Evaluation of Agroforestry Practices in Deoghar District, Jharkhand

Abstract

The study was conducted to know the traditional agroforestrypractices followed by farmers in Deoghar district, Jharkhand. The result was indicated that in agrisilviculture practices, *Acacia nilotica*, *Meliaazedarach* and *Dalbergiasisoo* were the major tree components and in agriculture crop, *Oryza sativa, Zea mays* and *Arachishypogaea*. In silvipastoral categories, *Gmelinaarborea, Mangiferaindica* and *Dalbergiasisoo* were the major tree component and in grasses, *Cynodondactylon*, *Cyperusscarious*. In homegarden practices, *M.oleifera, G.arborea* and *Tectonagrandis* were main tree components, while in agriculture crop, *Cicerarietinum* and *Brassica oleracea*and among horticultural crops, *Cocosnucifera, Musa paradisiaca* and *Mangiferaindica*. In agrihorticulture category, among agriculture crop, *Vignaradiata*, *Triticumaestivum* and in horticultural crop, *M.indica*, *Psidiumguajava* and *Emblicaofficinalis*. In trees along fish pond, major tree crops were *T.grandis, Azadirachtaindica, Bambusanutans* and different types of grasses was recorded around the fish pond. 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. 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.

Keywords: Agrisilviculture, Agrihorticulture, Silvipastoral, Agriculture, Deoghar

Comment [m1]: Make it in alphabetical order

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 20th 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].

Comment [m2]: It is better to include the agroforestry practices in India what looks like at least in one paragraph
What are the trends of agroforestry practices in india?

Method and methodology

Deoghar district is located in the western part of Santhalparaganas. 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. The district has 2 sub-division (Deoghar and Madhupur), 10 blocks (Deoghar, Devipur, Mohanpur, Sarwan, Sonaraithari, 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 for data collection related to agroforestry practices. The selected blocks were Palajori, Sarath and Mohanpur. Total interview 240 respondents in Deoghar district.

Statistical analyses were conducted using Microsoft Excel. Qualitative data was analyzed by using descriptive statistics and presented as means, percentages, frequency distributions standard deviation, error of mean and correlation coefficient was computed by the procedure [9].

Result and discussion

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 Deoghardistrict

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)

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.

Table 3: Correlation analysis between farmer's category and respective land use practices

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8
V_1	1.000							
V_2	0.999^{**}	1.000						
V_3	0.964^{*}	0.954^{*}	1.000					
V_4	0.988^{*}	0.993^{**}	0.920^{NS}	1.000				
V_5	0.981^{*}	0.978^{*}	0.944^{NS}	0.952^{*}	1.000			
V_6	0.992^{**}	0.992^{**}	0.966^{*}	0.988^{*}	0.951^{*}	1.000		
V_7	0.971^{*}	0.972^{*}	0.898^{NS}	0.957^{*}	0.991^{**}	0.935^{NS}	1.000	
V_8	0.871^{NS}	0.862^{NS}	0.839^{NS}	0.811^{NS}	0.949^{NS}	0.805^{NS}	0.940^{NS}	1.000

Where V_1 – Numbers of farmers under different categories

V_2 – Number of farmers engaged in agriculture

V_3 – Number of farmers engaged in agroforestry

V_4 – Number of farmers engaged in horticulture

V_5 – Number of farmers engaged in agri+horticulture

V_6 – Number of farmers engaged in home garden

V_7 – Number of farmers engaged in bamboo plantation

V_8 – 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)	**51 (21.25)**
2.	Silvipastoral	2 (5.00)	3 (7.50)	1 (2.50)	2 (5.00)	5 (12.50)	3 (7.50)	**16 (6.67)**
3.	Home garden	2 (5.00)	14 (35.00)	17 (42.50)	6 (15.00)	6 (15.00)	9 (22.50)	**54 (22.50)**
4.	Agrihorticulture	4 (10.00)	2 (5.00)	4 (10.00)	3 (7.50)	3 (7.50)	4 (10.00)	**20 (8.33)**
5.	Trees around fish pond	7 (17.50)	9 (22.50)	9 (22.50)	3 (7.50)	13 (32.50)	12 (30.00)	**53 (22.08)**

