Adaptation reasons of agroforestry in the study area of eastern Uttar Pradesh

ABSTRACT

It is paramount to assess the social and economic status of the farmers on the adaptation of any agro-ecosystem. Studies on the impact of socio-economic factors specifically in the agroforestry system adaption is meagre in Uttar Pradesh. Present research was carried out in the villages of the three selected districts (Kaushambi, Pratapgarh and Allahabad) of Eastern Uttar Pradesh with 750 respondents during 2020. The aim of the investigation was to assess the influence of socio-economic factors on agroforestry adaptation. A simple random sampling technique was employed to select the respondents and primary as well as secondary data were used for qualitative and quantitative analysis by using an appropriate statistical design. Results showed that socio-economic factors, like family size, education, age of the farmers greatly impacted the adaptation and difference in combinations of agroforestry systems. The land area under Agroforestry in Kaushambi with 54% followed by Pratapgarh (52%) and Allahabad (50%). the majority of the farmers adapting trees on their farmland for traditional purpose in Kaushambi district (72%) and in Pratapgarh and Allahabad districts having 72% and 70% respectively. The adoption of agroforestry systems for commercial purpose was observed highest in Allahabad (18%) followed by Kaushambi (16%) and Pratapgarh (12%). The Agrisilviculture system are practicing in the three districts and there were different combinations recorded in Pratapgarh (Teak+paddy: 96%); Allahabad (Eucalyptus+mustard: 96%) and Kaushambi (Teak+ mustard: 95.6%) districts. Conclusively, this study would be an asset and provide an idea for the policy makers in implementing or promoting agroforestry system practices in Uttar Pradesh.

Keywords: *Agroforestry; Social Background; Farmers decision; Survey study*

1. INTRODUCTION

Agroforestry is a dynamic, ecologically oriented integrated strategy for managing natural resources that enables greater social, economic, and environmental advantages (Lwayo and Maritim, 2003). During the last 20 years the efforts have been undertaken by farmers, business personnel and researchers to introduce tree-based agricultural techniques in the U.P. green belt. Every sixth Indian resides in Uttar Pradesh and state contributes almost 20.37 % of the nation's agricultural output (GOI, 2005).

Uttar Pradesh is the most important agricultural state of India, not only that it has the highest cropped area of 25,785 thousand hectares, but it has the highest number of over 21 million farm holdings as well. This state is the largest food grain producing state in the country. Agroforestry in the Eastern Plain region of Uttar Pradesh is in the early stages of development. Agroforestry practices vary by agro-climatic zone, land capabilities, and farmer socio-economic condition in Uttar Pradesh. The diversity in agroforestry systems reflects the heterogeneity, and comparative advantage has sparked renewed interest in harnessing the vibrant potential (Verma et al., 2017). According to the Forest Survey of India report in 2019, forest cover, including tree cover, accounts for 3.05% of the total area in Uttar Pradesh is 7342 sq km. Instead of monocropping, the states Eastern Plains and North Eastern Tarai zones should implement proper agroforestry systems such as agri-silviculture, silvi-horticulture, agri-silvi-horticulture, and silvo- pastoral systems. To succeed in the Indian agriculture, this state must become more competitive holistically and particularly in crop diversification. Agroforestry plays pivotal role in achieving the desired level of sustainability and stable livelihood of the people as compare to traditional cropping systems. Similarly, that should be linked to industrial sector to safeguard the people who are involving all these sectors by mutually upholding each other (Kareemulla et al., 2005).

Socioeconomic factors have frequently been linked to the adoption of agro-based technologies such as agroforestry practices (Abagale et al., 2003; Lwayo and Maritim, 2003; Nkamleu and Mamyong, 2005). Additionally, it is crucial to comprehend the underlying elements that might affect farmers' adoption choice processes in order to successfully assist the adoption of improved agricultural methods among smallholder farmers. With a focus on the integration of on-farm trees, this study investigates the socioeconomic determinants that affect smallholder farmers' adoption of agroforestry methods. It aims to give relevant information to extension services on smallholder farmers' planning and adoption strategies for established agro-based technology. (Abagale and colleagues, 2003; Nkamleu and Mamyong, 2005).

