



Adoption pattern of agroforestry systems-a case study from Nagri block of Ranchi district, Jharkhand

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ABSTRACT

Agroforestry's potentialities to challenge the livelihood security and improving the socio economic status of the rural poor area has been cited in literatures and well accepted one. Prior information on existing agroforestry system through preliminary survey works attempted to address the issues of agroforestry adoption pattern, constraints and problems, technological gaps and social acceptability. A preliminary study was conducted in Nagri block of Ranchi district, Jharkhand, by selecting four panchayat areas covering eight villages and total of 160 respondents. The objectives of this study was to evaluate the agroforestry adoption pattern, farmer's preferences of fruit and tree species and their constraints faced during practices of agroforestry system. From this study, it was identified that five agroforestry practices namely, agri-silviculture (trees in field), silvi-pasture, horti-pastoral, bund plantation, homestead garden have been predominantly practiced in which homestead/homegardens system (58.57 %) have been adopted by majority of the farmers. It was also noticed that majority of the respondents (79 %) have the intention to plant trees in their homegardens. Different trees species for timber, fuel wood, fodder and fruit production purposes have been used by people of this selected area, where adoption of trees for fruit purposes is higher. Amongst the constraints faced during the adoption of agroforestry system proved that lack of government initiatives like policy, crop insurances, subsidies, training and model demonstration have been the major hindrance in agroforestry adoption.

Introduction

The burgeoning pressure of human population along with the increasing multifarious demands for food, fodder, fibre, fuel wood, *etc.* has put up a challenging task to the farming communities. Besides, these, the current hot topic of the climate change also add another limitation for the production of agricultural and allied activities. Agroforestry, a diversified land use system in which tree components are deliberately grown with agricultural and animals components has been consider a viable option and the nature of agroforestry being complementary to food production and climate change mitigation approach is highly acceptable one and majorly, agroforestry system is of low input system (Singh *et al.*, 2017a). The adoption

pattern of agroforestry systems across the world is highly variable, starting from less diverse form of agroforestry such as trees in farm boundary, pasture land to multi diversified form of homegardens (Sinclair, 1999). The state of Jharkhand is one of the youngest states in the country. The state resides of both plateau and sub-plateau region and the current agriculture scenario is quite challenging due to number of problems such as soil erosion, soil acidity, moisture deficiency and low availability of nutrients mainly phosphorus besides erratic rainfall, poor water retention capacity and permeability of soil, resulting in low agricultural productivity. Apart from this, Jharkhand is also facing the problem of increasing pressure on limited land resources especially in the rural areas. Land degradation through poor agricultural practices has greatly impacted negatively on the

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forest resources threatening their extinction. Due to very small land holding and low productivity of the land most household make out a living by maintaining a diversified pattern of occupations, no single activity provide sufficient resources to entirely ensure their livelihood. To increase the agriculture productivity and to uplift the socio-economic condition of rural masses and tribal communities, there is a need of larger scale adoption of site-specific agroforestry systems along with other enterprises (like dairy, piggery, lac, apiculture, fishery, poultry, sericulture, gum, resin *etc.*) so that effective recycling of residue/wastes ensure better utilization of available resources and providing employment to the family labour during off season. Thus, the generation of information on agroforestry adoption by different farmers of this region is very critical and important step towards the advancement of agroforestry in the light of modern agriculture with highly specialised techniques. It is believed that the practice of agroforestry seems to be location specific, determined by edapho and climatic condition (Nair and Dagar, 1991) as well as economic factors (Scherr, 1995). Interestingly, the agroforestry systems that have been traditionally practicing only return the subsistence need of the local people and from this subsistence return; the socio-economic status has not been uplifted. The present need is the commercial and semi-commercial return from their productions and the integrated farming system so that they can get maximum benefit from the limited resources. Further agroforestry systems, identify the reasons of farmers to promote the systems, estimate the cost-benefit analysis and assessing the impact of agroforestry system on the social as well as economic condition of the farmers. Implementation of suitable agroforestry technologies will impart the adoptability and acceptability of agroforestry systems to the farmers. The proposed study will help to understand the impact of adoption of agroforestry system to farmers as a viable option for improving their livelihood and crop productivity. It also serve a baseline for future benchmark for identifying the existing agroforestry practices of the farmers, its relationship with socio-economic factor and to identify tree species for future tree planting programmes under agroforestry at district level.

