

## Evaluation of Agroforestry Practices in Deoghar District, Jharkhand

(The title, objective, methods, results and conclusion are not matched, change the title)

### Abstract

The study was conducted to know (or analyse) the traditional agroforestry practices followed by farmers in Deoghar district, Jharkhand. The result was indicated that in agrisilviculture practices, Babul tree (*Acacia nilotica*), Add local name (use botanical name in this area) *Melia azedarach* and *Dalbergia sisoo* were the major tree components and in agriculture crop (Forest tree, not agriculture), *Oryza sativa*, *Zea mays* and *Arachis hypogaea*. In silvipastoral categories, *Gmelina arborea*, *Mangifera indica* and *Dalbergia sisoo* were the major tree component and in grasses, Write the common name *Cynodon dactylon*, *Cyperus scariosus*. In home garden practices, *M. oleifera*, *G. arborea* and *Tectona grandis* were main tree components, while in agriculture crop, *Cicer arietinum* and *Brassica oleracea* and among horticultural crops, *Cocos nucifera*, *Musa paradisiaca* and *Mangifera indica*. In agrihorticulture category, among agriculture crop, *Vigna radiata*, *Triticum aestivum* and in horticultural crop, Write the common name *M. indica*, *Psidium guajava* and *Embllica officinalis*. In trees along fish pond (aquaculture), major tree crops were *T. grandis*, Write the common name *Azadirachta indica*, *Bambusa nutans* and different types of grasses was recorded around the fish pond. In all the three blocks (Surveyed area), most of the household (Majority of respondents) were interested to grow timber species on their farm and its range varied from 55.50% in Palojori block and 75.00% in Mohanpur block. In Palojori and Sarath block, almost 100% of household was interested to grow horticultural trees (What are the varieties)? In Mohanpur block, more than 90% of the household was also interested to grow horticultural trees. In overall calculation, 95.41% of the household was interested to grow horticultural trees (Types) and 74.50% of the household was interested to grow timber trees on their farm. (Result is not well organized, Methods and conclusion is missing in the abstract, re arrange it again) (make sure the scientific words are mentioned, instead of fish business aquaculture is the real term)

**Keywords:** Agroforestry, Agrisilviculture, Agrihorticulture, Silvipastoral, Agriculture

## Introduction

Agroforestry is the cultivation and use of trees, shrubs with crops and livestock in agricultural systems. Agroforestry seeks positive interactions between its components, aiming to achieve a more ecologically diverse and socially productive output from the land than is possible through conventional agriculture [1]. Agroforestry is a practical and low-cost means of implementing many forms of integrated land management, and it contributes to a green economy by promoting long-term, sustainable, and renewable forest management, especially for small-scale producers [2]. Although the modern concept of agroforestry emerged in the early 20<sup>th</sup> century, the use of woody perennials in agricultural systems is ancient, with written descriptions of the practice dating back to Roman times. Indeed, integrating trees with crops and animals is a long-standing tradition throughout the world. In 2004, the World Bank estimated that agroforestry practices were being used by 1.2 billion people [3].

Agroforestry can be recognized as potential solution to meet the needs of the society as well as sustainable development models [4,5] solutions to issues with soil productivity, product diversification and economic problems [6]. Recent years have witnessed an increasing interest in the adoption and promotion of agroforestry technologies among smallholder farmers worldwide and in particular, developing countries. The selection criteria for farmers' adoption of agroforestry practices depend on environmental as well as socio-economic pre-conditions that are related to successful cultivation of perennial crops and in particular trees [7,8].

Only 10 % introduction is given

Use the literature of

Agroforestry practices-Global and regional level

Types

Ongoing Practices in India

Challenges and benefits

Recent articles and and there suggestions(Such all review of article is mandatory to add, otherwise the paper will be worse)

## Method and methodology

Explain Why Deoghat is selected? Why not Dumka district > why these areas are purposively selected?

What types of esearch design is there? Explain

Makw a strata using table,

Add graph to show where Deoghat is located in India, Uses GIS graph of Forest regions to prove that the area is adequate for this study

What are the tools uses (Where is KIIIm FGD and HHs question)

Rekiability, Validity???

Analysis Strategy???

