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Agroforestry: A Sustainable Agro-technique for Red and Laterite Zone of West Bengal

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Abstract—*Agroforestry is any sustainable land-use system that maintains or increases total yields by combining food crops with tree crops or livestock on the same unit of land, either alternately or at the same time, using management practices that suit the social and cultural characteristics of the local people and the economic and ecological conditions of the area. Crop production on red and laterite soil under rainfed condition is low and unstable, and often uneconomic for aberrant monsoon behaviour. It is estimated that nearly 50 % of the western part of West Bengal under rainfed cultivation are facing some kind of land degradation and highly erosion prone and remain perpetually unutilized. These marginal lands are not able to sustain arable crops particularly during the drought years. This system makes maximum use of the land and every part of the land is considered suitable for useful plants. We can get food, fuels, fodder, fibers, wood in a same piece of land which not only helps to maintain our good health but also generating employment especially during the off-season when the crops are not cultivated. So, in view of that there is an urgent need to intervention of agroforestry system in this red and laterite zone of West Bengal*

Keyword*: Agroforestry, sustainable, land use systems, West Bengal.*

1. INTRODUCTION

Agroforestry is an age old practice followed in some form or other in different parts of the world. Agroforestry encompasses promotion of components like woody perennials, crops, livestock and other natural resources in temporal and spatial sequences, which will ultimately alter livelihood options and sustainability. It is a dynamic, ecologically based, natural resource management practice that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits [5].

Red and lateritic soils are one of the most important soil groups of India occupying 107 million ha, approximately one third of the cultivated area of the country. Aberrant monsoon behaviour under rainfed condition in Red and Laterite zone of West Bengal results in poor crop yields and make crop production unstable and sometime uneconomic. Red and Lateritic soils are low in organic matter and poor in their N, P and K contents; characterized by low water holding capacity and are prone to erosion, such lands have shallow soil depth and gravels. Poor management of marginal lands on the topmost tier of the undulating topography of these soils also results in land degradation. For profitable and sustainable cultivation some alternate land use systems are needed to be developed for this zone. Agroforestry that integrates cultivation of arable crops, fruit trees and forest tree component could be an alternative land use system for these lands.

2. CONCEPT OF AGROFORESTRY

Agroforestry systems make maximum use of the land. Every part of the land is considered suitable for useful plants. Emphasis is placed on perennial, multiple purpose crops that are planted once and yield benefits over a long period of time [2]. Such benefits include construction materials, food for humans and animals, fuels, fibers, and shade. Trees in agroforestry systems also have important uses such as holding the soil against erosion and improving soil fertility (by fixing nitrogen or bringing minerals from deep in the soil and depositing them by leaf-fall). The most common interaction is competition, which may be for light, water, or soil nutrients. Competition invariably reduces the growth and yield of any crop. Yet competition occurs in monoculture as well, and this need not be more deleterious in Agroforestry than monoculture systems. Agroforestry systems may be thought of as principle parts of the farm system itself, which contains many other sub-systems that together define a way of life.

3. COMPONENTS OF AN AGROFORESTRY SYSTEM

3.1 Land

Agroforestry is not a system of pots on a balcony or in a greenhouse. It is a system by which land is managed for the benefit of the landowner, environment and long-term welfare of society. While appropriate for all landholdings, this is

especially important in the case of hillside farming where agriculture may lead to rapid loss of soil.

3.2 Trees

In Agroforestry, particular attention is placed on multipurpose trees or perennial shrubs. The most important of these trees are the legumes because of their ability to fix nitrogen and thus make it available to other plants. Apart from legumes, fruit trees, vegetables plantation crops can also be include in this system. In order to plan for the use of trees in agroforestry systems, considerable knowledge and desirable information for each species is necessary which includes its benefits, adaptability to local conditions (climate, soil, and stresses), the size and form of the canopy, root system and suitability for various Agroforestry practices.

4. FEATURES OF AGROFORESTRY

Agroforestry practices are intentional systematic combinations of trees with crops and/or livestock that involve intensive management of the interactions between the components as an integrated agro ecosystem. These key features are the essence of Agroforestry and are what distinguish it from other farming or forestry practices. To be called Agroforestry, a land-use practice must satisfy following criteria:

- Intentional
- Intensive
- Interactive
- Integrated

5. TRADITIONAL AGROFORESTRY SYSTEMS IN INDIA

Agroforestry systems vary enormously in their structural complexity and species diversity, their productive and protective attributes and their socio-economic dimensions. They range from apparently simple forms of shifting cultivation to complex home-gardens. Most of these are anecdotal but in some enough research efforts have been carried out in recent times [6].