Therefore, the key objective of the study was to characterize and identify the factors that led farmers to promote agroforestry systems later assess the systems’ effects.

2. METHODOLOGY

2.1. Selection of the study area

Different varieties of agroforestry have been pushed throughout the nation, including in eastern Uttar Pradesh, southern Karnataka, and sections of Andhra Pradesh. Eastern Uttar Pradesh has been chosen for the different adoption of trees and crops on the farm fields for various advantages including water conservation, wind breaks, and microclimate conditions in the regions. Additionally, Uttar Pradesh was divided into two regions: Intensive (commercial) and traditional agroforestry region. The UP state is located between 25.31° N latitude and 77.84° E longitude. The State is split into the Western, Central, Eastern, and Bundelkhand areas. The tropical monsoon type of climate that prevails in Uttar Pradesh is characterized by warm temperatures.

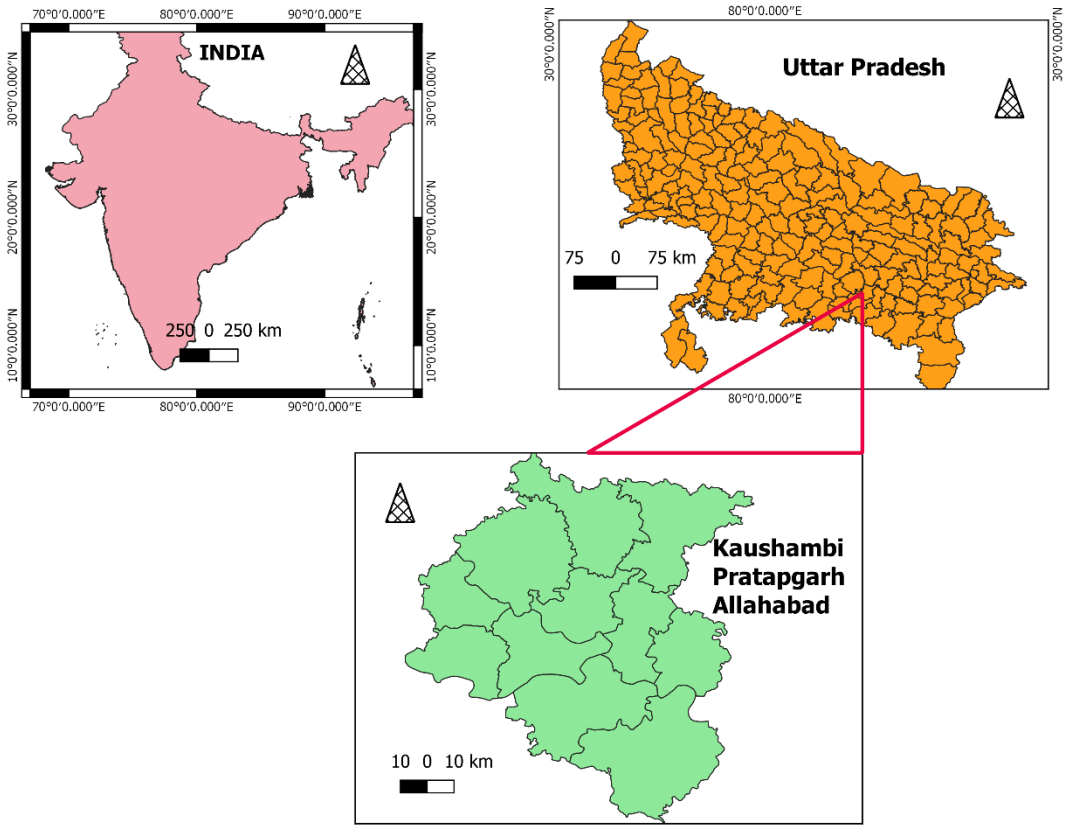

Figure 1. Map of the study area

The investigation was conducted in 3 districts (Kashumbi, Pratapgarh and Allahabad) of the multi-stage random sampling (Figure 1), from each of these areas, three blocks with 15 villages each 5 villages were chosen. The sample units for the study total of 750 farmers were chosen

based on the goal of the research on agroforestry systems and intensive farming systems as well as categories representing various, ages, education family size holdings of land, reasons for agroforestry adoption, farmer challenges, and various socioeconomic categories.

