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Impact of agroforestry on livelihood improvement of the farmers of Koraput District Odisha

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Abstract— A study was conducted for a period of one year from April, 2019 to March, 2020 to evaluate agroforestry practices and its impact on farmer's livelihood improvement in Koraput district of Odisha. A questionnaire was prepared to know the independent and dependent variables. The present investigation was conducted to identify the existing agroforestry practices and livelihood status of farmers. For conducting the study a total of 220 households from three blocks were selected through multistage random sampling. Data were collected through survey and by interview of head of the household on pre-tested and pre-structured questionnaire as well as group discussions with villagers. The results revealed that majority of households (90.00%) were headed by male member having age between 40-50 years. All the respondents practice different type of agroforestry practices on their farm. About 78.63 percent household practices agroforestry on 0.5 to 1.0 acre size of farm land. The prevalent existing agroforestry practices in the area were found to be Homestead (40.45%), Trees on Field Bunds (29.54%), Agrisilviculture (17.72 %) and Agrihorticulture (12.27%). 27.72 % household had maximum monthly income ranged between Rs. 7001-9000 followed by 17.72 % of 5001-7000. Therefore, the rural people should make some strategy for the implementation of agroforestry model with suitable combination of trees and field crops.

Key Words: Agroforestry, Household, Koraput Livelihood, and Socio-economic.

Introduction

Agroforestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers (Nair, 1979). In agroforestry model, a suitable combination of nitrogen fixing and multipurpose trees with field crops are played a major role in enhancement of better yield productivity, soil nutrient status and microbial population dynamics which plays a major role in nutrient cycling to maintain ecosystem (Raj *et al.,* 2014). According to Dhyani *et al.*, (2013) in India the current area under agroforestry is estimated at 25.32 M. ha, or 8.2% of total geographical area of the country. This includes 20.0 Mha in cultivated lands (7.0 Mha in irrigated and 13.0 Mha in rainfed areas) and 5.32 Mha in other areas such as shifting cultivation (2.28 Mha), home gardens and rehabilitation of problem soils (2.93 Mha).

According to WAC (2010), agroforestry is a source of improving the livelihoods of small marginal farmers of India by following productions: such as, fruit and nuts, fuel wood, timber, medicine, fodder for livestock, green manure, gum, resins, spices and additional / diversified income. The poor, particularly the rural poor, depend on nature for many elements of their livelihoods, including food, fuel, shelter and medicines (Jhariya and Raj, 2014).Moreover, agroforestry is also providing livelihood opportunities through lac, apiculture and sericulture cultivation and suitable trees for gum and resin have been identified for development under agroforestry (Dhyani, 2012). In the present scenario of climate change, agro-forestry practices, emerging as a viable option for combating negative impacts of climate change (Singh *et al.,* 2013). Therefore it is the only viable option to meet the ever growing need of burgeoning population. A worldwide initiative of agroforestry records indicates that it has the

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following potentials such as Supplement multiple products, ecological restoration, carbon sequestration and minimizes adverse climatic effect, maintenance of soil fertility ultimately leads to quality and quantity production, reduces nutrient loss and soil erosion, improves microclimatic of area by lowering the soil temperature, provides resistance from disease, insect, etc., due to variety in crops, conserves biodiversity by domesticating wild trees and shrubs, provide rural employment opportunities and increases farm income, utilizes wasteland and degraded land, aid industrial growth based on both agricultural and forestry raw materials, watershed stabilization etc.

Odisha is a state with immense possibilities of development in industrial and agricultural sector. The Forest Cover in the State is 51,618.51 sq km which is 33.15 % of the State's geographical area (ISFR, 2019). Out of thirty district of Odisha, Koraput is physiographically, ecologically and geologically much diversified, which is reflected through varied land-use pattern, soil conditions, water resources and agricultural practices. The main land use system/ practices is rainfed farming, while in rest of the year land is left as fallow land in most of region. In Koraput district more than 70% of farmers are small and marginal farmers and almost 85% of them own 1-2 acres of degraded lands. More than 80% of these farmers are presently living below poverty line and this intervention is intended to make a significant difference to their lives. The geographical area of Koraput district is 8807 sq.km out of which 2098.27 forest cover which is 16.60% of the district geographical area (ISFR, 2019). The National Agriculture Policy (2000) emphasized the role of agroforestry. The task force of planning commission on Greening India for Livelihood Security and Sustainable Development (2001) also recommended that agroforestry may be promoted for sustainable agriculture. Forest conservation efforts involving reduction of deforestation and degradation may have to increasingly rely on alternatives provided by TOF (Namwata, *et al.*, 2012) in catering to economic demand in forest edges. Various forms of agroforestry exists in koraput and they occupy considerable area in the whole district. This study has tried to investigate how influential agroforestry practices are in terms of improving rural livelihoods.

