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# National Agroforestry Policy in India: a low hanging fruit

S. B. Chavan\*, A. Keerthika, S. K. Dhyani, A. K. Handa, Ram Newaj and K. Rajarajan

Since ages agroforestry has been known as a traditional land-use system in India. The multivarious benefits and services generated are recognized as a tool to improve the livelihood status of farmers. Commercial agroforestry gained momentum in the regions where it got support from industry and assured market facilities. However, lack of policy initiatives and strict trade regulations has not supported wide adoption of agroforestry. Though prominent agroforestry models are being developed in different parts of the country, there is no clear-cut mechanism from seed procurement to marketing of the products. In this context, the National Agroforestry Policy, 2014 came in limelight to address the issues of quality planting material, tree insurance, restrictions on transit and harvesting, marketing of agroforestry produce, research and extension. This article links highlights of the policy to existing successful ground-level schemes and the challenges to focus on agroforestry not only as a successful land-use system, but also to utilize its full potential in the economic development of the country.

**Keywords:** Agroforestry policy, public private partnership, sustainability, tree insurance.

AGROFORESTRY – a judicious integration of tree species with agricultural crops and/or animals has been practised since ancient times across the world in both the tropics and temperate regions. Traditionally, people resorted to agroforestry practices for the inter-dependent benefits of the three components, viz. trees, crops and livestock in addition to the 6Fs, i.e. food, fruit, fodder, fuel, fertilizer and fibre. The nutrient cycling exchange and positive spill-off effects of each component brought sustainability to farm production mechanisms. Most of the agroforestry systems are part of indigenous traditional knowledge of local communities. These systems vary from one part of the country to another due its diverse climatic conditions. The prominent traditional systems like shifting cultivation, taungya and homegardens have evolved long ago. The shifting cultivation, i.e. sequential agroforestry system, believed to have originated in the Neolithic period around 7000 BC, is still extensively practiced in the North Eastern Hill (NEH) region and other humid and hilly parts of the Indian subcontinent<sup>1</sup>. The taungya system, a method of establishing forest species in temporary combination with field crops, was attempted in the Indian subcontinent soon after its first introduction by Brandis in Burma in 1856. Apart from these systems, others which

perform ecological as well as social functions for rural subsistence, the khejri-based system for arid ecosystem and alder-based systems in the northeastern Himalaya, evolved as a part of the human evolution for sustainability without much research.

The organized efforts in agroforestry research in India began in 1983 by the Indian Council of Agricultural Research (ICAR) with the establishment of All-India Coordinated Research Project on Agroforestry (AICRP-AF; 1983) and later the establishment of the National Research Centre for Agroforestry (NRCAF; 1988), which has now been upgraded as the Central Agroforestry Research Institute (CAFRI; 2014), Jhansi. These efforts resulted in collection and evaluation of germplasm of multipurpose tree species and development of location-specific agroforestry technology for different agro-climatic zones of the country such as *Grewia optiva* and *Morus alba*-based system for the Himalayan zone; poplar-based system for the Indo-Gangetic plains; *Hardwickia binata* and *Ailanthus excelsa*-based system for arid and semi-arid zones; *Acacia mangium* and *Gmelina arborea*-based system for humid and sub-humid zones and *Tectona grandis*-based system for tropical zone<sup>2</sup>.

There are a number of studies from different parts of the country suggesting that agroforestry is more profitable to farmers than agriculture or forestry for a particular area of land. A comprehensive analysis indicated economic viability with internal rate of return (IRR) ranging from 25 to 68 and B : C ratio of 1.01 to 4.17 for 24 agroforestry systems from different agroclimatic regions of

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the country<sup>3</sup>. Agroforestry models adopted by farmers in the Upper Gangetic region and especially in Haryana, Punjab and western Uttar Pradesh are highly lucrative, thus attracting farmers in a big way. In these areas poplar planted on agricultural fields and field boundaries is harvested at 6 to 8 years rotation, and the average economic return of poplar-based agroforestry systems is high compared to that of sole agriculture crop. Ram Newaj and Rai<sup>4</sup> analysed 13 years aonla-based agroforestry system in marginal lands under rainfed conditions and found a B : C ratio of 3.28 (on discounted rate it was 2.61), which indicated its profitability. Similarly, there are a number of studies indicating profitability of the systems. However, in most of the economic analysis of agroforestry systems, attempts have been made for accounting only the cost of inputs and outputs in material terms. But the cost of goods and services produced by the agroforestry systems in temporal and spatial dimensions has been left out. Therefore, more comprehensive analysis will have to be undertaken in future.

However, in modern times, the intangible benefits often referred to as ecosystem services rendered by the agroforestry systems have been widely recognized in different countries. These services include microclimate moderation, biodiversity conservation, carbon sequestration, protecting water sources, soil erosion and pollution control. It is a well-known fact that agroforestry is mentioned by IPCC as one of the instruments to fight climate change. Agroforestry systems have the potential for being an effective tool in climate change mitigation and adaptation steps<sup>5</sup>. Agroforestry practices are also linked with economic aspects of farmland production. Studies reveal that these agroforestry systems have the potential to generate employment opportunities of 450 man-days per hectare per year<sup>6</sup>.

