Role of agroforestry in poverty alleviation and livelihood support in Chhattisgarh

Abhishek Raj1,* Subhadra Chandrawanshi1

1Department of Forestry, College of Agriculture, I.G.K.V., Raipur- 492012 (C.G.), India
* Corresponding author: Abhishek Raj E-mail: ranger0392@gmail.com; Tel.: +91-8269718066

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Abstract
Agroforestry is a science of integrated farming system that is trees, crops and animals on the same land unit. This system has a tendency to provide maximum production as they are able to tap solar radiation and soil more efficiently. The recent agroforestry system involves land use pattern in such a way so as to obtain maximum production of food, fuel, fodder and other products and provide greater financial return. This article briefly reviews about the concept of agroforestry, its arrangements, preferable species, crop combinations and cultivation practices by the Chhattisgarh farmers, and agroforestry potentials to uplift economics rural area of Chhattisgarh. This is an attempt to compile and document information on different aspect of agroforestry to minimize poverty and to meet the other basic requirements by rural people.

Keywords: Agroforestry, farming system, fuel, fodder, poverty

1. Introduction:
Chhattisgarh is a tribal dominating state with geographical area of 135,191 km² which constitutes 4.1% of the land area of the country with 17° 47’ and 24° 06’ N latitude and from 80° 15’ to 84° 24’ E longitude. The region is divided into 3 agro climatic zones- viz., Chhattisgarh plains, Northern hills and Baster plateau. The annual rainfall varies from 1,100 mm to 1,700 mm and temperature ranges between 11°C to 47°C. It is one of the backward and poor areas of India in terms of poverty and productivity.

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., 2014a). As per Raj et al. (2014b) the soil biological attributes are also responsible for determination & maintenance of physical properties of soil. 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). Chhattisgarh adopted an agro-forestry policy in 2009 which includes marketing of agro-forestry products that it establishes a price floor and guaranteed market. It is an effective and alternative management system to meet the target of increasing forest cover to 33 % as given by the National Forest Policy 1952.

2. Facts and figures of Agro forestry potential:

According to WAC (2010), agro-forestry is a source of improving the livelihoods of small marginal farmers of Chhattisgarh 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 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.

3. Agro forestry arrangements and preferable tree species by farmers in Chhattisgarh:

Agroforestry may also give negative impact. However, the competition can be minimized by adopting suitable managerial practices. Majority of tree species are found in agricultural fields of Chhattisgarh which are Acacia nilotica, Butea monosperma, Terminalia arjuna, neem, Karanj etc. fruit trees like Carica papaya, Citrus spp, Mangifera indica, Psidium guajava because it provides fruit, medicine, wood and shelter as well as enhance the social and economic status of marginal farmers. MPTs in the region include Terminalia arjuna, T. tomentosa, Albizia procera, Mangifera indica, Butea monosperma, Zizyphus mauritiana, Azadirachta indica (neem) and Gmelina arborea grown on paddy field bunds (Jhariya et al., 2015). Further due to importance of neem in social forestry, agroforestry, reforestation and rehabilitation of the wasteland and degraded industrial lands it helps to combat desertification, deforestation and soil erosion and to reduce excessive global temperature (Jhariya et al., 2013).

Most prominent types of agroforestry system are agrisilviculture, silvopastoral and agri-silvopastoral arrangement. Also, agroforestry models in Bastar region are Agri-silviculture with one of the very good combinations of trees like Shorea robusta, Tectona grandis, Acacia spp, Phoenix sylvestris etc, Agro-silvopastoral with combination of crops with trees like Albizia spp, Leucaena leucocephala, Ficus racemosa etc and Agri-horti-silviculture practices with many fruit trees and multipurpose trees like Cocos nucifera,
Caraya papaya, Musa acuminate, Mangifera indica, Anacardium occidentale, Emblica officinalis etc (Hemrom and Nema, 2015).

