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Lac based agroforestry models for prosperity of farmers in Jharkhand

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Most farming families have adopted traditional farming systems such as plantations, homegardens and other practices like Sericulture and Lac cultivations as mean of their livelihoods. In Jharkhand, Lac production is mainly associated with various host plants which are mostly found in forest areas. However, new technologies have made it possible to adopt it for cultivation as well. Outcome of many researches and findings revealed that, Lac based agroforestry system has the potential to use the free time of the farmer, generate additional employment and get additional income. Thus, there is a huge scope to the Lac growers to improve their livelihood by adopting science, technologies and rural innovations; but at the same time, they can preserve and maintain the green cover of the earth.

INTRODUCTION

The supply of food, timber, firewood, fodder for animals and other NWFPs (Non-wood Forest Products) by agroforestry can not only improve the livelihood level of the people but also help in reducing the damage caused by climate change. Conventionally, trees are considered as agents to improve nutrient cycling and retention in agricultural ecosystems by performing a number of functions that helps in conservation of natural resources. Eastern region of India is about 22% of the total geographical area, but it maintains 34% human population and 31% livestock (Das *et al.,* 2016). This area is spread over eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, Chhattisgarh, West Bengal and Assam state. The part of the total area is under forest, which mostly caters to the need of biomass of tribal and non-tribal families which in long run leads to deforestation and environmental degradation (Das *et al.,* 2016; Sarkar *et al.,* 2017a, b & c; Shinde *et al.,* 2017; Das *et al.,* 2019a & b; Sarkar *et al.,* 2019a & b; Shinde *et al.,* 2019a & b; Sarkar, 2019). Hence, efforts should also be made to rehabilitate outside forest areas through agroforestry interventions so as to meet out the fuel, fodder and timber requirements on the one hand and to enhance area under forest cover on the other.

Farming system approach of land use must be replicated throughout the region with special emphasis on tribal farming systems, which are, by and large, ecologically and economically viable. This will ultimately help in increasing the forest area. Moreover, various agroforestry models including Lac based systems can be adopted to gain more profits by tribal farmers. Moreover, agroforestry has been practiced as traditional land use and livelihood option in Jharkhand since time immemorial. The 4.21 % of the total geographical area of Jharkhand is under tree green cover in agroforestry. Comparing the other states of eastern region, it has the highest area under wastelands (14.84%). Hence, there are scopes to intervene various agroforestry practices at the barren wastelands/degraded lands/ waterlogged areas

under rain-fed condition (Sarkar *et al.,* 2019c & d), keeping in view the average size of land holdings for agricultural production besides fuel, fodder and timber requirements of rural folk.

Features of agroforestry system

Soil productivity can be increased or maintained by choosing appropriate crops in agroforestry (Sarkar and Yadav, 2019). Following are some of the features of agroforestry:

1. Multipurpose trees/ woody plants should be selected for agroforestry.
2. There should be more than one farming component on the same land unit including forestry component.
3. Crops should be planted in multi-story or multi-tiered systems in such a way that there is less competition among plants for water, nutrients, sunlight and air.
4. Farmers should get regular income from this system.

Benefits of agroforestry

The following are the main benefits of agroforestry:

1. Reduces pressure on forest and preserves ecosystem.
2. Increases biological diversity by providing a favorable environment.
3. Increases recycling of nutrients at different depths within the soil.
4. The nutrient fixing component keeps the nutrients in the soil balanced.
5. Adding organic material to the soil improves its structure.
6. Reduces the total crop failure.
7. Increases production in unit area.
8. Brings overall improvement in livelihood, health and standard of living of rural people.

Traditional Agroforestry System of Jharkhand

Homestead gardens and scattered trees (like Acacia, Palas, Mahua, *etc*.) on agriculture fields, are some of the traditional agroforestry systems in Jharkhand. Under the agri-horticultural systems, fruit trees are planted on the field bunds in addition to crops. Cultivation of Lac, is a prevalent practice in the state but agrisilviculture with Lac cultivation is the most important agroforestry system being in their common practice. Kusum (*Schleichera oleosa*), Palash (*Butea monosperma*), Ber (*Zizyphus mauriatiana*) and hedge species like *Flemingia semialata* are the most suitable plants for Lac cultivation in the Agrisilvicultural system in Jharkhand (Sarkar *et al.,* 2017a & b).

For the livelihood improvement of the tribal farmers of the state, Lac-based integrated farming system model having components like Lac host, fruit plant and vegetable crops, had already been recommended. Lac worth rupees (₹.) 600 were received in a year from a plant of Palash. More than 400 lakhs of host plants are found all over the world (Sharma *et al.,* 2006). The trees like Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*), Ber (*Zizyphus mauritiana*) and *Ficus* spp. account for about 90 per cent of total Lac production in the country as host plants. It has been found that Lac cultivation is beneficial for upliftment of socioeconomic status of farmers because of income generation. Gum yielding trees species such as *Acacia Senegal* (gum Arabic) and *Boswellia serrata* (guggul gum) are having scope to introduce as potential species for agroforestry models in Jharkhand.

Lac based agroforestry model

Some Lac based agroforestry models are mentioned below:

1. *Flemingia semialata* + Papaya + Mango:

Planting of *Flemingia* plant can be done in paired row of 0.75 m distance and plant to plant distance 1.0 m. It should be planted in a triangular pattern. A distance of 2.0 meters should be maintained between its two pairs of rows in which a fruit plant can be planted. In this model, a total of 7200 *Flemingia* plants per hectare can be planted. The fruit plant can be planted in a ratio of 2:1 (Papaya : Mango), in which each papaya plant will be at a distance of 2 meters. The distance from mango to mango will be 4 meters. A total of 1200 papaya plants and 600 mango plants per hectare can be planted. After one year of planting, the *Flemingia* plant gets ready for Lac cultivation. The economic yield explains that this model is profitable with the B:C ratio of 3.65 during first year (Kumar, 2013).