In spite of multiple benefits from agroforestry practices, majority of farmers have been hesitant to adopt these systems on large scale primarily because of certain apprehensions about the tree component such as long rotation, reduction in gross area and complicated legal procedures involved in tree farming trade and market fluctuations. As a result, tree component on farmlands has often been restricted, which is evident from the global report on assessment of tree cover on agricultural land, which reveals 10% tree cover in just 48% of agricultural land<sup>7</sup>. In recent times, agroforestry has received more attention due to diversified outputs, sustained agricultural productivity, diverse incomes, moderation in climate aberrations and technological interventions led by research institutions and private organizations. One of the major concerns in large-scale adoption of agroforestry in spite of the huge potential is the lack of a well-defined set of regulations and guidelines related to harvesting, transportation and marketing of agroforestry produce<sup>8</sup>. Agroforestry finds a place in the National Agricultural Policy, 2000, wherein it is underlined that 'farmers will be

encouraged to take up farm/agroforestry for higher income generation by evolving technology, extension and credit support packages and removing constraints to development of agroforestry'. The Government of India (GoI) has launched several schemes/projects like the National Bamboo Mission (NBM) under the Ministry of Agriculture, GoI, Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM), National Biofuel Policy, etc. wherein integrating forestry components on farmlands has been given the much needed thrust. The National Bank for Agriculture and Rural Development (NABARD) provides financial and banking institutional support for social forestry, farm forestry and afforestation of wastelands. An initiative of agri-horticulture programme by an NGO, Bharatiya Agro-industries Foundation (BAIF), is another successful model (Box 1). Similarly, the National Medicinal Plants Board (NMPB) under Ayurveda, Yunani, Siddha and Homeopathy (AYUSH), GoI has laid emphasis on integrating medicinal plants and trees along with agricultural crops. Establishment of silvi-pastoral systems and fodder blocks/banks has been envisaged in various schemes operated by the Animal Husbandry Department. The National Afforestation and Eco-development Board (NAEB) under the Ministry of Environment, Forests and Climate Change, GoI is also promoting agroforestry practices on farm and wastelands. In addition to these schemes, State Governments also have schemes/projects that promote agroforestry. Thus, there have been some scattered efforts to bring more focus on agroforestry practices. However, the lacuna of not having an exclusive policy for agroforestry at the national level has hampered its adoption on a wider scale. In addition, agriculture is a state subject and forestry falls under concurrent list. The complicated and cumbersome legal procedures and hurdles involved in growing, felling, transportation and marketing of tree

#### Box 1. Wadi model: a livelihood programme

Wadi programme initiated by BAIF Development Research Foundation in south Gujarat in the 1980s, further expanded to different tribal regions of India. It is an agri-horti-silvi model spread over Maharashtra, Gujarat, Karnataka, Uttar Pradesh, Uttarakhand, Rajasthan, Madhya Pradesh, Chhattisgarh, Bihar, Andhra Pradesh and Jharkhand. For example, horticulture crops such as amla, mango (10 × 10 spacing), and cashew (7 × 7 spacing) with intercrops grown in these spaces and trees like gliricidia, subabul planted in closer spacing in the border in an area of 0.4–1.0 ha. So far, BAIF has assisted over 1.81 lakh families to establish 68,586 ha wadi. This concept is a comprehensive programme for natural resource management; adoption of sustainable farming practices uplifts the rural communities providing livelihood security (source: [www.baifwadi.org/](http://www.baifwadi.org/)).

species have only added to the woes. Markets and market information are not well established in all places as far as tree components are concerned. Non-uniformity in legal aspects and financial prospects across different states of the country also makes it difficult for many farmers to integrate trees into their cropping systems.

### Agroforestry policy initiatives at the world level

However, keeping in view the significant role that agroforestry plays in sustainable food production, ecosystem services and economic benefits, it is imperative to have a separate policy that exclusively sets in the framework for development of agroforestry as a key to sustainable farm production. The benefits and services produced by these systems are well documented and supported by several policy initiatives undertaken worldwide by different countries like many European nations, Kenya, Malawi, etc. The main goal of all these policies is to reduce the risk while increasing returns on small holder investments. A working paper on 'Advancing agroforestry on the policy agenda' Food and Agriculture Organization<sup>9</sup> mentioned about different policy initiatives in the world. In Malawi, the National Steering Committee on Agroforestry (NSCA) functions as an extension organ in disseminating success stories at field level, and checks and removes hurdles in the unsuccessful technologies. The European Commission has a separate Article on agroforestry and provides subsidies for agroforestry plots of less than <50 trees/ha as baseline. Procedures for timber harvesting in agroforestry have been simplified in Guatemala