Deoghar district is located in the western part of Santhal paraganas. Dumka in east and Jamtara in south and Giridih in west. Deoghar is located at 24°29'N 86°42'E / 24.48°N 86.7°E.9(Add map here using GIS Arch view, How a reader from Abroad will identify where is deoghar) The district has 2 sub-division (Deoghar and Madhupur), 10 blocks (Deoghar, Devipur, Mohanpur, Sarwan, Sonarathari, Madhupur, Sarath, Palojori, Karown and Margomunda) and 2662 villages. The average elevation of the district is 247 m above msl.

Multi-stage random sampling was adopted in which one district, three blocks and two panchayats in each block were selected randomly for the study. In each of the selected panchayats, 40 household were selected (Out of total????)for data collection related to agroforestry practices (this means this is purposive sample?).The selected blocks were Palajori, Sarath and Mohanpur(Add on Map). Total interview 240 respondents in Deoghar district (Out of how much percentages?).

Statistical analyses (What are they?) were conducted using Microsoft Excel(are you sure Corelation and 2 side ANOVA is possible through MS excel analysis). Qualitative data was analyzed by using descriptive statistics and presented as means, percentages, frequency(But I saw correlation analysis is high and NO SD and Mean explain) distributions standard deviation, error of mean and correlation coefficient was computed by the procedure [9]. (What this citation is doing here? All methods are setting through you and no citation is required to do so)

## Result and discussion

On this section add:

Socio economic situation

Agroforestry practices in the area, types

Add secondary review

Benefits and challenges of farming practices

Uses of Land in farming practices (analysis the importance of traditional farming and agroforestry)

What are the products they using and sale through farming (agroforestry of slash or burn)

Ass Statistical data after that to corelate each

Set hypothesis and prove it.

Analyse and if possible, add one hypothesis and prove it because you have too much data.

Conclusion

#### Land use characteristics of household

The land-use characteristics of household of three blocks of Deoghar district. The respondents having land area below 1 acre, the practice of agriculture was found most prevalent (76.62%), followed by agroforestry practices (16.08%) represent in table 1. The respondents having total land area of 1-2 acre, again agriculture was followed by 76.70% of the respondents, followed by agroforestry practices 14.92% whereas land area of 2-4 acre, maximum 80.39% of the respondent's adopted agriculture and 12.18% adopted agroforestry practices. The land area of 4-10 acre, again maximum 77.50% of the respondents followed agriculture and 15.16% of the respondents followed agroforestry practices.

**Table 1: Land use characteristics of household of three blocks of Deoghar district**

Land size	Number	Total land holding	Average land holding	Agriculture	Agroforestry	Horticulture	Fish pond	Fallow
Below 1 acre	47 (19.58)	37.00	0.79	28.35 (76.62)	5.95 (16.08)	2.30 (6.22)	0.00 (0.00)	0.40 (1.08)
1-2 acre	64 (26.67)	144.94	2.26	111.18 (76.70)	21.63 (14.92)	8.82 (6.09)	2.85 (1.97)	0.46 (0.32)
2-4 acre	108 (45.00)	344.52	3.19	276.97 (80.39)	41.95 (12.18)	20.90 (6.07)	3.25 (0.94)	1.45 (0.43)
4-10 acre	11 (4.58)	68.60	6.24	53.20 (77.50)	10.40 (15.16)	4.20 (6.12)	0.80 (1.17)	0.00 (0.00)

(Use Hectare instead of local unit)

Similarly, the average land holding for marginal farmers was 0.64 ha, 1.36 ha for small, 2.50 ha for semi-medium and 5.54 ha for medium farmers at Balaghat district, Madhya Pradesh [10]. The land holding size, 52.00% of respondents had between 1–4-acre land holdings, with just 10.66% having more than 4 acre land holdings [11].The average total land

holding of household was 0.67 - 0.70 ha among the forest dwelling *Siddi* tribal community in Karnataka [12]. The marginal farmers had an average land holding of 0.71 ha, the small farmers had a land holding of 3.14 ha while the medium to large farmers holding size was 3.46 ha [13]. The size of land holding was positively and significantly correlated with the extent of adoption of agroforestry model [14] and the size of land holding was found to have significant and positive relationship with extent of participation in the field implementation of micro-irrigation technology in Kasaragod district of Kerala state [15]. The size of land holding had showed no link to the people's dependence and participation in forest management particularly fire management [16].

### Numbers of farmers with their respective land use practices

The number of farmers with their respective land use practices in three blocks of Deoghar district. Among the entire farmers category, maximum concentration was found for medium farmers (108) followed by small farmers (74) and least for large farmers (11). In all the sections of farmers, maximum farmers adopted agriculture, followed by horticulture, agroforestry and home-garden represent in table 2.