2. *Flemingia semialata* + Papaya + Mango + Kusum:

In this model, a total of 7200 ***Flemingia***, 900 papaya, 450 mango and 450 Kusum can be planted in one hectare. The plant can be planted in a 2:1:1 ratio (Papaya : Mango : Kusum) with a distance of 2 meters between each row. Papaya plants will be 4 meters apart while the distance from mango to mango and Kusum to Kusum will be 8 meters (Kumar, 2013). The model has three components of income generation such as Lac, fruit and vegetable. This model is profitable from the first year itself (B:C ratio is 3.26 in the first year).

3. *Flemingia semialata* + Papaya + Mango + Kusum: In this model, a total of 5400 individuals of *Flemingia*, 433 papaya, 433 mango and 433 Kusum can be planted in one hectare. Income will start after three months with vegetable cultivation. The plants of *Flemingia* will be ready after one year for Lac inoculation in the month of July. The plant can be planted in a 1:1:1 ratio (Papaya : Mango : Kusum), with a distance of 2 meters between each row (Kumar, 2013).

Each similar species, papaya to papaya, mango to mango and Kusum to Kusum will be at a distance of 6 meters and alternate position in each row. Each line will be at a distance of 3.75 meters. It was reported that, the model has three components of income generation such as Lac, fruit and vegetable. This model is also profitable (B:C ratio of 2.68 during the first year), but is lower than the other two models as mentioned above.

4. *Flemingia semialata* + palas (*Butea monosperma*) + ber tree:

To promote livelihood opportunities for farmers, CAFRI introduced Lac-based farming system for Palash and ber trees for the semi-arid Bundelkhand region (Tewari *et al.*, 2013). Similar models are also being very widespread in the farmer's field of Jharkhand.

5. *Flemingia macrophylla + Dalbergia Sissoo*: An earlier experiment conducted on mean performance for height in *Flemingia macrophylla* showed that, in the control or open conditions (229.94 cm), there was almost twice the height of the plants grown compared to the shady condition (132.98 cm). The average 'scrap Lac' yield from the Aghani, Jethwi and Katki crop was reported as 166.64 g/plant, 105.36 g/plant and 81.47 g/plant, respectively, compared to the under-story method (63.63 g/plant, 27.58 g/plant and 17.00 g/plant, respectively).

Other systems

A) In some areas of Jharkhand, agroforestry systems like *Jatropha curcus* based, Lac cultivation based, gum yielding trees *etc*., through which farmers are earning a huge revenue that helps to strengthen their socio economic status.

B) In 0.42 hectare model of integrated farming systems (IFS) developed for each of the combinations *viz.,* Paddy + Lac + Fishery + Goat, Paddy + Vegetables + Lac + Duckry + Goat + Buffalo, Paddy + Vegetables + Lac + Goat + Cow + Poultry, and Paddy + Vegetables + Lac + Poultry + Cow yielded an annual net profit of ₹. 88,770 (B:C ratio of 7.39), ₹. 63,400 (B:C ratio of 5.04), ₹. 85,909 (B:C ratio of 7.81) and ₹. 65,090 (B:C ratio of 3.32), respectively. Whereas, from the IFS model of 1.25 hectares, the three farming system combinations, *viz.,* Paddy + Vegetables + Lac + Poultry, Paddy + Vegetables (potato and tomato) + Lac + Poultry, and Paddy + Vegetables + Lac + Goat + Buffalo had received an annual return of ₹. 1,02,000 (B:C ratio of 4.34), ₹. 1,08,440 (B:C ratio of 5.96) and ₹. 80,700 (B:C ratio of 7.34), respectively.

C) Palas (*Butea monosperma*) + Paddy based agroforestry system: It had also been reported that, the species, Palas has been planted on the ridge of the field in different parts of central India along with paddy crops, for cultivation of Lac which usually yields an annual return of ₹. 800 per tree.

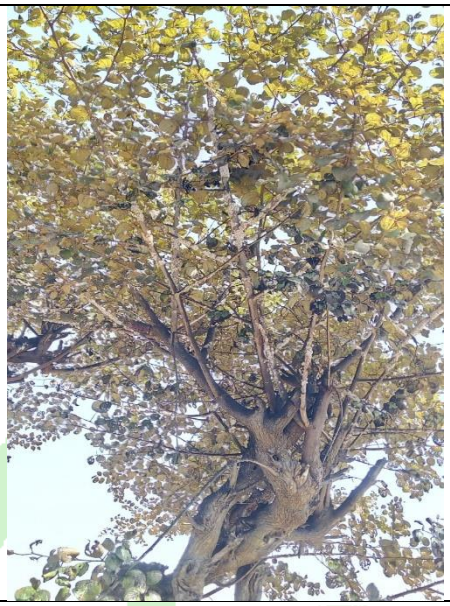
Management of Agroforestry

The farmer should have adequate knowledge on various aspects of agroforestry. Otherwise, training programme should be organized for the farmers from time to time. The farmer should especially be aware of the following aspects:

1. Host plants and the specific Lac producing insects
2. Season based Lac production technologies
3. Plant management techniques such as planting time, weed control, keeping the plantation cleaned, management of plant canopy by pruning, pest management, harvesting, processing, *etc.*

CONCLUSION

By adopting Lac based agroforestry models, the farmers can use their free time to get additional income and can generate additional employment. Thus, there is a huge scope to Lac growers to improve their livelihood by adopting science, technologies and rural innovations.

	
Distribution of broodlac to farmers	Lac cultivation on Ber (*Zizyphus mauriatiana*)

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