Forest Act, 1996. The Programme of Forestry Incentives for Owners of Small Plots of Land Used for Forestry and Agroforestry (PINPEP), Republic of Guatemala, a Central American Country promotes introduction of trees on small farms (less than 15 ha) owned by small-scale producers. In recent times, the Kenyan Government, under its Ministry of Agriculture has framed new rules that at least 10% of all farms are to be covered with trees. In 2011, the United States Development Agency (USDA) developed a strategic framework for agroforestry for the period 2011–16 for strengthening agroforestry research and extension. In India, major policy initiatives, including the National Agricultural Policy, 2000; National Forest Policy 1952, 1988; National Bamboo Mission, 2002; Green India Mission, 2010, etc. emphasized the role of agroforestry for sustained productivity and to achieve the goal of 33% forest cover. Chhattisgarh has taken the initiative on agroforestry policy to alleviate poverty and provide an alternate source of income to farmers. Madhya Pradesh has also started a 'Lok Vaniki' scheme to manage forests on private land in the year 1999 (Box 2). In other states also some efforts have been made to facilitate tree planting on field bunds and homesteads by issuing guidelines in this regard. In a broader term, the policy is formulated to address issues like food security, nutrition, employment generation, energy requirement, land degradation, soil and water conservation, climate change mitigation and adaptation, market facility and to establish industrial linkage mainly focusing on small farmers.

### National Agroforestry Policy, 2014

The World Congress on Agroforestry with the theme 'Trees for Life' was organized in February 2014 at New Delhi to have a forward outlook to any constraints that might restrict the adoption of agroforestry practices. More than a thousand delegates from 80 countries around the world attended the Congress, wherein the President of India launched the much-needed National Agroforestry Policy (NAP), 2014 first of its kind in the world<sup>10</sup>. NAP, 2014 is as recognition to the professionals who have spent half a century of research and documentation and thereby made agroforestry an integrated science, in addition to those communities who have been practising some form of agroforestry systems traditionally. Moreover, NAP, 2014 is a path-breaker in making agroforestry an instrument for transforming the lives of the rural farming population, protecting ecosystem and ensuring food security through sustainable means. The major highlights of the Policy are: establishment of institutional set-up at the national level to promote agroforestry under the mandate of the Ministry of Agriculture, GoI; simplify regulations related to harvesting, felling and transportation of trees grown on farmlands; ensuring security of land tenure and creating a sound base of land records and data for

#### Box 2. Lok Vaniki in Madhya Pradesh: a scheme for management of private forest

It is a scheme launched in 1999 for promotion of scientific management of degraded forest on private lands by farmers that will act as a vehicle for providing employment opportunities, ecological and economic development and poverty alleviation. Initially this scheme was implemented in four districts, and later extended to 10 districts; now it covers 45 districts of the state. Under this scheme, chartered foresters will be engaged to prepare separate management plans. As of now 749 management plans have been prepared out of which 613 have been sanctioned by competent authority. More than 23,707 farmers have been sensitized by conducting training, workshops, conferences and study tours. For example, in Hosangabad district, a farmer gets an annual income of Rs 97,705 in 3.05 ha area. In addition, quality planting material is being supplied. Lok Vaniki Kisan Sangh, a voluntary society of tree growers has attempted certification of timber produce by Forest Steward Council (FSC); source: mpforest.org/lokvaniki.html.

developing an market information system (MIS) for agroforestry; investing in research, extension and capacity building and related services; access to quality planting material; institutional credit and insurance cover to agroforestry practitioners; increased participation of industries dealing with agroforestry produce, and strengthening marketing information system for tree products. Initially 20 important multipurpose tree species have been identified at the national level to be exempted from all restrictions related to harvesting, transportation and marketing grown under agroforestry systems.

One of the objectives of NAP, 2014 is to bring together various programmes, schemes, missions among the elements of agroforestry under one platform functioning in various departments of agriculture, forestry and rural sectors of the government. It is proposed to be achieved through setting up of a National Agroforestry Mission/Board under the Department of Agriculture and Co-operation (DAC), Ministry of Agriculture, GoI and upgrading of NRCAF, Jhansi (now CAFRI, Jhansi) as a nodal centre with agro-ecology-based regional centres in different parts of the country. This step will promote value chain, climate-resilient technology development and pave the way for region-based marketing linkages in agroforestry. The Policy also suggests massive extension programmes in order to broadcast the outcomes of intensive R&D activities in the field of agroforestry.