**Table 2: Land use practices in three blocks of Deoghar district**

Land size	Number	Agriculture	Agro forestry	Horti culture	Agri+ Horti	Home garden	Bamboo plantation	Api culture
Marginal	47	33	16	16	3	12	3	0
Small	74	52	22	24	7	16	10	1
Medium	108	80	25	47	9	26	15	1
large	11	7	4	0	1	0	1	0

### Correlation analysis between farmer's category and respective land use practices

The correlation analysis between farmer's category and respective land use practices. From the analysis, it was observed that increasing or decreasing the number of farmers under different categories have highly significant correlation with practice of agriculture (0.999) and practice of home-garden (0.992). It has also significant correlation with practice of agroforestry (0.964), with horticulture (0.988), with agri+horticulture (0.981) and with bamboo plantation (0.971), however non-significant correlation was observed with practice of apiculture (0.871). The practice of apiculture was found highly significantly correlated with horticulture (0.993) and home garden (0.992) and significantly correlated with agroforestry (0.954), agri+horticulture (0.978) and bamboo plantation (0.972), but non-significantly correlated with practice of apiculture (0.862). The practice of agroforestry was found non-significantly correlated with horticulture, agri+horticulture, bamboo plantation and apiculture but significantly correlated with practice of homegarden (0.966). In case of

practice of horticulture, it was found significantly correlated with practice of agri+horticulture (0.952), home garden (0.988), and bamboo plantation (0.957) and again non-significantly correlated with apiculture (0.811). The practice of agri+horticulture was found highly significantly correlated with bamboo plantation (0.991) and significantly correlated with home garden (0.951). Rest of the combination showed non-significant correlation among them represent in table 3.

### Livelihood of marginal and role of Agroforestry in ethnics?????

**Table 3: Correlation analysis between farmer's category and respective land use practices (Keeo in annexes)**

	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>	V <sub>6</sub>	V <sub>7</sub>	V <sub>8</sub>
V <sub>1</sub>	1.000							
V <sub>2</sub>	0.999**	1.000						
V <sub>3</sub>	0.964*	0.954*	1.000					
V <sub>4</sub>	0.988*	0.993**	0.920 <sup>NS</sup>	1.000				
V <sub>5</sub>	0.981*	0.978*	0.944 <sup>NS</sup>	0.952*	1.000			
V <sub>6</sub>	0.992**	0.992**	0.966*	0.988*	0.951*	1.000		
V <sub>7</sub>	0.971*	0.972*	0.898 <sup>NS</sup>	0.957*	0.991**	0.935 <sup>NS</sup>	1.000	
V <sub>8</sub>	0.871 <sup>NS</sup>	0.862 <sup>NS</sup>	0.839 <sup>NS</sup>	0.811 <sup>NS</sup>	0.949 <sup>NS</sup>	0.805 <sup>NS</sup>	0.940 <sup>NS</sup>	1.000

Where V<sub>1</sub> – Numbers of farmers under different categories

V<sub>2</sub> – Number of farmers engaged in agriculture

V<sub>3</sub> – Number of farmers engaged in agroforestry

V<sub>4</sub> – Number of farmers engaged in horticulture

V<sub>5</sub> – Number of farmers engaged in agri+horticulture

V<sub>6</sub> – Number of farmers engaged in home garden

V<sub>7</sub> – Number of farmers engaged in bamboo plantation

V<sub>8</sub> – Number of farmers engaged in apiculture

### Agroforestry practices of household land

The agroforestry practices of household land of three blocks of Deoghar district. Among various agroforestry practices, the maximum 22.50% of the respondents adopting home-garden, followed by trees around fish pond (22.08%) and minimum 6.67% of the respondents followed silvipastoral practices in table 4.