Materials and Methods

Location of the site

Nagri is a small Village/hamlet near Bero Block in Ranchi District of Jharkhand State, India. It comes under Nagri Panchayath. It is located 36 km towards west from District headquarters Ranchi. Nagri is surrounded by Mandar Block towards North, Bhandra Block towards west, Lapung Block towards South, Ratu Block towards East. Nagri block

consists of tabular landmass. It has even flat surface with isolated hillocks known as Tongri. Hills lying on west have elevation above 800 metres and those lying in east have elevation less than 75 meters. The average elevation of the district is 650 metres but western portion is relatively higher than eastern part. The entire area is full of tarns and Dons on account of rolling topography. Tarns are the comparatively highlands and Dons are lower lands. Geologically the area is comprised with Archean granites; gneisses and schist.

Climate

The climate of this region is typically of a humid subtropical. Interestingly, this region have pleased with pleasant climate due to this region is abound by forests. Ranchi used to be a preferable hill station in the past. Temperature ranges from maximum 42 to 20 °C during summer and from 10 to 20°C during winter. December and January experienced the coolest months with temperature lowering to freezing point in some places of this region. The annual rainfall received is about 1430 mm (56.34 inches) with maximum during June to September which is nearly about 1,100 mm. Agro climatic zone of Ranchi comes under Central and North Eastern Plateau Zone (BI-4).

Methodology

To document the prevailing agroforestry systems practices by farmers of Nagri block of Ranchi, an exploratory study was conducted. The required data were collected by personal interviews of the respondents through a structured interview schedule. Interview schedule for respondents were prepared on the basis of literature referred, reconnaissance survey and discussion with subject matter specialist to collect information from them regarding their socio economic status, general awareness with respect to various agroforestry activities, participation in various agroforestry activities and effectiveness of motivational factors responsible for people's participation in agroforestry programmes. Apart from this qualitative analysis were done on the basis of observation and interaction with the respondents. Interview was conducted preferably in isolation and the information was further cross checked by Focus Group discussion and personal observations where ever possible. Selections of respondents were done by multi stage random technique. Household heads were treated as respondents – engaged in agroforestry were selected as target group for the data collection. For this study purpose, 4 panchayat areas in Nagri Block is selected, and in each selected panchayat, 2 villages are identified and from each village, 20 number of respondent, thus making a total of 160 have been interviewed and interacted.

Results and Discussion

Land use practices in Agroforestry in selected villages of Nagri Block

The data on availability of agroforestry land use practices in selected villages of Nagri block had shown a clear indication of farmers intended towards agroforestry practices (table 2). Nearly $\frac{3}{4}$ of respondents have less than one hectare area available for agroforestry, signifying the importance of agroforestry and showed that peoples around this region have been practiced agroforestry in every possible places, evidently, proved that agroforestry practiced has been practiced from long back ago and people wanted to carry this tradition in foreseeable future.

Existing Agroforestry adoption pattern in selected Villages of Nagri Block

Existing agroforestry adoption pattern in the study area revealed that five types of agroforestry systems namely, agri silviculture (trees in field), silvi pasture, horti pastoral, bund plantation, homestead garden have been predominantly used by farmers (Figure 1). Generally farmers adopted different systems according to their requirements and other socio-economic considerations (Singh *et al.*, 2017b; Alavalapati and Nair, 2001). In other words, the science of agroforestry will remain same but their components and structure tends to change with the preference of farmers and other locality factors.

Table 2. Land use practices in Agroforestry in selected villages of Nagri Block

Land use practices in Agroforestry		Villages								Total (N=160)
		Edchero		Saher		Lalgutuwa		Balalong		
Sl. No.	Land (in Ha)	Edchero (n=20)	Patrachauli (n=20)	Khunta (n=20)	Harhi (n=20)	Lalgutuwa (n=20)	Pundag (n=20)	Balalong (n=20)	Kelende (n=20)	
1	0	04 (20%)	05 (25%)	07 (35%)	08 (40%)	09 (45%)	04 (20%)	03 (15%)	04 (20%)	44 (27.5%)
2	Below 1	16 (80%)	15 (75%)	13 (65%)	12 (60%)	11 (55%)	16 (90.00)	17 (85%)	16 (80%)	116 (72.5%)