### Area under agroforestry in India

Though agroforestry is being practised in large parts of the country in one or another and has been adopted by the farmers in different agro-climatic zones, periodic estimation and monitoring of the area under it is still a challenging task due to lack of uniform methodology adopted by the different agencies<sup>11</sup>. The current approximate area under agroforestry is estimated to be 25.32 m ha, or 8.2% of the total geographical area of the country according to Dhyani *et al.*<sup>12</sup>. Based on data from CAFRI, Jhansi and Bhuvan LISS III, the area under agroforestry is 13.75 m ha<sup>13</sup>. However, Forest Survey of India (FSI; 2013) estimated the same as 11.54 m ha, which is 3.39% of the geographical area of the country<sup>14</sup>. Maharashtra, Gujarat and Rajasthan rank high in state-wise area under agroforestry. The area estimation according CAFRI, Jhansi and FSI, Dehradun is shown in Figure 1. The estimation by FSI does not include many agroforestry practices such as block plantations, thus reflecting lower values than CAFRI. The differences in the approximate figures by the two different organizations necessitated uniform and accurate assessment methods based of remote sensing and GIS application. Further, fine-tuning of area for a particular agroforestry system like agri-silviculture, silvi-pasture, agri-silvi-horticulture, traditional systems, area under a particular tree-based system is also to be

looked into and it will be a challenging task for research organizations. This can be achieved by developing digital signatures for all the important agroforestry tree species.

### Challenges in implementation of NAP, 2014

#### *Unified regulatory regimes for agroforestry*

The restrictions imposed on harvesting, transportation and marketing of agroforestry produce play a significant role in the minds of the farmer looking to adopt agroforestry. There are many common species which grow naturally in the forest areas and are well adapted to local regions and also grown by the farmers under agroforestry systems. There is an urgent need to remove these regulatory restrictions at least for those species which are widely adopted under agroforestry systems and providing raw material to the wood-based industries. The Bansal Committee (constituted by the Ministry of Environment, Forests and Climate Change, GoI in July 2011 to study the regulatory regime, felling and transit regulations for tree species grown on non-forest/private lands) recommended relaxation in transit and felling permission for the species preferred by the farmers and agroforesters. Implementing this action plan in the Policy will encourage active participation of farmers and help in achieving

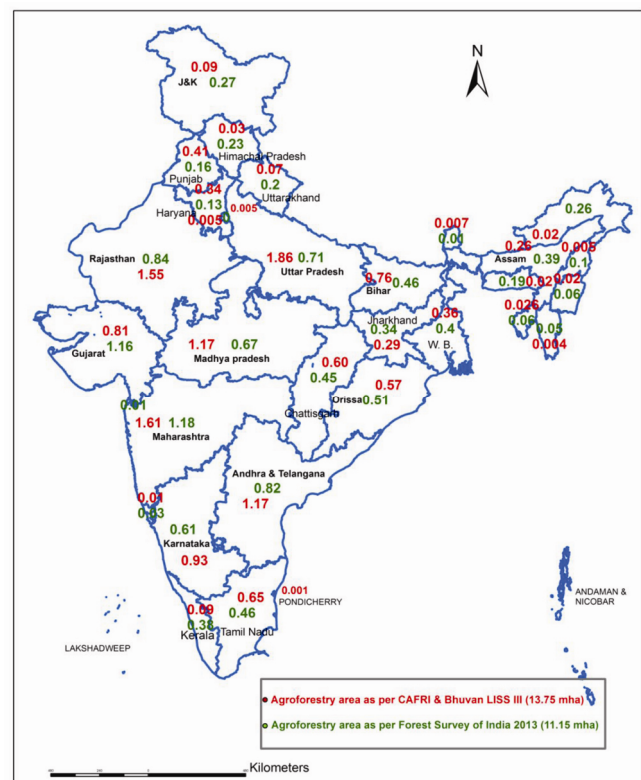


Figure 1. Agroforestry area (m ha) in India (CAFRI, Jhansi<sup>13</sup> and FSI, Dehradun<sup>14</sup>).

