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Status of Agroforestry Outside in Forest Area of Bilaspur (Chhattisgarh) and Constraints for Non Adoption

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Abstract

Agroforestry is emerged as climate smart agriculture system and known to help in maintaining soil nutrient sustainability but its rate of expansion is still not appreciable. The present paper incorporates the different species under various agroforestry practices its density, growth and growing stock. The most dominated agroforestry practices in Bilaspur district identified as boundary tree based agri- silviculture (32%) followed with inside field tree based agri-silviculture (21%). Agri-horti-silvicultural system found merely in 5% farmer's field while silvo-pastoral practice in 8% fields. The result depicts that the most prevailing agroforestry tree species in non-forest area of Bilaspur comprises *Acacia nilotica* 36%, *Butea monosperma* 22%, *Albizia spp* 16%, *Terminalia arjuna* 7%, *Azadirachta indica* 3.5% and other species 15.5%. More than 90% farmer allows tree species growing naturally in their fields mainly for fuel wood, timber and as source of additional income as these species need not require special attention and care, while only 5% farmer's has adopted *Tectona grandis*, *Dalbergia sissoo* etc commercially for higher future return. The paper also discusses the constraints on agroforestry for enabling development of agroforestry in future.

Key Words: agroforestry, tree species, density growing stock, farmers

Introduction

The forest and tree cover in India has over the years stabilized at around 23% of geographical area, whereas the National Forest Policy, 1988 lays down the national goal of 33% of forest and tree cover for ensuring ecological security and environmental balance. The explosive population growth of the country is causing continuous shrinkage of forest resources and this result in an increasing popularity on agroforestry for bridging the gap between demand and supply of timber, fuel wood and for other non-wood forest products. Agroforestry is a practice integrates tree species with agriculture and or livestock for inter dependent benefits of and has the potential to achieve sustainability in agriculture while optimizing its productivity and mitigating climate change impact (Chavan et al. 2015). From ancient time, Indian farmers has been practicing a different agroforestry practices as a part of indigenous traditional knowledge of local communities depending upon the agro-climatic conditions and local needs in various forms viz. bio-fencing, taungya, shifting cultivation, near ponds and river banks and homestead garden. There are a number of studies from different parts of the world suggesting that agroforestry renders tangible benefits to farmers than agriculture or forestry for a particular area of land. However, in current context, AF is being adopted more for intangible

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benefits include microclimate moderation, biodiversity conservation, carbon sequestration, protecting water sources, soil erosion, pollution control and is one of the instruments to fight climate change.

Chhattisgarh is a tribal dominated state of India, which has 4535 sq km area under tree green cover in agroforestry, constitutes 3.35% of the total geographical area containing 64.75 million cubic meter volume (Forest Survey of India 2013). In addition, 41.11% area is under natural forest in the State and government has initiated number of activities towards increasing forest but however the results so far is unsatisfactory as it is in negative trend (Forest Survey of India 2015). Now, it is well established that the further stretches in natural forests would be difficult while it is possible through adoption of agroforestry practices in outside forest. AF has the livelihood impact both in terms of supply of fuel wood, domestic use of timber, additional income and employment generation particularly in non-forest area of Chhattisgarh. There is a tremendous potential of agroforestry in Chhattisgarh plain zone not only to increase the productivity of agriculture but also in restoring wasteland, maintaining sustainability and environmental conservation (Puri and Pawar 2007). We are fortunate that we have National agroforestry policy 2014, however, the problems of the farmers are still untouched and must be resolved in order to facilitate agroforestry movement in every farmer's fields. Farmers of Chhattisgarh mainly rearing naturally growing tree species and hesitate for Teak (*Tectona grandis*), Shisham (*Dalbergia sissoo*) and other who require permission before felling and transits. In spite of multiple benefits from agroforestry practices, majority of farmers have been reluctant to adopt these systems on large scale primarily because of certain apprehensions about the tree component (Zomer et al. 2009). As the location specific information on agroforestry tree species in Chhattisgarh plain zones are sparse, the present study was conducted to evaluate the tree species, density and growing stock in non forest area of Bilaspur district. In addition, the constraints in adoption of different tree species raised by farmers during meeting has also identified for further expansion of agroforestry in Chhattisgarh.

Materials and Methods

Chhattisgarh plain zone covers 68.49 lakh ha area (50% of the total geographical area of Chhattisgarh) consist 17 districts. Site selection was done after reconnaissance survey of district Bilaspur based on the primary information from Agriculture department and Jila Panchayat regarding the status of tree species. Finally 05 villages from Bilaspur district located in different blocks were selected after extensive survey with intension to cover most of the existing agroforestry practices outside forest areas particularly agriculture fields, pasture lands, orchards etc. The different tree species used in agroforestry practices were identified from farmers' fields. Sample plot size in each village was 4 ha and 10% sampling intensity was considered. Only established trees of ten year and above age was considered for present investigation.

