are location specific in their relevance, performance and acceptability (Madiwalar *et al.*, 2007). In agroforestry, farm household characteristics determine the success of programmes promoting agroforestry systems and practices (Sabastian *et al.*, 2014). Agroforestry in India is as old as of Taungya system in Burma (part of the India, now known as Myanmar) in 1856. Agroforestry, the deliberate integration of trees with agricultural crops and/or live stocks either simultaneously or sequentially on the same unit of land, has been as established practice for centuries (Dhyani *et al.*, 2009). In different forms, Agroforestry has been promoted in differentparts of country (Dwivedi *et al.*, 2007). Haridwar is one of the important districts in Uttarakhand where characteristic feature of growing tree species under different agroforestry types in fields is being practices is continuing since generations. Farmer-oriented factors are critical in adoption of agroforestry practices among rural farmers. In rural context, farmers have different livelihood strategy in rural areas. Each household adopts agroforestry practices at different levels depending on their situations. Despite the fact that there are a number of factors influence the adoption of agroforestry (Oino and Mugure, 2013), there are a number of factors that actually do not affect much on what kind of practices an agroforestry farmer is adopting in his fields. Rather, individual characteristics also determine how individual will respond (Kant and Lehrer, 2004). Therefore, the main purpose of this study is to highlight those factors that are independent to different agroforestry practices.

The objectives of the study are:

– To distribute farmers practicing different agroforestry practice types into major individual, farm and household attributes, and

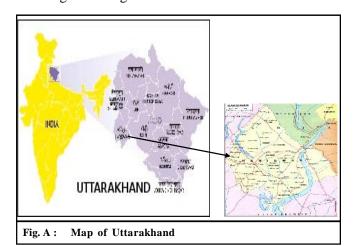– To describe those attributes which are independent to with different practise types.

Hypothesis tested:

The following hypotheses were tested in the study.

All studied factors like fertilizer and manure types their utilization, sources, main fuel sources, timber utilization as fuelwood, purpose behind rearing animal species etc. are independent and there is no significant association between factors and types of agroforestry practices being adopted by the farmers.

RESOURCES AND METHODS

Study area:

Uttarakhand, formed on 9 November 2000 as 28th state of India, spread over 53483 km² of land which extends between 77'34' and 81'02' E and 28'03 and 31'27' N, 13 districts, 16826 inhabited villages. As per census 2011, the population of the state is 10.12 million which constitutes 0.84 per cent of the country's population. Rural population constitutes 69.45 per cent (F.S.I., 2011). Haridwar district covers an area of about 2,310 km² in Uttarakhand, is having population around 19, 27 029 (Census, 2011). It is in the southwestern part of Uttarakhand (formerly known as Uttaranchal) state of India. Its latitude and longitude are 29.96 N and 78.16 E, respectively. The district is administratively subdivided into three tehsils: Haridwar, Roorkee, and Laksar. It is further divided into six development blocks: Bhagwanpur, Baharabad, Roorkee, Narsan, Laksar, and Khanpur covering 521 villages.

Fig. A :   Map of Uttarakhand

Agriculture is the mainstay of this well irrigated district. Tree outside forest in Uttarakhand is estimated to be 20,917 million (F.S.I., 2011). Subsistence agriculture is prime source of income for more than 70 per cent population and interlinked with forestry and animal husbandry making approximated 12 per cent land available for cultivation (Tewari *et al.*, 2007).

Sampling and data collection:

Random sampling technique (Singh *et al.*, 2009 and Mugure *et al.*, 2012) survey was used to select sample villages and respondents in the District. The survey was conducted during December 2013-March 2014 in thirty

six villages randomly selected from all three tehsils of Haridwar district of Uttarakhand with some criteria like agro-ecology, having more than five years of introduction of trees, types of crop-tree systems, sufficient numbers of adopters who have planted, grown and utilized trees on their farms, representing different income groups, age and gender etc. also knowing their knowledge, need and perception for tree species in agroforestry. 432 farmers (both adopters and non-adopters of agroforestry at the time of survey) were randomly selected with 12 farmers from each of the studied village. Six farmers' responses were discarded due to inadequacy and insufficient data. Pre tested semi structured questionnaires were used as data collection instrument in personal interviews and focus group discussion. Questions based on different categories like experience, purpose of planting tree species on their farmlands, labour resource types, reason behind different agroforestry practices adoption, decision making etc. were asked to the respondents. Selected farmers in each village were divided into different categories accordingly. Data of which was further used for analysis. Secondary data for literature were collected from relevant journals, reports, and online resources.

