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## Prevalent agroforestry systems of Jharkhand state of India: A livelihood option

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The topography of Jharkhand state of India is generally undulating, with alfisols as major soil type. It is characterized by having light textured soil and high rate of soil erosion (Gulati and Rai, 2014). The soils are generally acidic in reaction with low activity of clay and rich in hydrated oxides of Iron and Aluminium leading to Phosphate fixation. These soils have sufficient Potassium content but deficiency of Nitrogen, Phosphorus and some micronutrients like Zinc and Boron are common. Soils of this state are having low organic carbon and low to medium in fertility status. Due to these conditions of soil, the agricultural productivity of the state is low and unprofitable. Under these conditions, the agroforestry can act as one of the best alternative options.

Agroforestry as a wide-spread land-use adaptation having a potential to support livelihoods through production of food, fodder, fuelwood and other Non-Timber Forest Products (NTFPs) as well as helps in mitigation and adaptation to climate change and also provides the employment opportunity to deprived and native people. Generally, trees or any woody perennials are used in agroforestry systems act as an agent to improve nutrient cycling and its retention by performing a number of functions which helps in resource conservation.

Forest is a major source to meet out the biomass requirement of tribals as well as non-tribal communities to a great extent which also provides nutritional and livelihood security. Efforts should also be made to rehabilitate surrounding forest areas through agroforestry interventions so as to meet out the fuel, fodder and timber requirements on the one hand it will also enhance area under forest cover. Farming system approach of land use must be replicated throughout the country with special emphasis on tribal farming systems, which are ecologically and economically viable.

Agroforestry, which is the inclusion of woody perennials in farming systems has been practiced as traditional land use and livelihood option in Jharkhand state of India since time immemorial. The Jharkhand state is

well known for its vast coal reserves and forest cover, which also includes the traditional agroforestry systems. The state is having 4.21 per cent of total geographical area under tree green cover in agroforestry (FSI, 2011). Among various states of Eastern India (Eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, Chhattisgarh, West Bengal and Asom), Jharkhand has the highest area under wastelands/ degraded lands (14.84%), followed by Asom (11.20%) and Odisha (10.69%) (World Bank, 2007). There is a need to restore those wastelands/degraded lands through agroforestry interventions in order to supply the increasing demands of food, fuel, fodder and timber requirements of rural folks in Jharkhand. Thus agroforestry serves as one of the option to tackle the problems of resource degradations and it's over exploitation in this state.

Some of the traditional agroforestry systems of Jharkhand are homestead garden, agrisilvicultural system including scattered tree (species like Acacia, Palas, Mahua, etc.) on agriculture fields. Farmers/ tribal people of the state also maintain homestead garden for vegetable, fruit, fodder, fuelwood, timber, shade and also for religious purpose (*Sarna* tribal community worships the tree). The traditional agroforestry systems have three to four vertical strata, the upper most strata consists of timber trees *viz.*, Chakundi, Bakain, Gamhar, Karanj, Shisham, Mahua, Teak, etc., in the next strata the fruit trees like Tamarind, Jackfruit, litchi, mango, amla, etc. are present. The third strata consists of banana, citrus, papaya, etc. and in the lowest strata vegetables (*viz.*, tomato, chilli, turmeric, onion, ginger, yam, etc.) are taken for utilization of all the available natural resources. Under higher elevations of Jharkhand agri-horticultural systems with fruit plants in field bund is a common practice. Now-a-days, farmers have started fast growing tree species like Gamhar, Bakain, Karanj, Semul, Khair, etc. in a scattered or in lines or on bunds or in the boundaries of the annual crops like paddy, niger, maize, millet, cowpea, pigeonpea, etc. for marginal/wasteland of the state. In silvipastoral system, planting of

fodder producing trees (*viz.*, Melia, Gamhar, Ficus, ber, *Neem*, subabul, etc.) for improving the carrying capacity

of the pasture/ grazing land have also been found. Agrisilviculture with Lac cultivation is an age old