Tree density, girth, height were measured using tape and Sunto Clinometer respectively. Growing stock in tree species was determined by quarter girth formula. The group meeting of farmer's were organized in each villages selected for study inviting 15 to 20 farmers for gathering of information related to tree farming. Questionnaire for design and diagnostic survey was prepared as per the guidelines laid down by ICRAF for global inventory of agroforestry systems (Nair 1989).

Results and Discussion

In the study, different types of agroforestry practices were identified in the village of Bilaspur district to meet the diverse needs of the farmers (Table 1). Traditionally, farmers of Bilaspur district has adopted mainly *A. nilotica*, *Albizia spp*., *Butea monospera* and *Terminalia arjuna* for boundary planting, however, other species such as *Azadirachta indica* and *Gmelina arborea* also got considerable positions on boundaries with different agricultural crops. The practice of agri-silviculture based on boundary planting with naturally occurring tree species viz. *A. nilotica*, *Butea monosperma*, *Terminalia arjuna* and others was largest 32% among AF of Bilaspur district. It was also recorded that 95% tree species used in agroforestry are naturally growing while merely 5% species comprising *Eucalyptus*, *Tectona grandis*, *Moringa* etc are planted commercially for

Table 1. Existing agroforestry practices, tree crop structure and its percent expansion in studied villages of Bilaspur district

System	Tree component	Fruit tree component	Agriculture crops	% Expansion
Boundary tree based agri-silviculture	*Albizia procera, Terminalia arjuna, Butea monosperma, Azadirachta indica, Acacia nilotica, Gmelina arborea, Eucalyptus, Tectona grandis*	*Annona squamosa, Syzigium cumini, zyziphus marutiana* (very few in scattered manner and not utilizing commercially)	Paddy, Wheat, Khesari	32
Inside field tree based Agri-silviculture	*Acacia nilotica, Butea monosperma, Diospyros melanoxylon, Terminalia tomentosa, Madhuca latifolia*	-	Paddy, Khesari, Pea, Gram, Urd bean, Mustard	21
Agri-horti-silvicultural system	*Albizia procera, Albizia lebbeck, Eucalyptus, Tectona grandis*	*Guava, mango, Moringa, Zyziphus marutiana*	Papaya, cabbage, radish, banana, paddy, pea (no food crops)	05
Silvi-pastoral	*Acacia nilotica, Tamarindus indica, Albizia lebbeck, Butea monosperma, Acacia leucopholia*	-	Pasture/grasses	08
Block plantation	*Tectona grandis, Eucalyptus, Dalbergia sissoo, Gmelina arborea*	-	-	02

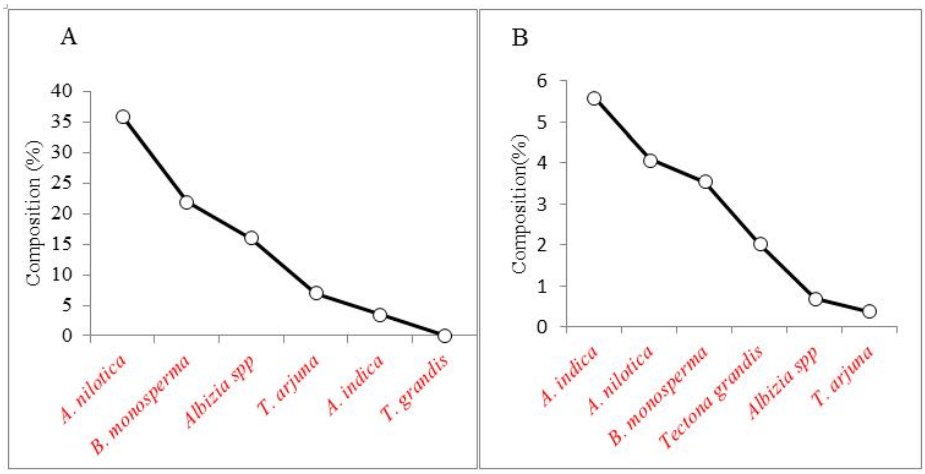

Fig. 1. Tree species composition (%) in different agroforestry practices (A) in Bilaspur district of CG and (B) in India.