Data analysis:

Data were first coded into 0 and 1 numbers. Data was analyzed using stastical procedures like frequency percentage and distribution, contingency tables, and Chi^2 test at p=0.05 level of significance. Chi^2 value were used for different attributes using following formula

$$\mathbf{Chi^2\ (X^2)\ N\ \frac{\ddot{y}(Observed\ frequency\ -\ expected\ frequency)^2}{Expected\ frequency}}$$

Precedents of Chi^2 test analysis results are found in the relevant available literature (Adedayo and Sobola, 2014; Singh *et al.*, 2009 and Kabwe *et al.*, 2009) to this study which generally confirms it as accepted method of analysis.

OBSERVATIONS AND ANALYSIS

During focus individual and group discussion, respondents accepted agroforestry practices as a potential source of fuelwood. Their main purpose behind planting tree species were timber for domestic use and commercial sale, firewood and fodder etc. almost one third of total farmers were living in good conditioned big houses most of which had adopted agri-silviculture and

pastoral based agroforestry practices.

Table 1 describes individual, household and farm attributes like housing type, farm level decision making, favor, knowledge, experience, types of fuel used and manure applies etc of sampled agroforestry farmers and farm households because before finding any association or independence, it is necessary to understand these conditions pertaining to different agroforestry practices prevalent in study area. From Table 1, it is clear that despite have good/medium (10-20 years) and sufficient (>20 yrs.) experience regarding agroforestry and agriculture, one in four farmers denied knowledge technologies, schemes and had never participated in any training related to agroforestry practices adopted by them. Condition of decision making by men and their supportive role in income generation activities in agroforestry households is almost same and very less families are having their actual and active role. There is no doubt that women are in many case, more constraints as compare to men in their access to resources and decision making (Baliyan, 2014) and the study area is not apart from this. The study observed that farmers are adopting different agroforestry practices because they traditionally following it or for some other reasons like income support and majority of farmers are well aware of benefits and demerits of agroforestry practices. All types of fuels, manures and fertilizers are frequently used applied in agroforestry households. Same is in case of reared animal species and the purpose behind it and there is no major difference in their distribution. Farm level decision making in usually done by men only in all households practicing different agroforestry practices. Farmers revealed that family, villagers and others like market facilities etc. affect most decision making in adoption of agroforestry practice types. Labour is considered as limiting factors in many agroforestry studies not only to farmers' decision to adopt agroforestry practices, but also in expansion of agroforestry practices (Oino and Mugure, 2013). In study area, as compare to permanent labour, temporary labour more hired by most of the agroforestry farmers. However like in other characteristics distribution, here also we find that both kind of labour is mostly utilized by farmers practicing agri-silvi-and pastoral based practices.

Table 1 revealed agroforestry adopters' individual, household and farm characteristics (objective 01) in relation to four major categories of agroforestry practice types being adopted by the farmers. Here, one thing to

Table 1 : Farm, household and individual characteristic percentage distribution of agroforestry farmers adopting different practices