**Table 4: Agroforestry practices of household land of three blocks of Deoghar district**

Sl. No.	Agroforestry practices	Palojori		Sarath		Mohanpur		Total (240)
		Matiyara	Bandhdih	Kerabank	Bochbandh	Dahijor	Banka	
1.	Agrisilviculture	11 (27.50)	10 (25.00)	4 (10.00)	9 (22.50)	8 (20.00)	9 (22.50)	<b>51 (21.25)</b>
2.	Silvipastoral	2 (5.00)	3 (7.50)	1 (2.50)	2 (5.00)	5 (12.50)	3 (7.50)	<b>16 (6.67)</b>
3.	Home garden	2 (5.00)	14 (35.00)	17 (42.50)	6 (15.00)	6 (15.00)	9 (22.50)	<b>54 (22.50)</b>

4.	Agrihorticulture	4 (10.00)	2 (5.00)	4 (10.00)	3 (7.50)	3 (7.50)	4 (10.00)	<b>20</b> <b>(8.33)</b>
5.	Trees around fish pond	7 (17.50)	9 (22.50)	9 (22.50)	3 (7.50)	13 (32.50)	12 (30.00)	<b>53</b> <b>(22.08)</b>

- *In parenthesis, percentage value has been given*

The similar result of respondents were 100 % farmers in agriculture and 76.88 % in agroforestry, whereas horticulture 42.49% and 22.50 % farmers grow bamboo on their land at Giridih District, Jharkhand [17]. 63% of household depend on one form of agriculture or another ranging from agriculture producing crops on their own land to selling labour for agriculture, 59% of occasionally poor household depend upon agriculture production on their own land, 23% depend on a combination of production from their own land and 70% on share-cropping, while 44% of the poor household always work primarily as agriculture labourers in Bangladesh [18]. The naturally growing trees or planting in agricultural fields and along field boundaries, in home gardens, intercropping in orchards and along the boundary of these orchards, and privately owned grasslands at Himachal Pradesh [19].

#### Correlation matrix between farmers category with different agro-forestry practices

The correlation matrix between farmers category with different agroforestry practices. The practice of agrisilviculture was found significantly correlated with silvipastoral system (0.960) only and non-significant correlation with rest of the practices. The practice of silvipastoral had significant correlation with agrihorticulture (0.984) and apiculture (0.974), but non-significantly correlated with home garden practices. The practice of agrihorticulture was found highly significantly correlated with practice of apiculture (0.991) represent in 5.

**Table 5: Correlation matrix between farmers category with different agroforestry practices**

	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>	V <sub>6</sub>
V <sub>1</sub>	1.000					
V <sub>2</sub>	0.907 <sup>NS</sup>	1.000				
V <sub>3</sub>	0.861 <sup>NS</sup>	0.960*	1.000			
V <sub>4</sub>	0.992**	0.917 <sup>NS</sup>	0.904 <sup>NS</sup>	1.000		
V <sub>5</sub>	0.869 <sup>NS</sup>	0.911 <sup>NS</sup>	0.984*	0.920 <sup>NS</sup>	1.000	
V <sub>6</sub>	0.795 <sup>NS</sup>	0.874 <sup>NS</sup>	0.974*	0.860 <sup>NS</sup>	0.991**	1.000

Where V<sub>1</sub> – Numbers of farmers under different categories

V<sub>2</sub> – Numbers of farmers followed agrisilviculture

V<sub>3</sub> – Numbers of farmers followed silvipasture

V<sub>4</sub> – Numbers of farmers followed home garden

V<sub>5</sub> – Numbers of farmers followed agrihorticulture

V<sub>6</sub> – Numbers of farmers followed apiculture

According to Pinto *et al.* [20] agroforestry practice composing fruit crops and other vegetables is most preferred to be practiced in homesteads. It is preferred for ease of management and to obtain different services from the practice. Homestead agroforestry practice enables the land user to keep his farm against animal damage and from theft. Similarly, homestead agroforestry provide shade to human and livestock.

#### Agroforestry components under different agroforestry practices

The agroforestry components under different agroforestry practices of Deoghar district. In agrisilviculture practices, *Acacia nilotica*, *Melia azedarach* and *Dalbergia sisoo* were the major tree crop components and in agriculture crop, it was *Oryza sativa*, *Zea mays* and *Arachis hypogaea*. In silvipastoral categories, *Gmelina arborea*, *Mangifera indica* and *D.sisoo* were the major tree crop component and in grasses category, it was *Cynodondactylon*, *Cyperus scarious*. In home-garden practices, *M. oleifera*, *G. arborea* and *T. grandis* were main tree components, while in agriculture crop, it was *Cicer arietinum* and *Brassica oleracea* and among horticultural crops, it was *Cocos nucifera*, *Musa paradisiaca* and *Mangifera indica*. In agrihorticulture category, among agriculture crop, it was *Vigna radiata*, *Triticum aestivum* and in horticultural crop, it was *M. indica*, *Psidium guajava* and *Emblica officinalis*. In trees along fish pond, major tree crops were *T. grandis*, *Azadirachta indica*, *Bambusa nutans* and different types of grasses was recorded around the fish pond represent in table 6.