Material Method

Koraput district is located in the Southern Odisha state of India (Figure 1). The district lies between 18° 13′ to 19° 10′ north latitude and between 82° 5′ to 83° 23′ east longitude. Farmers of Koraput are dependent on agricultural activities. The climate condition of the district is warm and humid. Average annual rainfall is 1567 mm. The selection criteria for study of villages were their geographical distribution under districts and presence of agroforestry in that area using random sampling. The study was observed through household survey with the help of questionnaire, house hold interviews, focus group discussions and participatory rural assessment using random sampling technique.

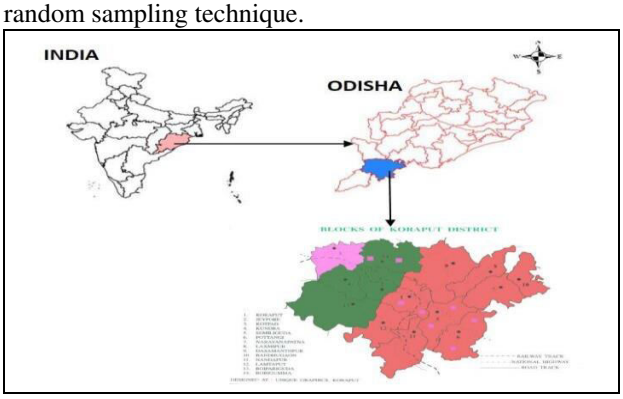

Fig.1 Location map of Koraput district

Data collection on socio-economic status, land use characteristics, resources/supporting services, general awareness and participation with respect to various agroforestry activities. Thus, 220 random selected households in the villages were surveyed to determine gender, cast, literacy, average land holding size, area under different land uses, trees, shrubs and crops used for various purposes and income generation. Data were recorded from these selected farmers from April, 2019 to March, 2020.

Results and Discussion

Details of the household: The details of the household study area are shown in Table 1. Perusal of the table indicated that 90.00 % male and 10.00 % of female respondents was found in area. According to Thakur *et al.,* 2018, family composition affects both household and individual needs and priorities for agroforestry interventions. Kamanaga (1998) suggested that gender of household's headship may influence the accessibility to farm resources. The maximum number of household found in 40-50 age profile 39.09 % followed by 50-60 age and 30-40 age class 20.45 % each and minimum were above 60 age class 8.18 %. Varied relationship between age of the farmers and innovation adoptions has been reported by Glover *et al.,* 2013 commented that younger farmers accept change and adopt innovations more

readily compared to older farmers. The caste of the study area was maximum found in ST 37.72 % followed by SC 34.54 % and minimum in GEN 5.45 %. Maximum 30.90 % of Literacy found in high school followed by Elementary 24.09 % and minimum were found in College 12.27 %. Farmers with lower education levels are considered to be low adopters and risk averse. (Himshikha, 2016) asserted that the education level decreases from innovators to late adopters, and persons with a higher level of education are supposedly more capable of understanding the innovation. Korsching *et al.,* (1983) showed that education relates directly to innovation. The higher the level of education the more likely landowners are to be interested in adopting new practices like agroforestry. Older farmers are viewed as less flexible, more risk averse, and less willing to engage in innovative farm technology (Thacher *et al*., 1997). The farm experience and education (both formal education and informal training) of the farmer are important characteristics that influence decisions made in farm tree growing (Adesina and Chianu, 2002). Aturamu and Daramola (2003) reported that adoption of agroforestry increased with the rise in level of farmer education. Maximum 82.72% of household found in Hindu community followed by 17.27 % of Christian community. In primary occupation maximum 83.18 % of households doing farming work followed by 7.72 % doing private job and minimum were 3.18 % doing construction worker. In secondary occupation maximum 43.63 % of households doing Agricultural worker followed by 29.09 % doing Non-Farm and minimum were 9.54 % doing Poultry/Mushroom/ Honey Bee/ Dairy etc. There are 55 % of the people were known abonut agroforestry in the study area.