## GENERAL ARTICLES

**Table 1.** List of exempted and restricted tree species from different states of India

State	Exempted (no permission)	Restricted species (permission required)
Tamil Nadu	<i>Grevillea robusta</i> , <i>Eucalyptus</i> spp., <i>Casuarina equisetifolia</i> and <i>Leucaena leucocephala</i>	<i>Santalum album</i> , <i>Diospyros melanoxylon</i> , <i>Pterocarpus santalinus</i> , <i>Dalbergia latifolia</i> and <i>Tectona grandis</i>
Kerala	61 species permitted. Some of the important ones are <i>Pongamia pinnata</i> , <i>Hevea brasiliensis</i> , <i>Ailanthus excelsa</i> , <i>Mangifera indica</i> , <i>Garcinia cambogia</i> and <i>Terminalia</i> spp.	<i>Santalum album</i> , <i>Tectona grandis</i> , <i>Dalbergia latifolia</i> , <i>Xylia xylocarpa</i> , <i>Hopea parviflora</i> , <i>Michelia champaca</i> , <i>Grewia tiliifolia</i> and <i>Toona ciliata</i>
Punjab and Haryana	<i>Eucalyptus</i> , poplar and <i>Melia composita</i>	<i>Acacia catechu</i> , <i>Embllica officinalis</i> and bamboo
Uttar Pradesh	Poplar, eucalyptus, subabul., <i>Casuarina</i> , <i>Ailanthus</i> spp., <i>Gmelina arborea</i> , <i>Grevillea robusta</i> , <i>Morus alba</i> , <i>Anthocephalus cadamba</i> , <i>Melia composita</i> , <i>Acacia</i> spp., <i>Albizia</i> spp., <i>Borassus flabeliformis</i> , <i>Butea monosperma</i> , <i>Tamarindus indica</i> and <i>Grewia oppositifolia</i>	<i>Mangifera indica</i> , <i>Madhuca indica</i> , <i>Ficus bengalensis</i> , <i>Azadirachta indica</i> and <i>Carpinus viminea</i>
Gujarat	<i>Eucalyptus</i> , <i>Casuarina equisetifolia</i> and <i>Prosopis juliflora</i>	<i>Tectona grandis</i> , <i>Mangifera indica</i> , <i>Madhuca latifolia</i> , <i>Acacia catechu</i> , <i>Dalbergia latifolia</i> , <i>Santalum album</i> , <i>Madhuca indica</i> , <i>Gmelina arborea</i> and <i>Anogeissus pendula</i>
Maharashtra	<i>Acacia nilotica</i> , <i>Leucaena leucocephala</i> , <i>Prosopis</i> , <i>Eucalyptus</i> , <i>Moringa</i> , <i>Phoenix</i> , sapota, <i>Acacia auriculiformis</i> and poplar	<i>Terminalia chebula</i> , <i>Tectona grandis</i> , <i>Madhuca latifolia</i> , <i>Tamarindus indica</i> , <i>Mangifera indica</i> , <i>Artocarpus integrifolia</i> , <i>Acacia catechu</i> , <i>Santalum album</i> , <i>Pterocarpus marsupium</i> , <i>Adina cordifolia</i> , <i>Terminalia tomentosa</i> , <i>Hardwickia binata</i> <i>Syzygium cumini</i> and mangroves
Bihar	Poplar, eucalyptus, <i>Anthocephalus cadamba</i> , <i>Mangifera indica</i> , <i>Bombax ceiba</i> , <i>Gmelina arborea</i> , litchi, phoenix and bamboo, except <i>Dendrocalamus strictus</i>	<i>Tectona grandis</i>
Madhya Pradesh	<i>Eucalyptus</i> , <i>Casuarina</i> , subabul, poplar, <i>Pithocellodium dulce</i> and <i>prosopis</i>	<i>Acacia nilotica</i> , <i>Albizia lebbek</i> , <i>Azadirachta indica</i> , <i>Zizyphus mauritiana</i> , <i>Butea monosperma</i> , <i>Syzygium cumini</i> , <i>Acacia leucophloea</i> and bamboo
West Bengal	No tree exempted	<i>Acacia catechu</i> , <i>Bombax ceiba</i> , <i>Dalbergia sissoo</i> , <i>Diospyros melanoxylon</i> , <i>Gmelina arborea</i> , <i>Madhuca indica</i> , <i>Michelia champaca</i> , <i>Shorea robusta</i> , <i>Swietenia mahagony</i> , <i>Tetona grandis</i> and mangroves
Odisha	<i>Bambusa nutan</i> , <i>B. vulgaris</i> , <i>B. tulda</i> , <i>Samania saman</i> , <i>Eucalyptus</i> hybrid, <i>Acacia auriculiformis</i> , <i>Cassia siamea</i> , <i>Casuarina equisetifolia</i> and silver oak	<i>Mangifera indica</i> , <i>Artocarpus heterophyllus</i> , <i>Schleichera oleosa</i> , <i>Madhuca indica</i> , <i>Tamarindus indica</i> and <i>Santalum album</i>
Karnataka	<i>Eucalyptus casuarina</i> , subabul, rubber, coconut, arecanut, orange, <i>Erythrina</i> , <i>Gliricidia</i> , <i>Sesbania</i> and Silver oak	<i>Dalbergia latifolia</i> , <i>Santalum album</i> and <i>Acacia catechu</i>
Jharkhand	<i>Acacia nilotica</i> , subabul, bamboo, cane, <i>Shorea robusta</i> , <i>Tectona grandis</i> , <i>Pterocarpus marsupium</i> , <i>Boswellia serrata</i> and <i>Terminalia elliptica</i>	<i>Mangifera indica</i> , <i>Madhuca indica</i> , <i>Gmelina arborea</i> , <i>Dalbergia sissoo</i> , <i>Artocarpus heterophyllus</i> and <i>Syzygium cumini</i>
Andhra Pradesh	<i>Mangifera indica</i> , <i>Casuarina equisetifolia</i> , <i>Acacia nilotica</i> , <i>Syzygium cumini</i> , <i>Psidium guajava</i> , <i>Azadirachta indica</i> , <i>Anacardium occidentale</i> , <i>Cocos nucifera</i> , <i>Ficus religiosa</i> , eucalyptus and subabul	<i>Pterocarpus santalinus</i> , <i>Tectona grandis</i> and <i>Santalum album</i>

33% forest cover ensuring raw material to wood-based industries as well as environmental security. An overview of regulated and restricted tree species existing in different states is given in Table 1. NAP, 2014 also identified 20 most important tree species preferred by the farmers in different parts of the country to be relaxed in the first phase from such restrictions.

