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# Proceedings of the National Workshop

## AGROFORESTRY AND FARM FORESTRY FOR SUSTAINABLE LAND AND ECOSYSTEM MANAGEMENT



**Indian Council of Forestry Research and Education**  
(An Autonomous Body of Ministry of Environment, Forest and Climate Change,  
Government of India)  
P.O. New Forest, Dehradun - 248006 (INDIA)





सत्यमेव जयते



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## AGROFORESTRY AND FARM FORESTRY FOR SUSTAINABLE LAND AND ECOSYSTEM MANAGEMENT

under Ecosystem Services Improvement Project

**05-06 January 2023**

**Indian Council of Forestry Research and Education**  
(An Autonomous Body of Ministry of Environment, Forest and Climate Change, Government of India)  
P.O. New Forest, Dehradun - 248006 (INDIA)



आजादी का  
अमृत महोत्सव



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Environment



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सत्यमेव जयते

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महानिदेशक  
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्  
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(An ISO 9001 : 2008 Certified Organization)



## FOREWORD

India's forest and tree cover are 24.62% of the total geographical area and play a vital role in ecological and economic development of the country. However, forests are degrading to meet the increasing demand of fuel wood, fodder, timber and non-timber forest products. Climate change is posing the additional stress on the forests and making them more vulnerable. To reduce the pressure on the existing forests, to meet the increasing demand of forest produces and to achieve national targets and international commitments some transformative projects need to be implemented on forest and non-forest lands. Agroforestry and farm forestry have potential for improving soil health, water conservation, carbon sequestration, biodiversity conservation and meeting national targets and international commitments related to climate change, biodiversity conservation, combating desertification and land degradation, and sustainable development goals.

The World Bank funded Ecosystem Services Improvement project (ESIP) supports the goals of the Green India Mission by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits. ESIP attempts to introduce new tool and technologies for better management of natural resources, including biodiversity and carbon stocks. As a Project Implementing Agency for ESIP, ICFRE has organized a National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management on 5-6 January 2023 at Dehradun with the aim to bring together experts from key Ministries, Departments, Science and Technology Institutions, International Organizations, Universities, NGOs, Industries, Farmers and Tree Growers for developing suitable strategies/ framework and to provide policy inputs to the Government for addressing issues and challenges for promotion of agroforestry and farm forestry for sustainable land and ecosystem management.

I am thankful to the invited experts, panelists and delegates of the workshop for their contribution and participation in the workshop. I am thankful to Director, Forest Research Institute and her team for providing necessary support in organizing this workshop. I appreciate the efforts of the Project Director, Project Manager and Project Coordinator of ESIP for putting in their best efforts in organisation of the workshop and for bringing out the proceedings of workshop in an articulate manner.

Dated: 05/04/2023

  
(A. S. Rawat)

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## ABBREVIATIONS USED

|                 |   |  |
|-----------------|---|--|
| BCC             | : | Biodiversity and Climate Change                    |
| CAFRI           | : | Central Agroforestry Research Institute            |
| CAZRI           | : | Central Arid Zone Research Institute               |
| CCF             | : | Chief Conservator of Forests                       |
| CDM             | : | Clean Development Mechanism                        |
| CFCs            | : | Common Facility Centres                            |
| CIFOR           | : | Centre for International Forestry Research         |
| CO <sub>2</sub> | : | Carbon dioxide                                     |
| CSR             | : | Corporate Social Responsibility                    |
| DAMIS           | : | Digital Agroforestry Management Information System |
| ESIP            | : | Ecosystem Services Improvement Project             |
| FAO             | : | Food and Agriculture Organization                  |
| FPO             | : | Farmers Producer Organisation                      |
| FRI             | : | Forest Research Institute                          |
| FSC             | : | Forest Stewardship Council                         |
| GDP             | : | Gross Domestic Product                             |
| GEF             | : | Global Environment Facility                        |