Total land holding details of households (in ha): Total land holding of the households (in ha) is shown in Table 2. Perusal of data showed that maximum 34.09 % of people had 1.51 – 2.0 ha followed by 19.54 % of people had 1.1 – 1.50 ha and minimum 3.63% had 3.51-4.00 ha land. Nahar (2009) studied on agroforestry and observed that the average size of the homestead in the study area was 0.12 ha which increased with the increased of farm size. The trade-off between agricultural production and tree growth is an important factor in the farmers' allocation of family land and labour. The positive effect of landholding size on farm level tree growing has been reported by Dwivedi *et al.,* (2009) in India. They argued that when land becomes scarce, the overriding need to produce food takes precedence over the long-term value of trees thereby implying a decreasing livelihood of growing trees with decreasing size of land holding. The present finding is in line with the findings of (Kumar *et al.,* 2017; Thakur *et al.,* 2018; Lakra *et al.,* 2018).

Land use practices: Different type of land use practices doing in the study area like agroforestry, bamboo, horticulture, agriculture is shown in Table 3. The data indicated that maximum 78.63 % of households doing agroforestry in 0.5 to 1 acre land where as 85.00 %, of household grow bamboo in less than 0.5 acre land. The horticulture crop grows maximum 60.90 % households in the area of 0.5 -1.0 acre lands where as 39.09 % of household doing agriculture 1.1-2.0 acre lands. The present finding is in line with the findings of (Kumar *et al.,* 2017; Thakur *et al.,* 2018;).

Existing agroforestry modules in the village: The existing modules of agroforestry in the study area are shown in Table 4. The data showed that Agrisilvicultural system, Agrihorticultural System bund plantation and home garden agroforestry systems was found in the study area. The data showed that 40.45% respondents were practicing home gardening system followed by 29.54% trees on field bunds, 17.72% Agrisilvicultural system and 12.27% on Agrihorticultural system. Dagar and Tewari (2016) reviewed research developments in agroforestry during past four decades, stated that the tress that are grown in agricultural fields or on fields bunds are also often and usually grown on farm boundaries. Pathak *et al.,* (2014) and Korwar *et al.,* (2014) have also dealt in detail the plantations on bunds for Rainfed areas of India.

Component distribution in different agroforestry system: The component distribution in different agroforestry system is presented in Table 5. The data has indicated that the tree species and agricultural crops combination reflects the different in agroforestry system. In agrisilvicultural system and on field Bunds system the tree species were *Gmelina arborea* (Gamhar), *Dalbergia sissoo* (Sissoo), *Tectona grandis* (Teak), *Syzygium cumini* (Jamun), *Mangifera indica* (Mango) *Artocarpus heterophyllus* (Jackfruit) *Glaricidia sepium,*(Glaricidia), *Silver oak, Cassia siamea* (Cassia Tree), *Eucalyptus hybrid* (Eucalyptus) *Acacia auriculiformis* (Acacia tree), *Acacia mangium* (mangium) *Pongamia pinnata*(Karanj) *Acacia nilotica* (Babul tree), *Palmyra palm* (Palm) where as agriculture species were Zea maize (Maize) *Solanum melongena* (Brinjal), *Solamum tuberosum* (Potato), *Lycopersicon esculentum* (Tomato), Zingiber *officinale* (Ginger), *Phaseolus vulgaris* (Bean), *Brassica oleracea capitata* (Cabbage), *Brassica oleracea appetite* (Cauliflower), *Capsicum annuum* (Chilly) *Oryza sativa* (Paddy),