**Table 6: Agroforestry components under different agroforestry practices at Deoghar district**

Sl. No.	Agroforestry practices	Tree crops	Agriculture crops / Grasses	Horticultural crops
1.	<b>Agrisilviculture</b>	<i>Acacia nilotica, Melia azedarach, Dalbergia sisoo, Azadirachta indica, Moringa oleifera, Artocarpus heterophyllus, Gmelina arborea, Tectona grandis, Dendrocalamus strictus, Populus deltoides, Bombax ceiba, Acacia mangium, Madhuca indica</i>	<i>Oryza sativa, Zea mays, Arachis hypogaea, Vigna radiata, Triticum aestivum, Brassica juncea, Cajanus cajan, Solanum tuberosum, Macrotyloma uniflorum</i>	
2.	<b>Silvipastoral</b>	<i>Gmelina arborea, Mangifera indica, Dalbergia sisoo, Ziziphus mauritiana, Tectona grandis, Swietenia mahagoni</i>	<i>Cynodondactylon, Cyperus scariosus, Cyperus rotundus</i>	-
3.	<b>Home garden</b>	<i>Moringa oleifera, Gmelina arborea, Tectona grandis, Azadirachta indica, Dendrocalamus strictus, Terminalia tomentosa, Swietenia mahagoni</i>	<i>Cicer arietinum, Brassica oleracea, Solanum melongena, Solanum lycopersicum, Spinacia oleracea, Pisum sativum, Ipomoea batatas, Capsicum annuum, Allium cepa, Curcuma longa, Brassica oleracea, Coriandrum sativum, Daucus carota, Abelmoschus esculentus, Raphanus sativus Phaseolus vulgaris, Amaranthus dubius, Coriandrum sativus, Cucumis sativus Lagenaria siceraria</i>	<i>Cocos nucifera, Musa paradisiaca, Mangifera indica, Psidium guajava, Emblica officinalis, Carica papaya, Citrus limon, Litchi chinensis Citrus limon, Ziziphus mauritiana, Punica granatum, Syzygiumcumini, Artocarpus heterophyllus.</i>
4.	<b>Agrihorticulture</b>		<i>Vigna radiata, Triticum aestivum, Brassica juncea, Cajanus cajan, Macrotyloma uniflorum, Zea mays, Oryza sativa</i>	<i>Mangifera indica, Psidium guajava, Emblica officinalis, Litchi chinensis, Carica papaya, Artocarpus heterophyllus, Ziziphus mauritiana, Citrus limon</i>
5.	<b>Trees around fish pond</b>	<i>Tectona grandis, Azadirachta indica, Bambusa nutans, Dalbergia sisoo, Grewia asiatica, Phoenix dactylifera, Vitex negundo, Millettia pinnata, Moringa oleifera, Dendrocalamus strictus, Acacia nilotica, Melia azedarach, Ficus benghalensis, Butea monosperma, Bambusa balcooa, Moringa oleifera, Ficus benghalensis, Acacia mangium</i>	Different types of grasses	

Similarly, result of different tree species viz., *A. heterophyllus*, *A. indica*, *D. sissoo*, *G. arborea*, *L.leucocephala*, *M.azadarech*, *S.cumini* and *T. grandis*, *L. chinensis*, *M. indica* etc. were grown by the local farmers in different district of Jharkhand [21, 22, 23, 24, 25, 26, 27]. The agrisilviculture with combination of trees viz., *Shorea robusta*, *T. grandis*, *Acacia spp.* etc., in agrisilvipastoral with combination of crops with trees like *Albizia spp.*, *L.leucocephala*, *Ficus racemosa* etc. In agrihorticultural practices, like *Carica papaya*, *Musa acuminata*, *M. indica*, *Anacardium occidentale*, *E. officinalis* etc. and in home garden species like *Dalbergia latifolia*, *M. indica*, *M. oleifera*, *L.leucocephala*, *A. heterophyllus*, *Anacardium occidentale* etc at Bastar region [28].