- *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 atGiridih 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_1	V_2	V_3	V_4	V_5	V_6
V_1	1.000					
V_2	0.907^{NS}	1.000				
V_3	0.861^{NS}	0.960^{*}	1.000			
V_4	0.992^{**}	0.917^{NS}	0.904^{NS}	1.000		
V_5	0.869^{NS}	0.911^{NS}	0.984^{*}	0.920^{NS}	1.000	
V_6	0.795^{NS}	0.874^{NS}	0.974^{*}	0.860^{NS}	0.991^{**}	1.000

Where V_1 – Numbers of farmers under different categories

V_2 – Numbers of farmers followed agrisilviculture

V_3 – Numbers of farmers followed silvipasture

V_4 – Numbers of farmers followed homegarden

V_5 – Numbers of farmers followed agrihorticulture

V_6 – 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, Meliaazedarach* and *Dalbergiasisoo* were the major tree crop components and in agriculture crop, it was *Oryza sativa, Zea mays* and *Arachishypogaea*. In silvipastoral categories, *Gmelinaarborea, Mangiferaindica* and *D.sisoo* were the major tree crop component and in grasses category, it was *Cynodondactylon, Cyperusscarious.* In home-garden practices, *M.oleifera, G.arborea* and *T.grandis* were main tree components, while in agriculture crop, it was *Cicerarietinum* and *Brassica oleracea*and among horticultural crops, it was *Cocosnucifera, Musa paradisiaca* and *Mangiferaindica.*In agrihorticulture category, among agriculture crop, it was *Vignaradiata, Triticumaestivum* and in horticultural crop, it was *M.indica, Psidiumguajava* and *Emblicaofficinalis.* In trees along fish pond, major tree crops were *T.grandis, Azadirachtaindica, Bambusanutans* and different types of grasses was recorded around the fish pond represent in table 6.

Comment [m3]: 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.	**Agrisilviculture**	*Acacia nilotica, Meliaazedarach, Dalbergiasisoo, Azadirachtaindica, Moringaoleifera, Artocarpusheterophyllus,Gmelinaarborea, Tectonagrandis, Dendrocalamusstrictus, Populusdeltoides, Bombaxceiba, Acacia mangium, Madhucaindica*	*Oryza sativa, Zea mays, Arachishypogaea, Vignaradiata, Triticumaestivum, Brassica juncea, Cajanuscajan, Solanumtuberosum, Macrotylomauniflorum*	
2.	**Silvipastoral**	*Gmelinaarborea, Mangiferaindica, Dalbergiasisoo, Ziziphusmauritiana, Tectonagrandis, Swieteniamahagoni*	*Cynodondactylon,Cyperusscariosus, Cyperusrotundus*	-
3.	**Home garden**	*Moringaoleifera, Gmelinaarborea, Tectonagrandis, Azadirachtaindica, Dendrocalamusstrictus, Terminaliatomentosa, Swieteniamahagoni*	*Cicerarietinum, Brassica oleracea, Solanummelongena, Solanumlycopersicum, Spinaciaoleracea, Pisumsativum, Ipomoea batatas, Capsicum annuum, Allium cepa, Curcuma longa, Brassica oleracea, Coriandrumsativum, Daucuscarota, Abelmoschusesculentus, RaphanussativusPhaseolus vulgaris Amaranthusdubius, Coriandrumsativus, CucumissativusLagenariasiceraria*	*Cocosnucifera, Musa paradisiaca, Mangiferaindica, Psidiumguajava,Emblicaofficinalis, Carica papaya, Citrus limon,Litchi chinensis Citrus limon, Ziziphusmauritiana, Punicagranatum, Syzygiumcumini, Artocarpusheterophyllus.*
4.	**Agrihorticulture**		*Vignaradiata, Triticumaestivum, Brassica juncea, Cajanuscajan, Macrotylomauniflorum, Zea mays,Oryza sativa*	*Mangiferaindica,Psidiumguajava, Emblicaofficinalis, Litchi chinensis, Carica papaya, Artocarpusheterophyllus, Ziziphusmauritiana, Citrus limon*
5.	**Trees around fish pond**	*Tectonagrandis, Azadirachtaindica, Bambusanutans, Dalbergiasisoo, Grewiaasiatica, Phoenix dactylifera, Vitexnegundo, Millettiapinnata, Moringaoleifera,Dendrocalamusstrictus, Acacia nilotica, Meliaazedarach, Ficusbenghalensis, Buteamonosperma, Bambusabalcooa,*	Different types of grasses	