Brassica nigra (Mustard), *Guizotia abyssinica* (Niger), *Eleusine coracana* (Finger millet) *Curcuma longa* (Turmeric), *Piper nigrum* (Black Pepper), *Coffea Arabica* (Coffee). In Agrihorticultural system horticultural tree species were *Mangifera indica* (Mango), *Psidium guajava* (Guajava) *Anacardium occidentale* (Cashew) where as agricultural species species were *Guizotia abyssinica* (Niger), *Eleusine coracana* (Finger millet) *Curcuma longa* (Turmeric), *Colocasia esculenta* (Colocasia), *Ananas comosus* (Pineapple), Zingiber *officinale* (Ginger),. They grow different species of bamboos like *Bambusa vulgaris* (common bamboo), *Bambusa tulda* (Spineless Indian bamboo), *and Bambusa nutan* (Nodding Bamboo). In Homegarden system, tree species were *Gmelina arborea, Tectona grandis, Mangifera indica Moringa oleifera*, *Psidium guajava* and *Artocarpus heterophyllus, Citrus limon, Bauhinia vahlii, Santalum album* where as agriculture species were *Solanum melongena, Solamum tuberosum, Lycopersicon esculentum, Brassica oleracea appetite, Phaseolus vulgaris, Capsicum annuum, Leafy vegetables, Piper nigrum* . Similarly, Hemrom and Nema (2015) the different agroforestry system perform by the people existing in Baster region are agrisilviculture with combination of tree like *Shorea robusta*, *Tectona grandis*, *Acacia spp.* etc. in agrisilvopastural with combination crop with tree like *Albizia Spp., Leucaena leucocephala*, *Ficus racemosa* etc. In agrihoritsilvcultural practices with many fruit trees and multipurpose trees like *Cocos nucifera, Caraya papaya, Musa acuminate, Mangifera indica, Anacardium ocidentale, Embellica officinalis* etc. and in homegarden species like Dalbergia latifolia, *Mangifera indica*, *Moringa oleifera*, *Leucaena leucocephala*, *Artocarpus heterophyllus*, *Anacardium occidentale* etc. In Manipur, under different agroforestry practices the agriculture crops like *zea mays, Cajanas cajan, Vigna* ungulcuate are grown with fodder grasses *Pemphis purpureum, Teosinte changing* etc, and the tree species are *Parkia roxburghii, Litsea polyantha, Alnus nepalensis, Albizia lebbeck, Artocarpus,* Ficus etc, (Singh *et al.*1996). Similar observation find in Singh *et al.,* 2017, Kumar *et al.,* 2017, Lakra *et al.,* 2018.

Monthly income of household: Monthly income of households from agroforestry system, agriculture, vegetable production, livestock and other source are shown in Table 6. The maximum monthly income 27.72 % of 7001-9000 followed by 17.72 % of 5001-7000 and minimum were in 05.45 % of more than 11000 of households. Fregene (2007) found on-farm monetary benefit to be positively and significantly associated with agroforestry adoption. It was observed that respondents that have achieved on-farm monetary benefits of agroforestry were five times more likely to adopt agroforestry. Examined adoption of traditional agroforestry in relation to economic and farming conditions of households and found increased agroforestry adoption among households with higher off-farm, agricultural, and total incomes (Sood, 2006).

Conclusion

There is a great scope for developing different agroforestry system in the Koraput district. Agroforestry can improve the status of the farmers with appropriate tree-crop combination in the study area and they can get better their livelihood and socioeconomic status. There are some of the major problems is lack of agroforestry knowledge about agroforestry. Beside this, many educated and skilled farmers are planting trees inside and outside their farm and practicing different Agroforestry practices like agrisilviculture, agrihorticulture, Bamboo and homegarden and getting optimum production and also improving their soil fertility. They also fulfilling their basic requirements from Agroforestry practices like 5Fs, i.e. food, fodder, Fruit, Fuel and fertilizer etc. and also getting extra benefit or income. Therefore, it suggests for considered extension of agroforestry for overall socio-economic development of the farmers and nature of agroforestry for future efforts should be directed at participating on- farm research.