2.2. Data collection

From each village, about 50 farmers were selected that making a total respondents of 750 randomly to participate in the survey. Face-to-face interviews, farm visits, and structured questionnaire were used to collect the data. Information was obtained on agroforestry adoption, socio-demographics of farmers, and desires of farmers for integration trees on farms.

2.3. Statistical analysis

Statistics are employed on the basis of percentages, comparisons are made with the help of the Z-test. All of the data were taken into account for the statistical analysis in order to create the best possible inference for each parameter in context of the study's goals.

3. Results and discussion

3.1. Age

The results of the socio-economic studies in villages of three districts (Kaushambi, Allahabad and Pratapgarh) revealed that the Age of the majority respondents (Table1) were in the middle age group with high percentage 68% in Pratapgarh district and the lowest was in Allahabad with 46%. Similarly, least percent of young aged farmers are involving in agricultural operations in the study area with 2 to 4% in the identified districts of the study.

Table 1. Age of the respondents in Survey districts.

Age of the respondents	Kaushambi		Pratapgarh		Allahabad	
	Frequency	%	Frequency	%	Frequency	%
Young (<30years)	5	2	5	2	10	4
Middle (Between 30-55)	130	52	170	68	115	46
Old (>55)	115	46	75	30	85	34
Total	**250**	**100**	**250**	**100**	**250**	**100**

3.2. Education

Based on survey the findings in (Table 2), education of the respondents were categorized into five categories as Illiterate, Primary school, Middle school, High school and Graduate. Based on survey in the Kaushambi district, about 50% of respondents were graduated followed by high school category (34%). But Primary school and Illiterate categories were very meager in the surveyed area of the study. In Allahabad district majority of the respondents had high school education and graduated. Less number of respondents studied up to middle and primary school education. In Pratapgarh district, graduated and high school educated respondents were more. Primary school level educated respondents were least in number. According to (Matata et al., 2010) education is an important variable that influences the knowledge of different farmers based on their ability to read and write. Present study also concluded that education is an important variable for farmers to know about their farming operations, level of technical knowledge on agricultural programmes, and knowledge about tree and crop adaptation.

Table 2. Education of the respondents in three survey districts

Education of the respondents	Kaushambi		Pratapgarh		Allahabad	
	Frequency	%	Frequency	%	Frequency	%
Illiterate	15	6	15	6	35	14
Primary	10	4	5	2	25	10
Middle	15	6	20	8	10	4
High school	85	34	75	30	110	44
Graduate	125	50	135	54	70	28
Total	**250**	**100**	**250**	**100**	**250**	**100**

3.3. Family size

Every family is one of the integral parts of human beings. Every human is incomplete without family. All the members in the family share equal parts while sharing (Mutonyi et al., 2011) the responsibilities within the family. Then it will make family complete. The family in members influence on decision making process the final decision on farming operations related to farming. Usually in the agriculture related decision taking by the head of the family particularly regarding farming operations and other personal activities in family. Table 3 showed that the majority of the family size is seen in four members's size and having 38% in Kaushmabi and Pratapgarh.

While in Allahabad it was 32%. Fewer are the family members who have at least two members with 2% in the survey districts.