		Moringaoleifera, Ficusbenghalensis, Acacia mangium		

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.,Shorearobusta, T.grandis, Acacia spp.* etc., in agrisilvipastoral with combination of crops with trees like *Albizia spp., L.leucocephala, Ficusracemosa* etc. In agrihortisilvicultural practices, like *Carica papaya, Musa acuminata, M.indica, Anacardiumoccidentale, E.officinalis*etc. and in homegarden species like *Dalbergialatifolia, M.indica, M.oleifera, L.leucocephala, A.heterophyllus, Anacardiumoccidentale*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 systemrepresentsin 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_1	V_2	V_3	V_4	V_5	V_6
V_1	1.000					
V_2	-0.568^{NS}	1.000				
V_3	-0.320^{NS}	0.961^{*}	1.000			
V_4	-0.411^{NS}	0.956^{*}	0.956^{*}	1.000		
V_5	-0.172^{NS}	0.908^{NS}	0.987^{*}	0.939^{NS}	1.000	
V_6	-0.227^{NS}	0.905^{NS}	0.973^{*}	0.863^{NS}	0.965^{*}	1.000

Where V_1 – Numbers of farmers under different categories

V_2 – Average number of trees/ha under agrisilviculture system

V_3 – Average number of trees/ha under silvipastoral system

V_4 – Average number of trees/ha under agrihorticulture system

V_5 – Average number of trees/ha under homegarden

V_6 – 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.

Comment [m4]: 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)	**53 (22.08)**
2.	No	33 (82.50)	31 (77.50)	31 (77.50)	37 (92.50)	27 (67.50)	28 (70.00)	**187 (77.92)**

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.	*Tectonagrandis*	160 (66.66)	*Mangiferaindica*	219 (91.25)	*Meliaazedarach*	165 (68.75)	*Leucaenaleucocephala*	136 (56.67)
2.	*Dalbergiasisoo*	144 (60.00)	*Litchi chinensis*	186 (77.50)	*Cassia siamea*	147 (61.25)	*Pongamiapinnata*	126 (52.50)
3.	*Gmelinaarborea*	138 (57.50)	*Psidiumguajava*	144 (60.00)	*Leucaenaleucocephala*	124 (51.67)	*Bauhinia variegata*	124 (51.67)
4.	*Swieteniamahagoni*	131 (54.58)	*Syzygiumcumini*	135 (56.25)	*Gmelinaarborea*	72 (30.00)	*Prosopis cineraria*	115 (47.91)
5.	*Terminaliaarjuna*	118 (49.17)	*Carica papaya*	102 (42.50)	*Buteamonosperma*	68 (28.33)	*Morus alba*	93 (38.75)
6.	*Terminaliatomentosa*	55 (22.91)	*Musa paradisiaca*	83 (34.58)	*Mangiferaindica*	58 (24.16)	*Azadirachtaindica*	83 (34.58)
7.	*Shorearobusta*	37 (15.41)	*Punicagranatum*	63 (26.25	*Dalbergiasisoo*	58 (24.16)	*Acacia nilotica*	75 (31.25)
8.	*Anthocephaluschinensis*	19 (7.91)	*Ziziphusmauritiana*	61 (25.41)	*Acacia nilotica*	40 (16.67)	*Moringaoleifera*	58 (24.16)
9.	*Mangiferaindica*	16 (6.67)	*Emblicaofficinalis*	28 (11.67)	*Albizzialebbeck*	32 (13.33)	*Albizzialebbeck*	36 (15.00)
10.	*Artocarpusheterophyllus*	9 (3.75)	*Aeglemarmelos*	20 (8.33)	*Madhucaindica*	27 (11.25)	*Madhucaindica*	17 (7.08)
11.	*Azadirachtaindica*	6 (2.50)	*Cocosnucifera*	16 (6.67)	*Albizziaprocera*	24 (10.00)	*Artocarpusheterophyllus*	8 (3.33)
12.	*Meliaazedarach*	5 (2.08)	*Citrus limon*	14 (5.83)	*Bombaxceiba*	7 (2.91)	*Ziziphusmauritiana*	7 (2.91)
13.	*Populusdeltoides*	3 (1.25)	*Pyruscalleryana*	10 (4.16)	*Pongamiapinnata*	5 (2.08)	*Meliaazedarach*	6 (2.50)
14.	*Santalum album*	2 (0.83)	*Artocarpusheterophyllus*	6 (2.50)	*Acacia auriculiformis*	3 (1.25)	*Albizziaprocera*	5 (2.08)
15.	*Bombaxceiba*	2 (0.83)	*Morus alba*	1 (0.41)	*Azadirachtaindica*	1 (0.41)	*Dendrocalamusstrictus*	3 (1.25)
16.	-	-	*Anacardiumoccidentale*	1 (0.41)	-	-	*Gmelinaarborea*	1 (0.41)
17.	-	-	-	-	-	-	*Dalbergiasisoo*	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.