**Table 1 : Lists of the traditionally grown forest tree species and its uses**

Species	Common/ Local name	Family	Uses
<b>Slow growing</b>			
<i>Azadirachta indica</i> A. Juss.	<i>Neem</i>	Meliaceae	Used as a pole, fuelwood, small Timber for furniture making, other Non-timber Forest Products (NTFPs), leaves as fodder, all parts of tree used as medicinal/ pesticide/ insecticide (e.g. used to protect grains, roots and tuber crops stored against potato moth/ any insects), used in cosmetics industries (oil, perfume, soap, etc.) and <i>Neem</i> cake is used as biopesticides
<i>Madhuca integrifolia</i> J.F.	Mahua	Sapotaceae	Timber is used in furniture making, leaves as fodder, all parts used as fuelwood, flower is edible food item for tribals and is also used for preparing local made alcoholic drinks, oil extracted from fruit is used as fuel oil and also in cosmetic industries, seed cakes obtained after extraction of oil constitute very good concentrated manure, several parts of the tree including the bark are used for their medicinal properties, tribals of Jharkhand also consider this tree as holy
<i>Pongamia pinnata</i> (L.) Pierre	Karanj	Fabaceae	Branches and stems are used as fuelwood, oil extracted from fruit is used as fuel oil ( <i>i.e.</i> biofuel) and also have medicinal value (for curing skin injury) and seed cakes obtained after extraction of oil constitute a very good manure
<b>Medium growing</b>			
<i>Artocarpus lakoocha</i> Roxb.	Barhal/ Dahu	Moraceae	All parts are used as fuelwood, timber is used in furniture making, leaves and fruits are used as fodder, fruits are edible to people, heartwood is locally used as medicinal purpose for skin treatment
<i>Dalbergia latifolia</i> Roxb.	Kala shisham	Leguminosae	Branches and stems are used as fuelwood, timber is used in furniture making, flooring and house construction, leaves are used as fodder
<i>Tectona grandis</i> Linn F.	Sagwan	Verbenaceae	All parts are used as fuelwood, timber is used in furniture making, flooring and house construction, leaves and are used as fodder, bark is used as medicine for curing swelling and relieving skin irritation
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae	Branches and stems are used as fuelwood, timber for furniture making, flooring and house construction, all parts are used as medicine, barks are used for curing heart diseases
<b>Fast growing</b>			
<i>Dalbergia sissoo</i> Roxb.	Shisham	Leguminosae	Branches and stems are used as fuelwood, timber for furniture making, flooring and house construction, leaves are used as fodder, various parts are used as medicine
<i>Gmelina arborea</i> Roxb.	Gamhar	Verbenaceae	Branches and stems are used as fuelwood, small timber is used as pole, large timber for furniture making, flooring and house construction, leaves and fruits are used as fodder
<i>Melia azedarach</i> L.	Bakain	Meliaceae	Used as a pole, stem and branches are used as fuelwood, small Timber is used for furniture making, leaves as fodder, all parts of tree used as medicinal/ pesticide/insecticide purpose, various parts of the tree are used to protect stored grains, roots and tuber crops, etc.

practice of the state, which is also the most important AFS in Jharkhand. The plant species like *Schleichera oleosa* (Kusum), *Zizyphus mauritiana* (Ber), *Butea monosperma* (Palas) and *Flemingia semialata* (Bara solpan) are most suitable for lac cultivation in agrisilvi system in Jharkhand. These plants are commonly found either on field bunds or in scattered patches in and around the hamlets.

The species (*Pongamia pinnata*, *Acacia catechu*, *Pterocarpus marsupium*, *Madhuca integrifolia*, *Azadirachta indica*, *Sapindus mukorossi*, *Embllica officinalis*, *Gmelina arborea*, *Dalbergia latifolia* and *Albizia procera*) are traditionally grown by the farmers of the state. Bakain (*Melia azedarach*), Teak (*Tectona grandis*) and Gamhar (*Gmelina arborea*) based agroforestry systems had been found very common in their farm land and even found to be suitable to grow on degraded/ wastelands. Some of traditionally grown forest tree species and their uses are listed in Table 1.

Bamboo based agroforestry systems are also found very common in the state (Sinha, 2009). Among the bamboo species like *Dendrocalamus strictus*, *Melocaena baccifera*, *Bambusa arundinacea*, *B. tulda*, *B. balcooa* etc. are the common in traditional boundary plantation. Bamboo shoots are consumed as vegetable by the tribals which one of the important sources of income for them. Sericulture is also an important source of income for tribal farmers in Jharkhand. Now-a-days, intercropping of mulberry (*Morus alba* L.) with pea and French bean in rainfed areas, particularly in Chotanagpur Plateau is being in practice (Tewary *et al.*, 2006).

In eastern India, water logging and salinity is one of the most wide spread problems. Agroforestry plays a vital role in rehabilitation of water logged and salinity affected areas by the agroforestry interventions where agroforestry species act as a biodrainage system, where the excess soil water gets drained out by deep rooted plants through the process so called bio-energy (Chauhan *et al.*, 2012). The fast growing trees and trees with deep tap root systems should be selected for effective management of such areas. Many fast growing species like *Dalbergia sissoo*, *Eucalyptus* spp., *Pongamia pinnata*, *Syzygium cuminii*, *Terminalia arjuna*, etc. are found to grow in the water logged conditions in Jharkhand.

Hence, traditional agroforestry systems of this state are providing sustainable benefits to the native farmers in terms of earning their livelihood. However there are few challenges the farmers face due to insufficient understanding of market structure of agroforestry products

which is a major hurdle in ensuring remunerative price to them. There is a need for more involvement of corporate and farmers co-operatives in this sector who can guide them, disseminate the novel technologies and various location specific improved agroforestry models. Also, there is a need to identify the plus trees or candidate trees based on selection of best phenotypes for further multiplication in a large-scale and to make available the quality planting stock (Hegde *et al.*, 2010).

Although the ecosystem services of different perennial species have already been established, the monetary gain from traditional agroforestry systems need to be highlighted for attracting small and marginal farmers for adoption of agroforestry along with the improved technology for sustainability. In this context, species with short gestation period should find a prominent place in different agroforestry systems in Jharkhand. Hence, there is an urgent need for strengthening research effort in identifying improved and qualitative planting stocks of suitable agroforestry species for the state. Strengthening of nursery programme for large-scale availability of quality planting materials of perennial trees can go a long way in rapid expansion of area under agroforestry systems in Jharkhand.

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