5.1 Different system are as follows

- Shifting cultivation
- Taungya system
- Plantation based Agroforestry systems
- Trees on farm-boundaries
- Home-gardens/homesteads Cultivation

6. AGROFORESTRY FOR SOIL CONSERVATION, ENHANCING SOIL FERTILITY AND WATER USE EFFICIENCY

In West Bengal, particularly Red and Laterite zone are critically affected by serious wind and water erosion. Afforestation with suitable tree species like *Acacia nilotica, Azadirachta indica, Butea moonosperma. Prosopis juliflora, Dalbergia sissoo, Tectona grandis, Bambusa spp.* and *Dendrocalamus* and other adaptable species such as grasses like *Dichanthium annulatum, Bothriochloa pertusa, Cynodon dactylon* and *Sehima nervosum* will help in soil conservation [8]. Maintenance and enhancement of soil fertility is vital for the global food security and environmental sustainability. Tree species have potential to conserve moisture and improve fertility status of the soil in agroforestry systems, legumes are the most effective for promoting soil fertility. In addition, deep rooted species could reduce competition for nutrients and moisture with crops by pumping from deeper layers of soil.Agroforestry may hold promise for regions where success of green revolution is yet to be realized due to lack of soil fertility. Trees with their comparatively deeper root system improve ground water quality by taking up the excess nutrients that have been leached below the rooting zone of agricultural crops. There is robust evidence that agroforestry systems have potential for improving water use efficiency by reducing the unproductive components of the water balance (run-off, soil evaporation and drainage).

7. BENEFITS FROM AGROFORESTRY

Table 1: Environmental, Economic and Social Benefits

Environment Benefits	Economic Benefits	Social Benefits
(i) Better protection of ecological systems.	(i) Increment in an maintenance of outputs of food, fuel wood, fodder, fertilizer and timber.	(i) Improvement in rural living standards from sustained employment and higher incomes.
(ii) More efficient recycling of nutrients by deep-rooted trees on the site.	(ii) Reduction in incidence of total crop failure, common to single-cropping or monoculture system.	(ii) Improvement in nutrition and health due to increased quality and diversity of food outputs.
(iii) Improvement of microclimate and increment in soil nutrients through addition and decomposition of litter-fall.	(iii) Increase in levels of farm incomes due to improved and sustained productivity.	(iii) Stabilization and improvement of upland communities through elimination of the need to shift sites of farm activities.

Source: [8,4,9].

8. LIMITATIONS OF AGROFORESTRY

Table 2. Environmental and Socioeconomic Aspects

Environment Aspects	Socioeconomic Aspects
(i) Possible competition of trees with food crops for space, sunlight, moisture and nutrients which may reduce food crop yield.	(i) Longer period required for trees to grow to maturity and acquire an economic value and required more labour inputs.
(ii) damage to food crop during tree harvest operation.	(ii) Competition between food and tree crops, which could cause aggregate yields to be lower than those of a single crop
(iii) Potential of trees to serve as hosts to insect pests that are harmful to food crops.	(iii) The fact that agroforestry is more complex, less well understood and more difficult to apply, compared to single-crop farm.

Source: [3].

9. SCOPE OF AGROFORESTRY

According to Puri and Nair (2004) the following scope of Agroforestry system discussed below

- ❖ Controlling poverty through increased income by higher production of Agroforestry products for home consumption and market.
- ❖ Empowerment to women farmers and other less-advantaged rural residents whose rights to land are insecure through better negotiations.
- ❖ Reducing deforestation and pressure on forest by providing fuel wood grown on farms.
- ❖ Improving soil health of the farm through ameliorated micro-climate and nutrition level.
- ❖ Augmenting accessibility to medicinal trees for cure of common and complex diseases.