References

1. www.worldagroforestry.org/about. 1978
2. Agritech.tnau.ac.in/ (2014).
3. World Bank. Sustaining forests: a development strategy. Retrieved from http://siteresources.worldbank.org/INTFORESTS/Resources/SustainingForests.pdf XV, No. 1. Oxfords University Press, New York, USA. 2004; 26-33p.
4. Bargali SS, Bargali K, Singh L, Ghosh L and Lakhera ML. *Acacia nilotica* based traditional agroforestry system: Effect on paddy crop and management. 2009; 96 (4):581-587.
5. Thanh MV. Center for agricultural research and ecological studies, Hanoi Agricultural University, 2005.
6. Franzel S and Scherr SJ. Trees on the farm: Assessing the adoption potential of agroforestry practices in Africa. Wallingford: CABI., 2002.
7. Eppink LAA and Palte JGL. Some socio-economic aspects of soil erosion in the Jatiluhur Basin. *Project vegetation and erosion*, Internal report No. 12/1980, Bandung: Institute of Ecology, UniversitasPadjadjaran, 1980.
8. Oldeman RAA. Diagnosis of Complex Ecosystems. Department of Ecological Agriculture, Wageningen University, Wageningen, The Netherlands, 1997.

Comment [m5]: ,

Comment [m6]: What are the significances of this study for the farmers, or society and another researcher? What the interventions to promote different agroforestry practices by the farmers in your study area
What you suggest for another researcher, who want to study in the area of agroforestry practices?

Comment [m7]: Either remove or re write

9. Singh RK and Chaudhary BD. Biometrical methods in quantitative genetic analysis. Kalyani Publishers, New Delhi, 1985.
10. Sarvade S,Shrivastava AK,Rai SK,Bisen S,Bisen U,Bisen, NK, Agrawal SBand Khan MI. Socio-economic study of farming communities, their knowledge on climate change and agroforestry systems in the cluster of villages of Chhattisgarh plain region, Madhya Pradesh. *Journal of Pharmacognosy and Phytochemistry*, 2020; 9(1): 2158-2166
11. Kumari M and Khare N. The study of existing agroforestry and socio-economic analysis on adoption of agroforestry practices. *The Pharma Innovation Journal*, 2022; 11(3): 1463-1470.
12. Bharathkumar LB. Impact of non- timber forest products on tribal economy- an economic analysis. M.Sc. Thesis, University of Agricultural Sciences (UAS), Dharwad, Karnataka, 2010.
13. Dwivedi PR, Kareemulla K, Singh R, Rizvi RH and Chauhan J. Socio-Economic Analysis of Agroforestry Systems in Western Uttar Pradesh. *Indian Res. J. Ext. Edu*., 2007; **7** (2&3).
14. Madiwalar SL, Channabasappa KS and Deshmukh RC. Survey and documentation of agroforestry models in Bidar, Gulbarga and Raichur district. *Karnataka Journal of Agricultural Sciences*, 2007; 20(1): 93-95.
15. Thamban C, Vasanthakumar J, Arulraj S, Mathew AC and Muralidharan K. Farmer's participation in the field implementation of micro-irrigation systems. *Journal of Plantation Crops*, 2008; 36 (3): 522-525.
16. Prakash O and Sharma R. Determining people's participation in forest fire control: A study of Himachal Pradesh. *Indian Journal of Forestry*, 2008; 31(1): 1-6.
17. Thakur PK, Malik MS, Singh BK and Oraon PR. Assessment of socio-economic status of agroforestry farmers in Giridih District, Jharkhand, *Journal of Pharmacognosy and Phytochemistry*; 2018; SP1: 929-932.
18. Rashid DA. The findings of the Northwest Rural Livelihoods Monitoring Project, Care Bangladesh. 2002; 59-67.
19. Verma KS and Mishra VK. Agroforestry systems, In: Sharma, L.R. (ed.), Natural Resources and Development in Himalaya, Malhotra Publishing House, New Delhi, 2000.
20. Pinto L, Lopez V, Ferrer J, Marcial GR, Montoya NG and Sinclair LF. The role of local knowledge in determining shade composition of multi-strata coffee system in Chiapas, Mexico. *Biodiversity and conservation*, 2005; 16: 419- 436