#### Average number of trees under different Agroforestry practices

The average number of trees/ha under different agroforestry practices at three blocks of Deoghar district. In all categories of agroforestry practices, maximum number of trees/ha was recorded under home-garden system and in this system, maximum trees/ha was recorded under large category (42.80), followed by medium category (39.80), small category (34.60) and least by marginal farmers (31.30).

After home garden system, the number of trees/ha was found almost same under agrisilviculture and agrihorticulture system. The range of trees/ha under agrisilviculture was recorded as 32.50 for large farmers to only 2.10 for marginal farmers. However, under agrihorticulture system, it was 28.50 for large farmers to 3.20 for marginal farmers. Trees around fish pond were recorded only for large and medium farmers and no trees were recorded under silvipastoral system represents in table 7.

**Table 7: Average number of trees under different Agroforestry practices at Deoghar district**

Sl. No.	Farm category	Average number of trees/ha				
		Agrisilviculture	Silvipastoral	Agrihorticulture	Home garden	Fish pond
1.	Large	32.6	9.8	28.5	42.8	12.3
2.	Medium	12.3	5.6	15.2	39.8	8.9
3.	Small	5.2	2.3	12.8	34.6	0.0
4.	Marginal	2.1	0.9	3.2	31.3	0.0

Similarity, the medium land holdings had more tree diversity. Significantly smaller numbers of tree species on small farms despite the high tree density per ha reflect the limited land availability for tree planting [29]. The small plots oblige farmers to select small sized trees. Big trees occupy much space and increase conflicts with the neighbours whose plots are affected by shade. Agroforestry provides all types of forest products for meeting needs of

households. Rural farmers depend on the farm trees for fuel, fodder, timber, litter, fruit and medicine [30]. The 26.66% of respondents had trees on their farm, whereas 73.33% of households do not have trees on their farm. A closer look at the data on types of agroforestry methods revealed that 11.33% of families had trees on the homestead and in the orchard, 12.66% had trees on field bunds, and just 2.00% had trees on fields [11].

### Correlation between farmers category with number of trees/ha under different agro-forestry practices

The correlation between farmers category with number of trees/ha under different agroforestry practices in Deoghar district. The number of trees/ha under agrisilviculture system was found positively significantly correlated with silvipastoral system (0.961) and agrihorticultural system (0.956), but non-significantly correlated with number of trees/ha under home garden and trees under fish pond. The number of trees/ha under silvipastoral system was found positively significantly correlated with agrihorticulture system (0.956), with homegarden system (0.987) and with trees around fish pond (0.973). However, trees/ha under agrihorticulture system was found non-significantly correlated with homegarden as well as trees around fish pond system. The number of trees/ha under homegarden system was also found positively significantly correlated with trees around fish pond (0.965) represent in table 8.

**Table 8: Correlation between farmers category with number of trees/ha under different agro-forestry practices in Deoghar district**

	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>	V <sub>6</sub>
V <sub>1</sub>	1.000					
V <sub>2</sub>	-0.568 <sup>NS</sup>	1.000				
V <sub>3</sub>	-0.320 <sup>NS</sup>	0.961 <sup>*</sup>	1.000			
V <sub>4</sub>	-0.411 <sup>NS</sup>	0.956 <sup>*</sup>	0.956 <sup>*</sup>	1.000		
V <sub>5</sub>	-0.172 <sup>NS</sup>	0.908 <sup>NS</sup>	0.987 <sup>*</sup>	0.939 <sup>NS</sup>	1.000	
V <sub>6</sub>	-0.227 <sup>NS</sup>	0.905 <sup>NS</sup>	0.973 <sup>*</sup>	0.863 <sup>NS</sup>	0.965 <sup>*</sup>	1.000

Where V<sub>1</sub> – Numbers of farmers under different categories

V<sub>2</sub> – Average number of trees/ha under agrisilviculture system

V<sub>3</sub> – Average number of trees/ha under silvipastoral system

V<sub>4</sub> – Average number of trees/ha under agrihorticulture system

V<sub>5</sub> – Average number of trees/ha under homegarden

V<sub>6</sub> – Average number of trees/ha under fishpond

### Availability of fish pond at household land

The availability of fish pond at household land of three blocks of Deoghar district. Maximum availability of fish pond was noticed in Mohanpur block (30.00-32.50%) and

minimum in Sarath block (7.50-22.50%). Only 22.08% of the respondents had availability of fish pond while remaining 77.92% of the respondents don't have availability of fish pond represent in table 9.