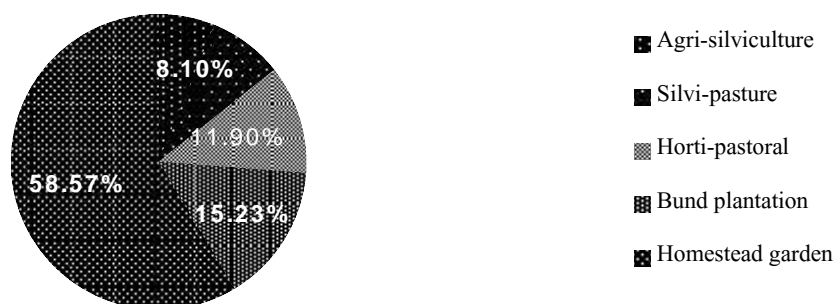


Figure 1. Existing Agroforestry modules in selected Villages of Nagri Bloc

Documentation and diagnosis of existing agroforestry system will give prior information on farmers' perception towards agroforestry and the use of developed agroforestry intervention. In this study, we found that, farmers of this area mainly adopted homestead systems (58.57 %) followed by bund planting (15.23 %). Agri-silviculture systems have recorded the lowest level of adoption (6.20 %). The percentage adoption of silvi-pasture and horti-pastoral systems in this study was found to be 8.00 % and 12.00 %, respectively. The popularity of homestead gardens in tribal regions of Ranchi is also witnessed by Kumar (2016) and Singh *et al.* (2018). However, agrisilvicultural systems is also adopted by majority of farmers in different parts of Ranchi and is conformity with the works of Kumar (2017); Oraon *et al.* (2005).

Tree planted by household of selected Villages of Nagri Block

The tree planted by household of the study area revealed that people of this region had preferred to establish trees in homegardens systems rather than upland (tarn) areas (Table 3). Khunta and Harhi panchayat areas have more trees in homegardens system as compared to other place of this study area while planting on tarn areas are found more in Balalong and Kelende (Table 3). The overall results have shown that 79.37% respondents would prefer to plant trees in homegardens and 18.12% respondents have planted trees in upland (tarn). A very less percentage of about 2.50% respondents had not planted any trees around their surrounding or farmland due to unavailability of lands for tree planting.

Therefore in this region, peoples have the intention to maintain the diversity the homegardens for several reasons especially for food and livelihood security, thus signifying homegardens helps in supporting the farmers' livelihood (Nair, 2001; Wiersum, 2006).

Fruit trees grown by household in selected Villages of Nagri Block

Respondents' preference for fruit tree species in this selected area ranged from 6.87 to 91.25 %. Fruit yielding tree species form an integral component of farming system of this region. Farmers of this region have traditionally planted fruit tree species in their farmlands or other surrounding areas such as homegardens. From this study, it was observed that farmers commonly used eight different fruit trees species. Among them, mango trees have been used by majority (91.25 %) of the farmers of this region as compared to rest of the species (Table 4). It is also found that Jamun trees (6.87 %) are less preferred by the farmers. More than 95 per cent respondents of Edchero village have grown mango as fruit yielding tree in their lands. Other than mango, jackfruit (67.50 %), Guava (55.62 %) and sahjan (53.75%) have been preferred by people of Nagri block. The higher adoptability of fruit yielding trees by farmers might be due to early returns, ease of establishment, easily available of planting materials and in conformity with Anand *et al.* (2016).

Production of different materials from agroforestry

The level of production of different materials from agroforestry in this study is represented in Table 5. From this table, it is clearly seen that agroforestry provides different sources of materials like fodder, food, timber and fuel wood requirements of the farmers. Although, the level of production or availability of different components is still in lesser quantity, but this form the basis for sustenance requirements of farmers in this study. The maximum respondents from this study had revealed that majority of them are not available for green fodder. Consistently, agroforestry provides a fodder availability of 15-40 % up to 6 months in all the selected villages. Food production from agroforestry also revealed that there is shortage of food availability to the agroforestry users and only limited amount of food production can be produced from their lands. A maximum of 60% respondents in Lalgutuwa had enough food for 3-6 months only followed by 55% respondents in Pundag and Harhi. None of the respondents were found for enough food for more than 12 months. Agroforestry only accounts 18.12 % moderate timber produce indicating there is huge deficit of about 81.88% of timber availability to the respondents of the selected study.