21. Oraon PR, Yadav MS and Siddiqui MH. Comparative performance of Agroforestry in Kumharia Village of Ranchi District. *Indian Journal of Agroforestry*. 2005; 7 (2): 19 -24.
22. Sood KK. The influence of household economics and farming aspects on adoption of traditional agroforestry in Western Himalaya. *Mountain Research and Development*, 2006; 26(2):124-130.
23. Singh KB, Oraon PR, Kumar A and Malik MS. Traditional Agroforestry practices existing at Lohardaga District of Jharkhand. *Trends in Bioscience*, 2017; 10 (23): 4651-4654.
24. Kumar A, Sah RB, Singh BK and Oraon PR. Socioeconomic Analysis of Tribal Farmers in the Gumla District of Jharkhand from Existing Agroforestry Practices *Int. J. Curr. Microbiol. App. Sci.*, 2018; 7(6): 595-604
25. Oraon PR, Singh BK, Kumar A, Singh PK and Malik MS. Traditional Agroforestry Practices of Jharkhand: a Viable Options for Livelihood Upliftment, *Multilogic in Science*, 2018; Viii(c), 66 - 67.
26. Mahato RK, Sah RB, Oraon PR and Singh BK. Impact of Agroforestry Practices on Livelihood Improvement of Farmers in Ichak Block of Hazaribagh District, Jharkhand *Int. J. Curr. Microbiol. App. Sci.*, 2019; 8(1): 702-712.
27. Singh BK, Oraon PR, Ranjan S, Kumar A and Suman KK. Survey of Existing Farming System and Agroforestry Practices in the Lohardaga District, Jharkhand, India, *Int. J. Curr. Microbiol. App. Sci*, 2019; 8(9): 1625-1633.
28. Hemrom A and Nema S. A study on traditional agroforestry practices existing at Bastar region of Chhattisgarh, *IJMRD*, 2015; 2(3): 56-64.
29. Acharya KP and Acharya M. Traditional knowledge on medicinal plants used for the treatment of livestock diseases in Sardikhola VDC, Kaski. IAAS Rampur, Tribhuvan University, Nepal, 2009.
30. Khanal S. Contribution of agroforestry in biodiversity conservation and rural needs fulfilment (a study from Leakhnath Municipality and Bharatpokhari VDC of Kaski district) M.Sc. Thesis, Tribhuwan University, Nepal, 2011; 113+Xl
31. Jamil M. Farmers Attitude Towards Tree Plantation in District Attock, M.Sc. (Hons.). Thesis, Pakistan Forest Institute, Peshawar, 2003.
32. Kumar A, Sah RB, Singh, BK and Oraon PR. Tree Species Preferences on Agroforestry Practices in Bishunpur Block of Gumla District, Jharkhand. *Trends in Biosciences*, 2017; 10(40):8508-8516.