### Quality planting stock and certification

As mentioned in the Policy, only 10% of quality planting material reaches the resource-poor remote regions. Quality

assurance of genetically improved planting stock, particularly for long-rotation timber species is crucial for safeguarding the interest of farmers and industries. To achieve the large-scale supply of genetically superior quality planting material, there is a need to replicate the success achieved in case of eucalyptus, poplar, casuarina and subabul through a larger role played by private sector companies. The supply of quality planting material by them is one of the biggest factors in the large-scale adoption of agroforestry in Punjab, Haryana, Uttarkhand, Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra and Madhya Pradesh. Pragati Biotech is pioneer in the

distribution of high-yielding clones of eucalyptus and poplar in North India since 2001. Apart from this, superior quality seeds obtained from seed orchards and seed production areas (CSO, SSO, vegetative multiplication garden) have a positive impact on productivity of plantations.

The projected annual requirement of planting stock is 6160 million seedlings of different tree species<sup>15</sup> and to fulfil this, research institutions, private organizations and forest departments must come together to establish good linkages among farmers for the production of planting material for 20 identified species in the National Agroforestry Policy. National and state-level research institutions, forest departments and universities should enter into a convergence mode to cater to the needs of superior planting stock.

Certification of quality seed and planting material is an important issue and has been referred to in NAP, 2014. However, there is a challenge to develop a mechanism for certification of nurseries and planting material. NAP, 2014 can adopt a mechanism for laboratory and nursery accreditation as done by the National Horticulture Mission and to identify the organizations for assisting the accreditation process. NAP can take a clue from some of the agencies involved in certification services in the forestry sector in the country, such as Patneshwari Agri Co-operative Ltd. (PACL), The Forest Trust (TFT), SWISO International certification services, etc. having experience in certification for eucalyptus, poplar and *Melia azederach* species in the Indo-Gangetic region. Forest certification processes, criteria and indicators for Sustainable Forest Management and chain of custody initiated in the international markets can be tapped through the international certification agencies like Forest Stewardship Council and International Timber Trade Organization (ITTO).

Well-evolved agroforestry systems can turn out to be self-sustained production systems wherein zero external inputs like fertilizers and pesticides are used. These kinds of agroforestry systems can also be subjected to organic farming certification at the national and international level to bring in additional income and incentives. Further, the Policy emphasis shall bring forward all wood-based sectors involved in economically viable agroforestry management.

#### *Role of financial and insurance sector in NAP, 2014*

The agriculture sector has the facilities of insurance and credit from the financial institutions and an organized marketing structure. However, the farmers practising tree-based farming are devoid of any such facilities and this major hurdle in boosting agroforestry among resource-poor farmers. NAP, 2014 has made recommendations for credit and market facilities to the farmers

adopting tree-based farming. The recommendations for tree insurance/credit cover mentioned in the Policy will encourage involvement of farmers in expanding the area under agroforestry. However, the Policy is not clear about how to achieve these objectives. To provide financial assistance to agroforestry farmers bankable projects need to be formulated in agroforestry as in the case of agriculture and other allied subjects such as horticulture, animal husbandry, etc. There is a need to expand the tree insurance initiatives taken in Tamil Nadu for 'Agroforestry Plantation Insurance' by United India Insurance, Chennai, for ensuring financial protection against natural calamities (flood and cyclone), wild animal damage, and pest and disease for the species that are widely cultivated in the state, including casuarina, eucalyptus, sissoo, *G. arborea*, *M. dubia*, *A. excelsa* and subabul at the national level covering all major tree species grown under agroforestry. In such an initiative, in the event of damage due to any of the above-mentioned perils, the farmer would be settled at the premium rate of 1.25% of the input cost of the respective trees. Similarly, in Kerala, insurance scheme for coconut and rubber is in existence. For mature and immature plantations of rubber, provision for compensation on account of natural calamities will be provided with replacement cost plus future returns of present value arising out of loss or death of the plant. Agricultural Insurance Company India Limited is providing bio-fuel tree/plant insurance for the species such as *Jatropha curcas*, *Pongamia pinnata*, *Azadirachta indica*, *Bassia latifolia*, *Callophyllum inophyllum* and *Simarouba glauca* at the premium cost of 125–150% of the input cost. Unlike crop insurance, the credit cover mentioned in the Policy is positively expected to receive widespread attention and support from the farmers.