Fuel wood generated from agroforestry in the study area showed that on an average 24.37% respondents had sufficient fuel wood harvest and none of the respondents have more than sufficient wood harvest. Maximum 85% respondents in Patrachauli, Lalgutuwa, and Pundag had less fuel wood harvest followed by 75% respondents in Edchero and Balalong villages. The shortages of fuel wood availability from agroforestry have an impact on encroachment of nearby forests by farmers in need of their fuel wood requirement.

From this study it is generalized that farmers of this selected area have dependent on agroforestry only for their sustenance needs thereby serving a supportive role in the overall socio-economic development of the farmers (Parwada *et al.*, 2010; Bijalwan *et al.*, 2011; Pandit *et al.*, 2014). In this respect, Nair (1993) also emphasized agroforestry have played a significant role in meeting the livelihood requirements of the rural farmers. In overall the tangible products derived from agroforestry system under this study is very minimal and there is huge scope for improvement of existing system by implementing suitable agroforestry intervention. Introduction of improved genotypes for crops, fast growing and multipurpose tree species would help to maximise the productivity of the system as well as farmers income on one side and conservation of nature resources on the another side. Therefore, acceptability of agroforestry system by farmers or rural poor families would play a deciding factor while implementing agroforestry system in a particular area (Bijalwan *et al.*, 2011; Bijarpas *et al.*, 2015).

Constraints related to adoption of agroforestry in selected Villages of Nagri Block

Constraints faced during practices of agroforestry system by farmers are identified and the major constraints were non-availability of nursery area, governmental programmes to aid agroforestry practices, Village level workers (VLWs) to assist in transfer of technology in the agroforestry sector and problems of stray cattle. It is evident from the table 6, non-availability of government programmes to aid agroforestry practices have the highest problems faced by different agroforestry users of the selected villages. Lack of government initiatives like agroforestry policy, crop insurances, subsidies, training and model demonstration have been the major hindrance in agroforestry adoption and expansion in different parts of India (Madiwalar *et al.*, 2007; Padmavathy and Poyyamoli, 2013; Anand *et al.*, 2016)

Table 3. Tree planted by household of selected Villages of Nagri Block

Tree planted by household		Villages								Total (N=160)
		Edchero		Saher		Lalgutuwa		Balalong		
Sl. No.	Tree planted in area	Edchero (n=20)	Patrachauli (n=20)	Khunta (n=20)	Harhi (n=20)	Lalgutuwa (n=20)	Pundag (n=20)	Balalong (n=20)	Kelende (n=20)	
1	Home garden	15 (75%)	16 (80%)	17 (85%)	17 (85%)	15 (75%)	17 (85%)	16 (80%)	14 (70%)	127 (79.37%)
2	Upland (Tarn)	04 # (20%)	04 (20%)	03 (15%)	02 (10%)	05 (25%)	01 (05%)	04 (20%)	06 (30%)	29 (18.12%)
3	No tree planted by household	01 (05%)	00 (00.00)	00 (00.00)	01 (05%)	00 (00.00)	02 (10%)	00 (00.00)	00 (00.00)	04 (02.50)

Table 4. Fruit trees grown by household of selected Villages of Nagri Block

Fruit trees grown by household	Villages								Total (N=160)
	Edchero		Saher		Lalgutuwa		Balalong		
Fruit tree	Edchero (n=20)	Patrachauli (n=20)	Khunta (n=20)	Harhi (n=20)	Lalgutuwa (n=20)	Pundag (n=20)	Balalong (n=20)	Kelende (n=20)	
Mango	19 (95%)	20 (100%)	19 (95%)	18 (90%)	16 (80%)	17 (85%)	19 (95%)	18 (90%)	146 (91.25%)
Jackfruit	15 (75%)	16 (80%)	17 (85%)	12 (60%)	15 (75%)	16 (80%)	07 (35%)	10 (50%)	108 (67.5%)
Tamarind	04 (20%)	05 (25%)	01 (05%)	00 (00.00)	03 (15%)	00 (00.00)	02 (10%)	05 (25%)	20 (12.5%)
Sahjan	08 (40%)	10 (50%)	13 (65%)	08 (40%)	09 (45%)	14 (70%)	17 (85%)	07 (35%)	86 (53.75%)
Jamun	02 (10%)	02 (10%)	01 (05%)	00 (00.00)	02 (10%)	01 (05%)	03 (15%)	00 (00.00)	11 (06.87%)
Sharifa	02 (10%)	03 (15%)	00 (00.00)	00 (00.00)	02 (10%)	01 (05%)	01 (05%)	03 (15%)	12 (07.5%)
Guava	11 (55%)	08 (40%)	07 (35%)	13 (65%)	12 (60%)	16 (80%)	07 (35%)	15 (75%)	89 (55.62%)
Ber	08 (40%)	06 (30%)	07 (35%)	00 (00.00)	03 (15%)	04 (20%)	06 (30%)	04 (20%)	38 (23.75%)