**Table 9-Availability of fish pond at household land of three blocks of Deoghar district**

Sl. No.	Availability status	Palojori		Sarath		Mohanpur		Total (N=240)
		Matiyara	Bandhdih	Kerabank	Bochbandh	Dahijor	Banka	
1.	Yes	7 (17.50)	9 (22.50)	9 (22.50)	3 (7.50)	13 (32.50)	12 (30.00)	<b>53</b> <b>(22.08)</b>
2.	No	33 (82.50)	31 (77.50)	31 (77.50)	37 (92.50)	27 (67.50)	28 (70.00)	<b>187</b> <b>(77.92)</b>

### Future planning for tree plantation by household

The future planning for tree plantation by household at three blocks of Deoghar district. In all the three blocks, most of the household were interested to grow timber species on their farm and its range varied from 55.50% in Palojori block and 75.00% in Mohanpur block. However, plantation of horticultural trees was found more intensified than plantation of timber species. In Palojori and Sarath block, almost 100% of household was interested to grow horticultural trees. In Mohanpur block, more than 90% of the household was also interested to grow horticultural trees. In overall calculation, 95.41% of the household was interested to grow horticultural trees and 74.50% of the household was interested to grow timber trees on their farm in represent in table 10. Similar, study in Attock district, that the farmers highly preferred *D. sissoo* and *Acacia nilotica* for planting on their farms on account of better economic value, quality timber, fuel wood and fodder [31].

**Table 10 - Future planning for tree plantation by household of three blocks of Deoghar district**

Sl. No.	Future planning	Option	Palojori		Sarath		Mohanpur		Total (N=240)
			Matiyara	Bandhdih	Kerabank	Bochbandh	Dahijor	Banka	
1.	Planting timber species on your farm	Yes	31 (77.50)	22 (55.50)	31 (77.50)	35 (87.50)	30 (75.00)	30 (75.00)	179 (74.50)
		No	9 (22.50)	18 (45.00)	9 (22.50)	5 (12.50)	10 (25.00)	10 (25.00)	61 (25.41)
2.	Growing horticulture trees	Yes	40 (100)	35 (87.50)	39 (97.50)	40 (100.00)	37 (92.50)	38 (95.00)	229 (95.41)
		No	0 (0.00)	5 (12.50)	1 (2.50)	0 (0.00)	3 (7.50)	2 (5.00)	11 (4.58)

### Cumulative preference of species for future tree planting

The cumulative preference of species for future tree planting in three blocks of Deoghar district. Among the timber species, total 15 number of trees were screened out and among them; top five tree species were *T. grandis* by (66.66% household), *D. sissoo* (60.00%), *G. arborea* (57.50%), *S. mahogany* (54.58%) and *T. arjuna* (49.17%). Among the

horticultural species, total 16 numbers of species were screened out and among these, top five preferred species were *M. indica* (91.25%), *L. chinensis* (77.50%), *P. guajava* (80.00%), *S.cumini* (56.25%) and *C. papaya* (42.50%). In the category of fuel wood species, 15 number of species were screened out and the top five most preferred species were *M. azedarach* (68.75%), *C.siamia* (61.25%), *L.leucocephala* (51.67%), *G. arborea* (30.00) and *B.monosperma* (28.33%). In the category of fodder tree species, total 17 number of trees were screened out and among them, top five preferred species were *L.leucocephala* (56.67%), *P. pinnata* (52.50%), *B. variegata* (51.67%), *P. cineraria* (47.91%) and *M. alba* (38.75%) represent in table 11.