Table -3. Yield (t/ha) of different intercrops as affected by system of cropping and spacing during rainy (kharif) season 2008
Intercrop

Intercrop	Sole cropping	*Bambusa tulda*		*Bambusa balcooa*	
		10 × 10 m	12 × 10 m	10 × 10 m	12 × 10 m
Rice	1.95	1.80	1.88	1.85	1.90
Groundnut	1.57	1.34	1.45	1.40	1.47
Pigeon pea	2.20	1.92	2.10	1.98	2.17
Cowpea	5.20	4.89	5.11	4.95	5.15
Lady's finger	7.50	6.95	7.10	7.05	7.12
Bottle gourd	11.50	10.00	11.01	11.15	11.11
Turmeric	25.05	21.90	24.00	22.16	24.52
Colocasia	30.50	28.47	29.65	28.50	29.71
Elephant Foot Yam	52.50	49.00	50.10	49.57	51.25

Source: [1]

There is still a substantial need to promote bamboo based agroforestry systems as well as utilization of bamboos to the extent possible.

- ❖ There are some following models which can also be applied in the agroforestry system providing livelihood security and higher income to the poor farmers for red & laterite zone of West Bengal.

Model 1

Lamboo+ Mango + Pigeon pea
Lamboo+ Mango + Maize followed by Mustard
Lamboo+ Mango + Lady's finger followed by Mustard
Lamboo+ Mango

Model 2

Bamboo + Rice
Bamboo + Pigeon pea
Bamboo + Black gram
Bamboo + Bottle gourd
Bamboo + Turmeric
Bamboo + Ginger
Bamboo + Elephant foot yam

Model 3

Gamhar + Mango + Pigeon pea
Gamhar + Mango + Maize fallowed by Mustard
Gamhar + Mango + Groundnut fallowed by Mustard
Gamhar + Mango + Bottle gourd fallowed by Mustard
Eucalyptus + Mango + Pigeon pea
Eucalyptus + Mango + Maize fallowed by Mustard
Eucalyptus + Mango + Groundnut fallowed by Mustard
Eucalyptus + Mango + Bottle gourd fallowed by Mustard
Gamhar + Mango
Eucalyptus + Mango

10. CONCLUSION

So far as different fruit-based agroforestry system models are concerned it may be concluded that Gamhar + Mango + Legume crops are the best with respect to improvement for soil health; Gamhar + Mango + Vegetable in *kharif* followed by Mustard/ any crops in *rabi* of agro-production system can profitably be grown in rainfed uplands under Red and Leterite zone and in New Alluvial zone of West Bengal which are supposed to improve and maintain good health of that local people throw filling up the deficiency of nutrients by fruits and vegetables. The improvement in soil fertility indicate that there is an immediate need for development of agriculture in rainfed areas together with trees like Gamhar (*Gmelina arborea*), *Eucalyptus tereticornis*, Kadam (*Anthocephalus cadamba*) and Lamboo (*Dysoxylum binectariferum*) fruit

crops like Mango, Guava, Ber, different crops like pulses, oilseed crops and vegetable crops like okra and bottle gourd for attaining maximum and sustainable gross monetary returns under erosion prone areas of West Bengal for marginal and resource-poor farmers.

REFERENCES

[1] Banerjee, H, Dhara, P. K. and Mazumdar, D. 2009. Bamboo (*Bambusa spp*.) based agroforestry systems under rainfed upland ecosystem. *Journal of Crop and Weed*, 5(**1**): 286-290

[2] Chundawat, D.S. and Gautam, S.K. 1999. A text Book of Agroforestry Oxford& IBH, New Delhi.

[3] Dhyani, S. K. and Tripathi, R. S. 1998. Tree growth and crop yield under agrisilvicultural practices in north-east India. *Agrofor. Syst*., **44**, 1–12.

[4] Kang, B.T., Reynolds, L. and Atta-krah, A.N. 1990. Alley Farming advances in Agro-forestry. *Agroforestry Sys.* **43**:315-359.

[5] Leakey, R. 1996. Definition of Agroforestry Revisited. Agroforestry, Today 8 (**1**) : 5-7.

[6] Nair, P.K.R. Classification of Agroforestry Systems. Agroforestry Systems. **3**: 97-128.

[7] Puri, S. and Nair, P.K.R. 2004. Agroforestry research for developmentin India: 25 years of experiences of a national program. *Agrofor. Syst*., 61/62, 437–452.

[8] Tewari, S. K. 2008. Farm Forestry in Agroforestry. Agro-forestry Project

Dept. of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar.

[9] Young, A. 1986. Effects of Trees on Soils. In Amelioration of soil by Trees. Commonwealth Science Council, Longon. Technical Publication 190:28-41