Table 3. Family size of the respondents in Survey area

Family size in numbers	Kaushambi		Pratapgarh		Allahabad	
	Frequency	%	Frequency	%	Frequency	%
2	10	4	5	2	5	2
3	5	2	55	22	15	6
4	95	38	95	38	80	32
5	75	30	60	24	70	28
6	30	12	25	10	40	16
7	25	10	5	2	30	12
8	10	4	5	2	10	4
Total	**250**	**100**	**250**	**100**	**250**	**100**

3.4. Land under Agroforestry system

Land is used for agroforestry system for cultivation different crops, like (wheat, mustard, paddy, chickpea) trees (Poplar, Eucalyptus, Teak, Mango, Neem and also guava etc.,) and pastures on the land by the farmers is a parameter to segregate the land into three different categories viz., small, medium and large as given by (Kumar et al., 2017). It is depending on the availability of total land and awareness of the farmer about agroforestry and also its significance in making sustainability of farmer and productivity of soil to assign the part of available land for agroforestry. Results in Table 4 revealed that the land under Agroforestry in three districts having high percent of land is in large group and it was present in Kaushambi with 54% followed by Pratapgarh (52%) and Allahabad (50%). The least land holding farmers were mainly present in the medium category in Kaushambi and Pratapgarh with percent of 2%.

Table 4. Land under Agroforestry system in Survey area

Land under Agroforestry	Kaushambi		Pratapgarh		Allahabad	
	Frequency	%	Frequency	%	Frequency	%
Small (1-2)	110	44	115	46	95	38
Medium(2-3)	5	2	5	2	30	12
Large(>3)	135	54	130	52	125	50

Total	**250**	**100**	**250**	**100**	**250**	**100**

3.5. Reason for the adaptation of agroforestry

Combining crops, trees, and cattle is a typical method among farmers to deal with the problem of a severe lack of fuel, fodder, and other supplies (Bhatt et al., 2002). The farmers have little options to choose the tree species, so they settle with whatever is there on their property (Bhatt et al., 2010). As stated by (Dwivedi et al., 2007), agroforestry is the driving force behind this system's advantages for farmers. While the availability of fuel wood was the main factor in traditional agroforestry systems, commercial agroforestry in Eastern Uttar Pradesh was based on huge revenue. As presented in Table 5, the majority of the farmers adapting trees on their farmland for traditional purpose in Kaushambi district (72%) and in Pratapgarh and Allahabad districts having 72% and 70% respectively. The adoption of agroforestry systems for commercial purpose was observed highest in Allahabad (18%) followed by Kaushambi (16%) and Pratapgarh (12%).

Table 5. Reason for adaptation of agroforestry by respondents in survey area.

Reason for Adaptation of AGF	Kaushambi		Pratapgarh		Allahabad	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Traditional	185	72	180	72	175	70
Trial	25	10	40	16	30	12
Commercial	40	16	30	12	45	18
Total	**250**	**100**	**250**	**100**	**250**	**100**

3.6. Agrisilviculture system followed by the farmers

During the survey, a question regarding the preference of the trees for future adoption was also asked from the respondents and the resultant data have been presented in Table 6. It was evident that agri-silviculture is the most widely practiced agroforestry type in the area, while silvi-pastrol is the least widely practiced agroforestry type. The study conducted by Kumar *et al.,* (2017) identified that agri-silviculture, silvipastoral, and agri-silvopastoral are the most common

agroforestry types in Uttarpradesh, India. The combination of trees and crops known as the Agrisilviculture system and the farmers are mostly cultivating agriculture crops like paddy, mustard, wheat in combination with the trees like Teak, Eucalyptus on their same piece of the land. The results mentioned that the Agrisilviculture system are practicing in the three districts and there were different combinations recorded in Pratapgarh (Teak+paddy: 96%); Allahabad (Eucalyptus+mustard: 96%) and Kaushambi (Teak+ mustard: 95.6%) districts.

Table 6. Agrisilviculture system followed by respondents in survey districts.