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Table 1: Details of the Household

Details of the Household		Total (N=220)	Percentage (%)
Gender	Male	198	90.00
	Female	22	10.00
Age Profile	20-30	26	11.81
	30-40	45	20.45
	40-50	86	39.09
	50-60	45	20.45
	Above 60	18	8.18
Caste	GEN	12	5.45
	OBC	49	22.27
	SC	76	34.54
	ST	83	37.72
Literacy	No Schooling	42	19.09
	Elementary	53	24.09
	High School	68	30.90
	Intermediate	30	13.63
	College	27	12.27
Religion	Hindu	182	82.72
	Christian	38	17.27
Primary occupation	Farming	183	83.18
	Construction Worker	07	3.18
	Private Job	17	7.72
	Government job	13	5.90
Secondary occupation	Agri Labour	96	43.63
	Poultry /Diary / Mushroom / Honey bee / Goatery	21	9.54
	Non Farm (Wage Carrier)	64	29.09
	Private Job	39	17.72
Knowledge about agroforestry		121	55.00

Table 2: Total Land holding details of Households (in ha)

Sl. No.	Total Land holding details of Households (in ha)	Total N=220	Percentage (%)
1	>0.50	17	7.72
2	0.51 -1.0	23	10.45
3	1.1 – 1.50	43	19.54
4	1.51 -2.0	75	34.09
5	2.1- 2.50	26	11.81
6	2.51 – 3.0	12	5.45
7	3.1 – 3.50	16	7.27
8	3.51 – 4.0	08	3.63

Table 3: Land use practices

Land use practices in (Acre)	Total N=220	Percentage (%)
Agroforestry		
< 0.5	47	21.36
0.5 – 1	173	78.63
Bamboo		
< 0.5	187	85.00
0.5 – 1	33	15.00
Horticulture		
< 0.5	62	28.18
0.5 – 1.0	134	60.90
1.5 – 2	16	07.27
2.5 – 3	08	03.63
Agriculture		
0.1-1.0	65	29.54
1.1-2.0	86	39.09
2.1-4.0	61	27.72
4.0<	08	3.63

Table 4: Existing agroforestry modules in the village

Sl. No.	Existing modules agroforestry in the village	Total N=220	Percentage (%)
1.	Agrisilvicultural System	39	17.72

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2.	Agrihorticultural System	27	12.27
3.	Trees on Field Bunds	65	29.54
4.	Homegarden	89	40.45

Table.5 Component distribution in different agroforestry system

Agroforestry system	**Tree species/ Horticultural tree**	**Agricultural crop**
Trees on Field Bunds and Agrisilvicultural system	*Gmelina arborea, Dalbergia sissoo, Tectona grandis, Syzygium cumini, Mangifera indica Artocarpus heterophyllus, Glaricidia sepium, Silver oak, Cassia siamea Eucalyptus hybrid Acacia auriculiformis Acacia mangium, Pongamia pinnata, Acacia nilotica palmyra palm*	*Zea maize, Solanum melongena, Solamum tuberosum, Lycopersicon esculentum, Zingiber officinale, Phaseolus vulgaris, Brassica oleracea capitata, Brassica oleracea appetite, Capsicum annuum, Oryza sativa, Brassica nigra, Guizotia abyssinica, Eleusine coracana, Curcuma longa, Piper nigrum, Coffea arabica*
Agrihorticultural system	*Mangifera indica, Psidium guajava Anacardium occidentale*	*Guizotia abyssinica, Eleusine coracana, Colocasia esculenta, Ananas comosus, Curcuma longa, Zingiber officinale*
Bamboos	*Bambusa vulgaris, Bambusa tulda and Bambusa nutan*	
Homegarden system	*Gmelina arborea, Tectona grandis, Mangifera indica, Moringa oleifera, Psidium guajava, Artocarpus heterophyllus, Citrus limon,Bauhinia vahlii Santalum album, Musa acuminate*	*Solanum melongena, Solamum tuberosum, Lycopersicon esculentum, Capsicum annuum, Brassica oleracea appetite, Phaseolus vulgaris,* Leafy vegetables, *Piper nigrum*

Table 6: Monthly income of household

Sl No.	**Monthly income**	**Total (N=220)**	**Percentage (%)**
1.	1000-3000	35	15.90
2.	3001-5000	43	19.54
3.	5001-7000	39	17.72
4.	7001-9000	61	27.72
5.	9001-11000	30	13.63
6.	> 11000	12	05.45