wood and fruit production. Paddy is dominant crop in kharif while pulses are commonly grown during rabi season, however, in irrigated area summer rice and other vegetables are cultivated in scattered small areas. No systematic arrangement was noticed in tree on boundary but farmer adopts tending operations to reduce the shade effects on crops and also to produce large size timbers for higher economic returns. Agri-silviculture system where tree species grown inside the fields with agriculture crops was the second largest adopted AF practices (21%) in the district. The naturally grown tree species such as *A. nilotica, B. monosperma* and *Albizia procera* were dominated in upland condition while *T. arjuna* in lowland area or area near river. Farmers managing tree species alongwith agriculture crop primarily for the purpose of fuel, fodder and wood for domestic use irrespective of following spatial or temporal manners. Only 5% farmers has adopted agri-horti-silvicultural systems on commercial way without food grain crops where light crowned species i.e. *G. arborea, T. grandis* and *Eucalyptus* are given preference on boundary to minimize the shade effects on crop and simultaneously to fetch higher income from trees while Guava, Mango, Papaya, Banana

and vegetable crops are taken inside the fields compared to traditional agroforestry practices such as tree species with paddy or pulses etc. Similarly, silvi-pastoral practices found 8% mainly in degraded lands of village while 2% resource rich farmers have established block plantations in farms using Teak and Shisham (Table 1). *B. monosperma* is used for lac production therefore the satisfactory number of plants maintained by farmers in AF. Toppo et al. (2016) propounded that choice of species in AF determines on the basis of soil and needs of the farmers for family consumptions.

The composition of *A. nilotica* observed highest 36% followed by *B. monosperma* (22%) and *Albizia spp* (16%) in AF practices at Bilaspur (Fig. 1A) while the status of these tree species on the national level reported 4.09% (*A. nilotica*), 3.54% (*B. monosperma*) and 0.68% (*Albizia spp*) (Fig. 1B) (Forest Survey of India, 2013), which indicates the dominance of these trees in agroforestry systems in C.G. plain zone. The tree density in AF ranged 16 to 30 tree per ha (Fig. 2) however, the existence of above mentioned tree species again proved their dominancy with higher density under AF practices in Bilaspur district. The poor tree density in AF was due to removal of large size tree by farmers from fields for regular income and also to reduce the yield losses of agriculture due to shade of trees therefore, the small size trees present in majority compared to medium and large size tree. This also resulted to poor growing stock in AF trees which found minimum 5.15 to maximum 10.3 cubic meter per ha in sampled villages of the district (Fig. 2). In the study *Albizia spp* rendered highest wood growing stock (0.735m^3/tree) while dominated *A. nilotica* found to produces 0.425 m^3 wood per tree (Table 2). *T. arjuna* also found to grow very well under high moisture condition near river and canals resulted into good growth and higher wood volume compared to other tree species of agroforestry in study sites. *A. nilotica* an indigenous tree species identified as best for dry upland area in all forms of agroforestry as the species grow naturally without any extra care, fetch higher return and requires no permission for felling and transit.

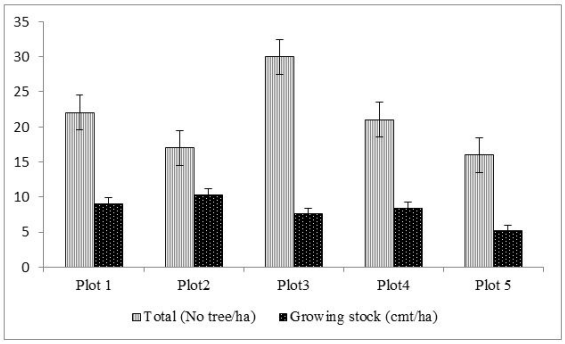

Fig. 2. Tree density (no tree/ha) and growing stock (m3/ha) of tree species used in AF in Bilaspur district.

Farmers meeting conducted in each of selected villages and the results on positive and negative attributes of agroforestry on farmers perceptions are given in Fig. 3 and 4 respectively. It reveals that fuel wood is a basic need of rural India and agroforestry plays pivotal role in the domestic supply of fuel wood and timber particularly in non-forest areas where the value of trees are more compared to the value of tree in forest area. About 76% farmers primarily depend upon agroforestry trees for fuel wood while 60% respondent has given I^{st} importance to trees for wood production (Fig. 3). Similarly, 20% farmers adopts trees mainly as a source of income while only 2% farmers doing agroforestry using fruit yielding tree species. Overall, all farmers who participated in the meeting agreed that tree are very important in the fulfillment of many outputs required for

Table 2. Average girth (BH), height and growing stock of tree species grown under agroforestry practices in study areas