Sr. No.	Attributes/factors	Sub categories	Freq.	Agrisilvi and pastoral (%)	Live fences (%)	Horticulture tree sp.(%)	MPT. woodlots (%)
1.	Housing type	Small	122	93.44	14.75	3.28	0.03
		Big	243	95.88	11.93	4.53	0.02
2.	Land holding effect	Yes	269	86.25	5.58	2.97	0.15
		No	98	92.86	0	0	0.07
3.	Knowledge of related schemes to agroforestry	Yes	91	95.6	12.09	5.49	0.04
		No	274	93.43	13.14	3.65	0.01
4.	Favor to agroforestry	Yes	351	94.3	12.82	4.27	0.02
		No	14	85.71	14.29	0	0
5.	Any training	Yes	65	92.31	10.77	3.08	0.03
		No	300	94.33	13.33	4.33	0.02
6.	Like to adopt/ promote agroforestry	Yes	347	94.24	12.97	4.03	0.02
		No	18	88.89	11.11	5.56	0
7.	Knowledge about benefit/ demerits	Yes	352	93.75	13.35	4.26	0.02
		No	13	100	0	0	0
8.	Need training programme	Yes	117	93.16	16.24	3.42	0.04
		No	248	94.35	11.29	4.44	0.01
9.	Total farming experience	Low	12	100	25	0	0.08
		Med.	133	94.74	12.03	3.76	0.02
		Sufficient.	220	93.18	12.73	4.55	0.02
10.	Level of knowledge	Nil	37	86.49	27.03	0	0.03
		low	139	94.96	10.07	5.04	0.02
		Med.	139	94.24	13.67	5.76	0.02
		Sufficient	50	96	8	0	0.02
11.	Agroforestry experience	Nil	8	100	25	0	0
		low	36	97.22	11.11	0	0
		Ave.	207	91.79	14.01	4.35	0.02
		Sufficient	114	96.49	10.53	5.26	0.03
12.	Temporary labour	Yes	314	93.95	13.38	4.46	0.02
		No	51	94.12	9.8	1.96	0.02
13.	Permanent labour	Yes	125	96.8	8	6.4	0.02
		No	240	92.5	15.42	2.92	0.03
14.	Farming output	Positive	304	93.75	13.16	3.95	0.02
		Negative	61	95.08	11.48	4.92	0.02
15.	Purpose of planting tree species	Fodder	55	96.36	12.73	1.82	0
		Firewood	342	94.44	12.87	4.09	0.02
		Shade	43	100	9.3	2.33	0
		Timber	357	94.68	12.04	4.2	0.02
		Fruits	38	97.37	13.16	5.26	0.03
		Others	113	92.04	15.04	5.31	0.02
		None	8	62.5	50	0	0
16.	Reason of growing agroforestry	Traditional	143	92.31	16.08	6.29	0.03
		Trial	62	98.39	6.45	1.61	0
		Indefinite	21	95.24	0	0	0.05
		Other	139	93.53	14.39	3.6	0.02
17.	Women support in income generation	Yes	67	97.01	7.46	5.97	0.01
		No	298	93.29	14.09	3.69	0.02
18.	Decision making by women	Yes	75	98.67	8	6.67	0.01
		No	290	92.76	14.14	3.45	0.02

Table 1 contd....

Contd... Table 1

19.	Manure and/ fertilizer type	Chemical	359	93.87	12.53	4.18	0.02
		FYM	350	94	13.43	3.71	0.02
		Green	214	94.39	12.62	2.8	0.03
		Other	309	94.17	13.27	3.88	0.03
		None	1	100	0	0	0
20.	Source of fertilizer /manure	Home	327	93.58	14.07	3.36	0.02
		Local area	225	93.78	12.44	4.89	0.03
		Market	360	94.17	12.78	4.17	0.02
		Govt. block	136	97.06	11.76	2.21	0.03
		None	1	100	0	0	0
21.	Main fuel type	Trees	359	95.54	13.09	4.18	0.02
		Kerosene	219	94.06	9.59	2.28	0.03
		LPG	364	93.96	12.91	4.12	0.02
		Dung	241	94.19	11.2	3.32	0.02
		Other	19	100	5.26	0	0
22.	Timber as main source of fuel	Yes	169	105.92	18.34	6.51	0.04
		No	196	83.67	8.16	2.04	0.01
23.	Purpose of rearing animal	Milk	361	94.18	13.02	3.88	0.02
		Dung	259	94.21	13.51	4.25	0.02
		Manure	299	92.98	15.38	3.68	0.03
		Farming	266	94.36	13.53	3.76	0.03
		Income	142	91.55	13.38	0.7	0.05
		None	3	66.67	0	33.33	0
24.	Availability of source of information	No	2	100	0	0	0
		Yes	363	93.94	12.95	4.13	0.02
25.	Farm decision making	Frequently	9	100	22.22	0	0
		Men	284	93.66	14.44	3.87	0.02
		Women	1	100	0	0	0
		Combined	71	94.37	5.63	5.63	0.01
26.	Others affecting farmer's decision making	Family	186	95.16	10.22	4.84	0.03
		Friend	118	94.92	12.71	3.39	0.03
		Villagers	182	93.41	12.09	2.2	0.03
		Govt. Officers	66	95.45	7.58	1.52	0.02
		Others	149	93.29	12.75	5.37	0.03
		None	91	90.11	18.68	5.49	0.02

be noted is, that majority of all respondent falling under different house hold characteristics are have adopted agri-silvi-culture and pastoral based practices like block plantation followed by live fences like bund plantation, horticulture tree species based like orchard plantation and woodlots.