Conclusion

From this study, it is evident that maximum of the respondents is having small land holding and wherever possible people are focussing to adopt agroforestry practices with the aim to improve their livelihoods and for better economy. People have the intention to adopt fruit based agroforestry system as it delivers high rate of returns and fulfil nutritional demand of the family/household. Unfortunately, non-availability of nursery area, governmental programmes to aid agroforestry practices, Village level workers (VLWs) to assist in transfer of technology in the agroforestry sector and problems of stray cattle has been identified as major constraints faced during practices of agroforestry system by farmers of this region. Therefore, government attention towards agroforestry related programmes, initiatives, proper assistance and advance training related to agroforestry practices and modules at ground level would be highly beneficial to agroforestry adopters in particular and overall socioeconomic development of the region in general.

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Table 5. Production of different materials from agroforestry in selected villages of Nagri Block

Materials availability	Villages								Total
	Edchero	Saher	Lalgutuwa	Balalong					
Fodder availability									
Duration of fodder availability	Edchero (n=20)	Patrachauli (n=20)	Khunta (n=20)	Harhi (n=20)	Lalgutuwa (n=20)	Pundag (n=20)	Balalong (n=20)	Kelende (n=20)	(N=160)
3 month	04 (20.00)	05 (25.00)	03 (15.00)	04 (20.00)	03 (15.00)	04 (20.00)	03 (15.00)	03 (15.00)	29 (18.12)
6 month	03 (15.00)	02 (10.00)	02 (10.00)	01 (05.00)	05 (25.00)	04 (20.00)	03 (15.00)	04 (20.00)	24 (15.00)
>6 month	06 (30.00)	07 (35.00)	06 (30.00)	08 (40.00)	00 (00.00)	00 (00.00)	03 (15.00)	00 (00.00)	30 (18.75)
>12 month	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)
None	07 (35.00)	06 (30.00)	09 (45.00)	07 (35.00)	12 (60.00)	12 (60.00)	11 (55.00)	13 (65.00)	77 (48.12)
Food availability									
1-3 months only	04 (20.00)	03 (15.00)	04 (20.00)	00 (00.00)	00 (00.00)	02 (10.00)	00 (00.00)	04 (20.00)	17 (10.62)
3-6 months only	07 (35.00)	09 (18.00)	08 (40.00)	11 (55.00)	08 (40.00)	07 (35.00)	10 (50.00)	09 (45.00)	69 (43.12)
6-12 months only	09 (45.00)	08 (40.00)	08 (40.00)	09 (45.00)	12 (60.00)	11 (55.00)	10 (50.00)	07 (35.00)	74 (46.25)
>12month	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)
Timber availability									
More than sufficient	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)
Moderate level	03 (15%)	04 (20%)	03 (15%)	05 (25%)	03 (15%)	04 (20%)	04 (20%)	03 (15%)	29 (18.12%)
Not sufficient	17 (85%)	16 (80%)	17 (85%)	15 (75%)	17 (85%)	16 (80%)	16 (80%)	17 (85%)	131 (81.88%)
Fuel wood availability									
More than sufficient	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	00 (00.00)	0 (00.00)	00 (00.00)
Sufficient	05 (25.00)	03 (15.00)	07 (35.00)	06 (30.00)	04 (20.00)	03 (15.00)	05 (25.00)	06 (30.00)	39 (24.37)
Less	15 (75.00)	17 (85.00)	13 (65.00)	14 (70.00)	16 (85.00)	17 (85.00)	15 (75.00)	14 (70.00)	121 (75.63)

Table 6. Constraints in adopting agroforestry in selected Villages of Nagri Block

Sl.no	Constraints	Percentage of respondents (n=160)
1	Non availability of nursery area	13.12
2	Non-availability of Gov. programme to promote agroforestry	34.37
3	Non – availability of VLW to assists in agroforestry	30.00
4	Stray cattle problems	23.12