S. No.	Species	Girth (cm)	Height (m)	Growing stock (m^3)
1	*Acacia nilotica*	71.00	13.50	0.425
2	*Butea monosperma*	54.00	10.80	0.196
3	*Albizia spp*	81.00	17.93	0.735
4	*Terminalia arjuna*	68.00	15.10	0.436
5	*Azadirachta indica*	39.00	11.50	0.014
6	*Tectona grandis*	55.50	17.00	0.327
7	Rest of species	44.70	12.00	0.149

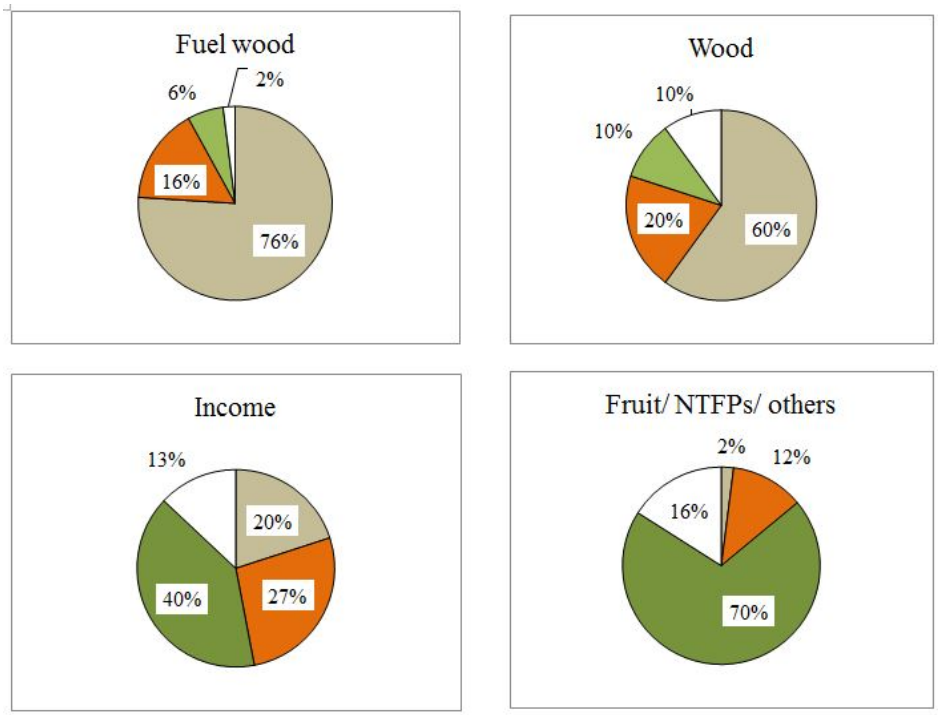

Fig. 3. Percent farmers responded on benefits parameters of tree species used in agroforestry.

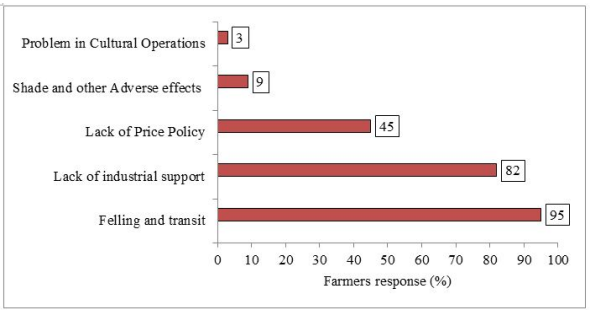

Fig. 4. Percent farmer's response on different constraints parameters identified during meeting with farmers (n=78).

their family and also for improving agriculture however, 2 to 13% farmers do not agree about the benefits of trees grown in agricultural fields (Fig. 3). As for as constraints of AF is concern, 95% respondent said permission for felling and transit as major problem while 82% farmers identified lack of industrial support as second constraint in the area (Fig. 4). Merely 3% farmers raised problem in cultural operations due to trees in agriculture field. Similarly, the present results concord with the findings of Dhyani and Handa (2013) who reported the lacking of well-defined regulations and guidelines related to harvesting, transportation and marketing of agroforestry produce as a major constraint of AF.

Conclusion

Indigenous tree species viz. *A. nilotica*, *Albizia spp*, *T. arjuna* and *B. monosperma* are dominated in different AF practices in Bilaspur district of Chhattisgarh, India due to its easier establishment, grows naturally and also fetch higher income to growers in short period of time compared to Teak and Shisham. Though the growing stock of AF in the district found poor because of the low tree density and regular removal of large size tree from fields by farmers for income and management point of view, there is scope for further expansion in context of climate smart agriculture and sustainability. The major constraints in adoption of commercial AF identified are problem in getting permission for felling and lack of industrial support. Until and unless these constraints are not resolved appropriately farmers continually exhibit reluctant towards agroforestry.

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