4. Justification of Agroforestry for poverty alleviation and livelihood support in Chhattisgarh:

Chhattisgarh is physiographic, ecological and geological diversified which has greatly influenced soil, land-use pattern, water resources and appraisal of agriculture system. Although agro-forestry, as a science and practice, has the potential to secure the growing food insecurity, provides multiple outputs such as enhance farm production, income and employment opportunities to smallholders which increases rural living standards. Intensive agroforestry has certainly created investment and employment opportunities to supplement on the farm income (Saigal et al., 2002; Kareemulla et al., 2003). In Chhattisgarh state, Agri-horticulture model comprises combination of horticulture tree (Aonla) and field crops (groundnut and gram) and their different parameter of economic analysis (input/output) including total expense (tree+crops) per ha (86,494 Rs.), total benefits per ha (93,903 Rs.), net Benefit per ha. (7,410 Rs.), B: C ratio (1.09). Similarly, Agri-silviculture system comprises combination of tree species (Gmelina arborea) and field crop (paddy and linseed) and their economic parameters are total expense (tree+crops) per ha (69139 Rs.), total benefits per ha (119,997 Rs.), net benefit per ha. (50,858 Rs.), B: C ratio (1.74). These economic analysis are sufficient to measure socioeconomic potential of different agroforestry models and gives idea about whether this model be accepted or not (Government of India 2001). Related case study comprises Jatropha based plantation, lac cultivation, gum yielding tree and their contribution in agroforestry are studied. Jatropha curcas L., is a small tree or large bush belonging to the Euphorbiaceae family (Achten et al., 2008). As per Kheira and Atta (2009) its characteristics is suitable not only for oil production, but also for use as a live fence and for reclamation of eroded land. That’s why; small holding farmers are keen to plant and use Jatropha in agro-forestry model in Chhattisgarh state. Jatropha spp. is the source of rural employment (Jhariya et al., 2011). It has been estimated that Chhattisgarh aims at becoming a bio-fuel self-reliant state by 2015 with the decision of planting 160 million Jatropha saplings in all its 16 districts during 2006 (India eNews Pvt. Ltd, 2006). Therefore, Jatropha based intercropping systems has potential to improve the socioeconomic conditions in rural areas and to transform the National energy scenario and the ecological landscape (Raj et al., 2016).

India is having highest rank in lac production in the world and generally tree hosts for lac cultivation is ber (Zizyphus mauritiana) and palas (Butea monosperma). Chhattisgarh farmers are practicing lac based silvi-agri-lac system; broodlac of kusmi strain from the kanker forest division was inoculated on F. semialata and F. macrophylla after organic manure was added and irrigation, avoiding water logging. The data revealed gradual increase in height maximum 2.5 m in F. semialata and 2.4 m in F. macrophylla intercropped with oleic crop viz. Lycopersicon esculentum as summer crop. The system is maintained with regular irrigation and other cultural operation monitored (ICFRE, 2014). Thus lac cultivation is beneficial for upliftment of socio-economic status of farmers by source of income generation.

Gums and resins is an important of non-wood forest products. As per Abtew (2014) gum and resin income contributes to 14%–23% of the small-scale producers’ household income in the dryland of Ethiopia and Sudan. Gum yielding trees species such as Acacia senegal (yields gum Arabic) and Boswellia serrata (yields guggul gum) are potential species for agroforestry models in Chhattisgarh.

Moreover, gum trees are economically important and found in tropical moist and dry deciduous forests, produce a significant quantity of gum, which are widely used as industrial, food and medicinal purposes in India (Das, 2014). Gum production is a pillar of family economy and considered as an
income-generating source that requires only a low input of work after the rainy season (Raj et al., 2015). As per Painkra et al., (2015) India is a rich diversity centre of medicinal and aromatic plants and plays an important role in supporting health care system in India. The central India comprises, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Orissa, Jharkhand and Bihar and to some extent Gujarat and Rajasthan are major source of commercially important gums in good quantity and forms one of the major ecosystems of the Indian subcontinent and constitutes a large tract of tropical dry deciduous and tropical moist deciduous forest type (Raj and Toppo, 2014; Toppo et al., 2014). *Acacia nilotica* gum is known as ‘Indian gum Arabic’. It exudes from the wounds in bark. It generally exudes during March-May. It occurs in the form of rounded or ovoid tears and size up to 1cm and color varies from pale-yellow to brown or almost black (Raj, 2015a). Exploiting Babul tree for gum tapping will help farmers to strengthen their socioeconomic conditions as well as to help conserve environment and biodiversity too (Raj, 2015b).

5. Conclusion

Agroforestry is both economically and ecologically more complex form of land management than other forestry or agriculture systems. It plays a major role in providing both tangible and intangible benefits, tangible benefits like employment generation and increased farm income and intangible one includes ecological restoration which has been emphasized in respect of the various agroforestry systems. In Chhattisgarh there are many cultivation practices under agroforestry system like Jatropha plantation, lac cultivation, gum yielding trees etc., through which farmers are earning huge revenue side by side it also helps to strengthen their socio economic status. Several factors such as crop combination, crop interaction, selection of suitable species and management considerations gives positive impact on the ecological aspects as well as total yield and income of the farmers which helps for poverty alleviation and livelihood security by meeting the demand of fodder fuel and other basic requirements of rural farmer of Chhattisgarh.

Conflict of interest statement

We declare that we have no conflict of interest.

Reference