Agrisilviculture system	Kaushambi		Pratapgarh		Allahabad	
	Frequency	%	Frequency	%	Frequency	%
Teak+ Paddy	237	94.8	240	96	239	95.6
Teak+ Mustard	239	95.6	235	94	237	94.8
Teak+wheat	234	93.6	238	95.2	234	93.6
Eucalyptus +Paddy	235	94	235	94	238	95.2
Eucalyptus + Mustard	238	95.2	240	96	240	96
Eucalyptus + Wheat	236	94.4	237	94.8	239	95.6

4. Conclusion

Agroforestry is a sustainable land use system that maintains and increases crop yields by combining different crops with trees on the same plot of land. Farmers in the eastern high lands have been employing the agroforestry method for many years for traditional purposes, and they have accepted trees on wide stretches of land. It also enhances the productivity of the products and preserves soil fertility, which decreases crop failure rates. In the present investigation, it was noticed that paddy, mustard, and wheat are the main crops grown in the agrisilviculture system, which also includes the tree species *Tectona gradins*, *Eucalyptus globulus*, and *populus spp*. These trees play a significant role in all types of terrestrial ecosystems and offer a variety of services and goods to both urban and rural communities. Nevertheless, the socio-economic background of the farmers strongly influences the adaption of agroforestry. Role of stakeholders such as farmers, government and non-government organizations, scientists, researchers, and policy makers' collaborative approach helps in promoting agroforestry system in Uttar Pradesh.

REFERENCES

Abagale, A. F., Addo, Adisenu-doe, R., Mensah A. K., Apana, S., Boateng, E. A., Owusu, A. and Parahoe, M. (2003). The Potential and Constraints of Agroforestry in Forest Fringe Communities of the Asunafo District-Ghana. Tropenbos International.

Bhatt, V.P. (2002). Germination behaviour of Ficus spp. in Garhwal Himalaya. Ph.D. Thesis, HNB, Garhwal University, Sri Nagar, Garhwal, 40–50 pp.

Bhatt, V.P., Purohit, V. and Negi, V. (2010). Multipurpose tree species of Western Himalaya with an agroforestry perspective for rural needs. J. American Sci., 6(1): 73–80.

Dwivedi, R.P., Karemulla, K., Singh R., Rizvi, R.H. and Singh J. (2007). Socio-economic analysis of agroforestry systems in Western Uttar Pradesh. Indian Research Journal of Extension Education, 7 (2& 3): 18-12.

G.O.I. (2005). Ground water broacher of Haridwar District, Uttarakhand. Government of India. (Ministry of water resource) Central Ground Water Board, 1-7 pp.

Lwayo, M. K. and Maritim, H. K. (2003).Socio-economic Factors Affecting Farmers Decision to Adopt Farm Forestry: An Application of Multivariate Logistic Analysis in Busia District, Kenya.

Karemulla, K., Rizwi, R.H., Kumar, K., Dwivedi, R.P. and Singh, R. (2005). Poplar agroforestry systems in Western Uttar Pradesh: A Socio-economic analysis. Forests, Trees and Livelihoods, 15(4): 375-382.

Kamleu, G. B. and Manyong, V. M. (2005). Factors affecting the adoption of agroforestry practices by farmers in Cameroon. Journal of small-scale Forestry, 4 (2): 135-148.

Matata, P. Z., Ajay, O. C., Oduol, P. A. and Agumya, A. (2010). Socio-economic factors influencing adoption of improved fallow practices among smallholder farmers in western Tanzania. Africa Journal of Agriculture Research, 5 (8): 818 - 823.

Kumar, Y., Thakur, T.K. and Thakur, A. (2017). Socio-cultural paradigm of Agroforestry in India. Int. J Curr. Microbiol. App. Sci., 6 (6):1371-1377.

Mutonyi, S. and Fungo, B. (2011). Patterns of Agroforestry Practices among Smallholder Farmers in the Lake Victoria Crescent Zone of Uganda. Research Journal of Applied Sciences, 6 (4): 251-257.

Verma, P., Bijalwan, A., Dobriyal, M.J.R., Swami, S.L. and Thakur, T.K. (2017). A paradigm shift in agroforestry practices in Uttar Pradesh. Current Science, 112 (3): 509-515.