#### *Public private partnership (PPP) based model for expansion of agroforestry*

Agroforestry has expanded in a big way wherever it has been supported by the private sector due to assured market for the growers. The private sector has established many successful agroforestry models like pulp and paper mills in Tamil Nadu (Tamil Nadu Newsprint Ltd), Andhra Pradesh (ITC Paper Board), Gujarat and Odisha (JK Paper Mills), Uttar Pradesh (West Coast Paper Mill); plywood industries in Haryana and Punjab (Yamunana-gar) and Uttarakhand (Rudrapur); other wood-based industries (WIMCO Ltd) in the Indo-Gangetic region; gums and resins in Chhattisgarh, Jharkhand; tendu in Madhya Pradesh; cardamom in North East India and homegardens in Kerala are regional-specific models that have identified marketing linkages with farmers through contract farming. There is a need to develop strong linkages between different institutions and clients on the PPP model and ensure a complete value chain of agroforestry



produce. It can be ensured by adopting the model developed by Tamil Nadu Agricultural University (TNAU), Coimbatore as mentioned in Box 3, and needs to be replicated region-wise, for different species, which will further establish good linkages with farmers and help in enhancing the database on marketing information system. PPP in development of agroforestry as envisaged in the Policy has immense potential to provide opportunities in the production and supply of quality planting materials, land development activities, buy-back schemes of farm produce, research and extension activities, etc.

In other words, commercial agroforestry is gaining momentum due to large-scale demand from pulp and paper industries. In order to meet the requirement of paper mills, industry requires around 2.5 million ha of land for pulpwood plantation. Currently, the commercial agroforestry is estimated to be practised over 5 million ha with tree species belonging to *Eucalyptus*, *Populus*, *Casuarina*, *Leucaena*, *Ailanthus*, *Melia*, *Anthocephalus*, *Acacia*, *Bombax*, etc. The area under commercial agroforestry is given in Table 2.

The practice is estimated to produce 100 million cubic metre timber/pulpwood for industrial and domestic use and 150 million tonnes firewood, add approximately 15 million tonnes organic matter through leaf fall, sequester 60 million tonnes carbon annually in tree components (excluding in soil and that locked in the wood products), and generate employment of 4000 million person days/annum in nursery and plantation activities. The value of wood/pulpwood produced is estimated to be around Rs 10,000 billion and that of firewood as Rs 30,000 million annually<sup>16</sup>. It is evident that private enterprises like pulpwood, match wood and other plywood industries are in huge demand for raw material supply which can be tied up through PPP model or any new approaches that will be beneficial to the farmer also and will indirectly help in achieving forest cover.

**Box 3.** Contract farming model in Tamil Nadu: a value chain

Tamil Nadu Agricultural University (TNAU), Coimbatore has demonstrated contract-farming-based industrial agroforestry using tripartite and quadpartite model involving industries, farmers, research and financial institutions. Credit facilities are provided to the farmers at the rate of Rs 15,000–20,000 per acre. Industry supplies quality planting material at subsidized rate and assures prevailing marketing price; the farmer assures end-product (timber) to contracting industry, and research institutes advice on site-specific technology. Until now, TNAU has produced and supplied 0.72 million quality planting material to 217 farmers at free of cost, covering 212 ha in five districts of Tamil Nadu using short rotation clones such as eucalyptus (MTP 1), *Casuarina* (MTP 1 and 2), *Melia dubia* (MTP 1), subabul, etc. (source: [www.fcrinaip.org](http://www.fcrinaip.org)).

### Contribution of agroforestry to ecosystem services

India has a long historical tradition of growing trees on farms and around homes. They play an important role in the ethos of people. Across the diversified agro-climatic regions there are different region-based culturally and religiously attached traditional agroforestry systems oriented with livelihood activities of local people. These are natural ecosystems which are efficient in conservation of local resources. Such systems include homegardens in Kerala and North East India, kangeyam tract in south India, khejri-based in the northwest, *Acacia nilotica* based in the central parts, alder-based in the Himalaya and so on. Some of these traditional systems with area distribution are mentioned in Table 2. Traditional systems are one of the best examples of ecosystem services providing several goods and services. Such systems conserve the soil by improving its fertility levels and erosion; provide quality water for local consumption, fodder for livestock, fuel and timber for use as energy and construction materials, and traditional crops for food security. A recent global survey found at least 300 new cases of payment of ecosystem services<sup>17</sup>. Examples include: watershed protection in Karnataka, payment of ecosystem services in the Great Himalayan National Park in Kullu district, Himachal Pradesh, and cardamom-based agroforestry system in North East India, etc. Baseline for evaluating traditional cardamom-based agroforestry ecosystem services has been initiated and the system parameters such as nutrient efficiency, biomass and soil loss, and cardamom production have been calculated<sup>1</sup>. The comparative efficiency of soil loss (kg/ha) in different land-use systems, including cardamom-based agroforestry (30 kg/ha), forest-based (74 kg/ha), horticulture-based agroforestry (145 kg/ha) and rained agriculture (477 kg/ha) indicates minimum soil loss from cardamom agroforestry. There are few case studies for evaluating the agroforestry-based ecosystem services. The Millennium ecosystem assessment report serves as a baseline for evaluating the indirect benefits. However, there exists difficulty in methodologies to evaluate ecosystem services in agroforestry according to different agro-climatic zones and also in terms of monetary values, i.e. payment of ecosystem services. As of now, methodologies for carbon sequestration (regulating services) are framed clearly and the overall carbon sequestered in agroforestry systems ranges from 0.5 to 2.0 Mg/ha/yr (ref. 18). For other services, the methodologies need further attention. The Policy is lacking any guidelines regarding traditional agroforestry and ecosystem services. The criteria and indicators, field methods for quantification and evaluating traditional agroforestry systems are also to be focused upon as these systems help in sustaining ecosystem combined with human well-being.