Table 2 shows those attributes which are independent to different practise types. Chi^2 test (p=0.5) shows that there is no significant association between all above studies individual, household and farm attributes to agroforestry practices adoption. In study area, farmers revealed that the extent of land holding the poses, affect their decision to on adoption of agroforestry. Land fragmentation is one of the critical factors that have given consideration in agroforestry practices adoption studies (Mugure *et al.*, 2012). However Chi^2 test does not find any association between landholding effects on types of agroforestry practices being adopted by agroforestry farmers. House conditions of farmers also not associated with their choice to adopt kind of agroforestry practices. The study found that agroforestry practice types are independent of farmers' house type, land holding effect, knowledge of related scheme or technology, like and favour to agroforestry, training done or its requirement

Table 2 : Chi² values of different household and farm attributes to different agroforestry practices

Sr. No.	Attributes	Chi² value	Critical value	Degree of freedom	Significant/non significant (P=0.05)
1.	House type	2.04	7.81	3	NS
2.	Land holding effect	0.69	7.81	3	NS
3.	Knowledge of related scheme to agroforestry	3.05	7.81	3	NS
4.	Favor to agroforestry	0.92	7.81	3	NS
5.	Any training done previously	0.69	7.81	3	NS
6.	Like to adopt/ promote agroforestry	2.73	7.81	3	NS
7.	Knowledge about benefit/ demerits of agroforestry	0.79	7.81	3	NS
8.	Need training programme	4.81	7.81	3	NS
9.	Total farming experience	3.52	12.59	6	NS
10.	Level of knowledge	12.31	16.91	9	NS
11.	Agroforestry experience	5.01	16.91	9	NS
12.	Temporary labour utilization	1.1	7.81	3	NS
13.	Permanent labour utilization	6.41	7.81	3	NS
14.	Farming output	0.34	7.81	3	NS
15.	Purpose of planting tree species	15.11	28.86	18	NS
16.	Reason of growing agri/ agroforestry	11.91	16.91	9	NS
17.	Women support in income generation	2.84	7.81	3	NS
18.	Decision making by women	3.81	7.81	3	NS
19.	Manure and/ fertilizer utilization	1.28	21.02	12	NS
20.	Source of fertilizer /manure	3.24	21.02	12	NS
21.	Fuel types used in households	5.58	21.02	12	NS
22.	Timber as main source of fuel	6.71	7.81	3	NS
23.	Purpose of rearing animal	18.64	24.99	15	NS
24.	Availability of source of information	0.41	7.81	3	NS
25.	Farm decision making	5.33	16.91	9	NS
26.	Others affecting farmer's decision making	9.8	24.99	15	NS

NS=Non-significant

in the study area. The reason behind this might not be unconnected with the fact that there is no clear cut distinction between schemes, or technology programmes to the practices types. Similar reason can be with farmers favor to adopt promote agroforestry and previous training done by them, or need of training, if any. Although farming experience, agroforestry experience, knowledge about benefit/demerits of agroforestry, level of knowledge, availability of sources of information are well differentiated by the farmers, as Chi² test (p=0.05) shows no association of these factors to practise type. The reason behind this might be that farmers consider them in their decision to adopt of not to adopt. But when it comes to the types of agroforestry practices that have adopted or want to adopt, all these factors hardly matters between the practice types. In the same vein, purpose of planning tree species, reason of growing agroforestry, other factors influencing decision making are independent

to agroforestry practices types as shown by Chi² test. Fertilizer and manure types their utilization, sources, main fuel sources, timber utilization as fuelwood, rearing animal species and purpose behind rearing animal species are also having no relationship with adoption of agroforestry practices types (Chi² hypothesis). This means these factors are not important to farmers who adopting different types of agroforestry practices.

Conclusion :

The study has shown that agroforestry farmers practicing four major kind of agroforestry practice types are distributed differentially in to independent, household and farm level attributes like their favor, level of knowledge, experience to agroforestry; decision making regarding farm level activities, decision making by female, their contribution to household income, rearing animal species and purpose being rearing them, timber as main

source of fuel, purpose behind tree plantation, knowledge of schemes, need of training, fuel types, manure and fertilizer used in their agroforestry plantations, purpose behind adoption of agroforestry practices etc. though farmers considered these factors while adopting or rejecting agroforestry, but all these factors hardly found to be important to them while making their choices to four major kind of agroforestry practices namely, agri-silvi and pastoral based practice, horticulture tree species based practice, live fences and multipurpose tree species woodlots. Analysis of data (Chi^2 test, p=0.05) results no association between studied attributes and practice types. Though all these factors are not associated with these agroforestry types, majority of agroforestry farmers falling under these categories have adopted agri-silvi and pastoral based agroforestry mostly.

Authors' affiliations :

CHARAN SINGH, Forest Extension Division, Forest Research Institute, DEHRADUN (UTTARAKHAND) INDIA Email : charas@icfre.org

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