**Table 11 -Cumulative preference of species for future tree planting at Deoghar district (In descending order)**

Sl. No.	Timber tree species	No.	Horticultural species	No.	Fuelwood tree species	No.	Fodder tree species	No.
1.	<i>Tectona grandis</i>	160 (66.66)	<i>Mangifera indica</i>	219 (91.25)	<i>Melia azedarach</i>	165 (68.75)	<i>Leucaena leucocephala</i>	136 (56.67)
2.	<i>Dalbergia sisoo</i>	144 (60.00)	<i>Litchi chinensis</i>	186 (77.50)	<i>Cassia siamea</i>	147 (61.25)	<i>Pongamia pinnata</i>	126 (52.50)
3.	<i>Gmelina arborea</i>	138 (57.50)	<i>Psidium guajava</i>	144 (60.00)	<i>Leucaena leucocephala</i>	124 (51.67)	<i>Bauhinia variegata</i>	124 (51.67)
4.	<i>Swietenia mahagoni</i>	131 (54.58)	<i>Syzygiumcumini</i>	135 (56.25)	<i>Gmelina arborea</i>	72 (30.00)	<i>Prosopis cineraria</i>	115 (47.91)
5.	<i>Terminalia arjuna</i>	118 (49.17)	<i>Carica papaya</i>	102 (42.50)	<i>Butea monosperma</i>	68 (28.33)	<i>Morus alba</i>	93 (38.75)
6.	<i>Terminalia tomentosa</i>	55 (22.91)	<i>Musa paradisiaca</i>	83 (34.58)	<i>Mangifera indica</i>	58 (24.16)	<i>Azadirachta indica</i>	83 (34.58)
7.	<i>Shorea robusta</i>	37 (15.41)	<i>Punica granatum</i>	63 (26.25)	<i>Dalbergia sisoo</i>	58 (24.16)	<i>Acacia nilotica</i>	75 (31.25)
8.	<i>Anthocephalus chinensis</i>	19 (7.91)	<i>Ziziphus mauritiana</i>	61 (25.41)	<i>Acacia nilotica</i>	40 (16.67)	<i>Moringa oleifera</i>	58 (24.16)
9.	<i>Mangifera indica</i>	16 (6.67)	<i>Emblica officinalis</i>	28 (11.67)	<i>Albizzia lebbeck</i>	32 (13.33)	<i>Albizzia lebbeck</i>	36 (15.00)
10.	<i>Artocarpus heterophyllus</i>	9 (3.75)	<i>Aegle marmelos</i>	20 (8.33)	<i>Madhuca indica</i>	27 (11.25)	<i>Madhuca indica</i>	17 (7.08)
11.	<i>Azadirachta indica</i>	6 (2.50)	<i>Cocos nucifera</i>	16 (6.67)	<i>Albizzia procera</i>	24 (10.00)	<i>Artocarpus heterophyllus</i>	8 (3.33)
12.	<i>Melia azedarach</i>	5 (2.08)	<i>Citrus limon</i>	14 (5.83)	<i>Bombax ceiba</i>	7 (2.91)	<i>Ziziphus mauritiana</i>	7 (2.91)
13.	<i>Populus deltoides</i>	3 (1.25)	<i>Pyrus calleryana</i>	10 (4.16)	<i>Pongamia pinnata</i>	5 (2.08)	<i>Melia azedarach</i>	6 (2.50)
14.	<i>Santalum album</i>	2 (0.83)	<i>Artocarpus heterophyllus</i>	6 (2.50)	<i>Acacia auriculiformis</i>	3 (1.25)	<i>Albizzia procera</i>	5 (2.08)
15.	<i>Bombax ceiba</i>	2 (0.83)	<i>Morus alba</i>	1 (0.41)	<i>Azadirachta indica</i>	1 (0.41)	<i>Dendrocalamusstrictus</i>	3 (1.25)
16.	-	-	<i>Anacardium occidentale</i>	1 (0.41)	-	-	<i>Gmelina arborea</i>	1 (0.41)
17.	-	-	-	-	-	-	<i>Dalbergia sisoo</i>	1 (0.41)

Similarly, the farmers preferred fuel wood yielding species, fruit yielding species, fodder yielding species, timber yielding species, short duration species [14]. The majority of households 75.00% were growing vegetables in homestead whereas 26.67 % were having fruit trees, 17.50 % having fodder trees and only 3.33 % were having timber trees in homestead agroforestry [32].

## Conclusion

In the study area practice of home garden was found prevalent (22.50%) with maximum number of trees/ha followed by agrihorticulture and agrisilviculture practices. More percentage (95.41%) of respondents were interested in growing horticulture trees than timber trees (74.50%) around their farms. Among the choice of timber species, they wish to plant *T. grandis*, *D. sissoo*, *G. arborea*, *S.mahagoni* and *T. arjuna* in descending order. Promotion of home garden, agrihorticulture and silvipastoral system should be promoted as respondents were more inclined towards it, which was indicated by significant positive correlation as 0.992, 0.961 and 0.956 respectively. Raising awareness on benefits of agroforestry, providing adequate technical support as well as ensuring the efficient use of resources is necessary for successful acceptance of agroforestry system to raise farm productivity and overall income.

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**ADD questions and KII formats to validate this research**

UNDER PEER REVIEW