**Table 2.** Area expansion of traditional and commercial agroforestry systems (AFS) in India

Type of AFS	State	Area (000' ha)	Species
Traditional agroforestry			
Alder-cardamom <sup>19</sup>	North East India	34	<i>Alnus nepalensis</i>
Kangayam agroforestry <sup>20</sup>	Tamil Nadu	384	<i>Acacia leucophloea</i>
Homegardens <sup>21</sup>	Kerala	1330	Mix tree species
Khejri-based agroforestry <sup>22</sup>	Rajasthan	1586	<i>Prosopis cineraria</i>
Commercial agroforestry			
Pulpwood agroforestry <sup>23</sup> (paper)	Punjab, Haryana, Uttar Pradesh, Andhra Pradesh, Gujarat and Tamil Nadu	657	Eucalyptus, poplar, casuarina and subabul
Timber-based agroforestry <sup>24</sup> (furniture)	Kerala, Maharashtra, Tamil Nadu and Madhya Pradesh	1700	<i>Tectona grandis</i>
Willow-based agroforestry <sup>25</sup> (bat industry)	Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Punjab	137	<i>Salix</i> species

### Gaps in the National Agroforestry Policy

On a broader view, the Policy has focused on generalized aspects of coordination and convergence among different departments but the pathway for each action points is not given in a detailed manner. Our personal opinions on lacunas in the Policy are follows.

- *Agroforestry Tree Manual* containing standard silvicultural practices including nursery, field techniques, harvesting guidelines and market information which can be part of extension activity is one of the important challenging tasks for the identified agroforestry tree species. Initially there is an urgent need to prepare such a manual for the 20 identified species at country level.

- Region-specific agroforestry models for small, marginal and large farmers need to be developed. The value-added tree products (NTFPs) and their processing are not widespread which needs attention.

- Uniform guidelines for exemption of agroforestry tree species from restrictive regulatory regimes in all states are required with uniformity in tree and land tenure laws across the country. This is a difficult task and needs convergence of interests among multiple stakeholders.

- Though methodologies have been framed for ecosystem services at the international level and Indian Institute of Forest Management (IIFM), Bhopal at the national level for pure forests or plantations, there is a need to focus on methodologies for quantification and payment of ecosystem services (PES) in agroforestry system, which will link consumers of environmental services with suppliers. Another question here is who will be the seller and who will be the buyer of services? This would be a challenge and may take time for implementation.

- The mode of operation of insurance scheme/credit covers for agroforestry is new and proper guidelines are lacking. Similarly, the subsidy for planting material or other components is to be discussed.

- Less emphasis on unique and hi-tech agroforestry systems such as aqua-forestry.

- Extension services are important and can be delivered through Krishi Vigyan Kendra's (KVK) with the help of specialists in agroforestry or where agroforestry is prominent; Krishivaniki Vigyan Kendra (KvVKs) can be established for smooth dissemination of successful agroforestry models. It would also be better to strengthen the existing KVKs, Regional Agricultural Research Stations of ICAR, ICFRE and SAUs, R&D Extension Institutions operating under various bodies of the State Governments.

- The Policy is silent about the traditional agroforestry systems like the Oraons of Rajasthan, Kangeyam system of Tamil Nadu, homegardens and Cardamom Hill Reserves of Kerala, alder-based large cardamom system in Sikkim and other NE states. The Policy should have dealt with some suggestions to revive and replicate such time-tested and sustainable but now fast-disappearing systems.

- The Policy also does not put forward any suggestion for managing the challenges and degradation related to primitive agroforestry system, namely shifting cultivation.

- The grassroots level mechanism for convergence of schemes and programmes like MNREGS, NHM, NBM, GIM, etc. needs to be elaborated.

- There are many community based agroforestry (predominantly silvi-pastoral) systems that are part of the Common Property Resources (CPRs); for example, community grazing and fodder/fuel banks. These tree-based systems are breaking down as community rights are being vanishing and these CPRs are being divided and distributed among individuals resulting into changes in land-use pattern and community access. The Policy is also silent about these kinds of CPRs that support some agroforestry components in various proportions.

### Summary

The details envisaged in the Policy present a positive picture on adoption of agroforestry. The Policy is expected

to remove the constraints and bring a major shift in outlook of agroforestry. Hence, the Policy guidelines will be a potent driver of change in achieving food and nutritional, energy and environmental, employment and livelihood security. Despite all these factors, the key challenge is to move forward from paper to ground level that will bear fruit to small-scale farmers. In short, a new paradigm must be embedded in intersectoral planning of flagship programmes and scale up the efforts that will contribute towards a second revolution, i.e. evergreen revolution in India.

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