|           |   |   |
|-----------|---|---|
| GHG       | : | Greenhouse gas  |
| ICAR      | : | Indian Council of Agricultural Research                       |
| ICFRE     | : | Indian Council of Forestry Research and Education             |
| ICM       | : | International Carbon Market                                   |
| ICRAF     | : | International Centre for Research in Agroforestry             |
| IFGTB     | : | Institute of Forest Genetics and Tree Breeding                |
| IGNFA     | : | Indira Gandhi National Forest Academy                         |
| IIFM      | : | Indian Institute of Forest Management                         |
| ITC       | : | India Tobacco Company   |
| ITTO      | : | International Tropical Timber Organization                    |
| KVK       | : | Krishi Vigyan Kendra  |
| MGNREGA   | : | Mahatma Gandhi National Rural Employment Guarantee Act        |
| Mha       | : | Million Hectare   |
| MoAFW     | : | Ministry of Agriculture & Farmers Welfare                     |
| MoEFCC    | : | Ministry of Environment, Forest and Climate Change            |
| NbS       | : | Nature-based Solutions  |
| NCCF      | : | Network for Certification and Conservation of Forests         |
| NDC       | : | Nationally Determined Contributions                           |
| NGO       | : | Non-governmental Organization                                 |
| NTFP      | : | Non-timber Forest Products                                    |
| PCCF&HoFF | : | Principal Chief Conservator of Forests & Head of Forest Force |
| PNG       | : | Piped Natural Gas   |
| PPP       | : | Public Private Partnership                                    |
| QPM       | : | Quality Planting Material                                     |
| SDG       | : | Sustainable Development Goal                                  |
| TERI      | : | The Energy and Resources Institute                            |
| TNAU      | : | Tamil Nadu Agricultural University                            |
| TOFI      | : | Trees Outside Forests in India                                |
| UNFCCC    | : | United Nations Framework Convention on Climate Change         |
| USAID     | : | United States Agency for International Development            |
| VVK       | : | Van Vigyan Kendra   |
| WRI       | : | World Resources Institute                                     |



## EXECUTIVE SUMMARY

India is known for its diverse forest ecosystems and mega biodiversity. It ranks 10<sup>th</sup> amongst the most forested nations of the world with nearly one fourth of its geographical area under forest and tree cover. Increased pressure on forest resources of the country over the last few decades has threatened the livelihoods of millions of forest-dwellers and other poor people living in the vicinity of the forests. The pressure on existing forest resources is immense in India. In this context, it is imperative to preserve the forests and manage them sustainably, so as to ensure secure livelihood of the forest-dependent communities as well as conserving the biodiversity.

National Forest Policy, 1988 intends to reduce the pressure on natural forests for fuelwood, fodder and industrial raw material and lays emphasis on growing trees outside forests. Agroforestry is an established nature-based activity that can aid carbon-neutral growth. In 2014, India became the first country to adopt an agroforestry policy to promote employment, productivity, and environmental conservation. Agroforestry and farm forestry generate significant ecosystem services such as watershed protection, soil conservation, biodiversity conservation, carbon sequestration and avoided emissions, and also

minimizes climatic and financial risks. Agroforestry and farm forestry also act as an important source for timber and fuel wood to meet the demands of fast-growing population of the country and can save huge amount of funds. There is a need to enhance productivity of agroforestry and farm forestry by adopting better management and planting practices for sustainable land and ecosystem management.

Research organizations like ICFRE, ICAR and universities are continuously working towards development of high yielding, disease and pest resistant clones and varieties of trees for higher returns to the farmers. Introduction of these varieties with different agroforestry models is encouraging farmers to introduce tree crop in farming systems. Today many successful models are available in agroforestry and farm forestry but more is required to be done. Despite a number of efforts by the Government to promote agroforestry and farm forestry in the country, there are still some issues and challenges for its development and expansion such as difficulty in obtaining felling permit, non-availability of organized trade in wood, lack of well-developed markets for agroforestry and farm forestry products, predominant buyers' market, absence of locally

available wood processing units, non-availability of quality planting material, inadequate network of forest nurseries, pests and diseases management, lack of investments, inadequate knowledge dissemination, etc.

The World Bank is supporting Ecosystem Services Improvement Project (ESIP) with an overall objective to improve forest quality, sustainable land management and NTFP benefits for forest dependent communities in selected landscapes in Madhya Pradesh and Chhattisgarh. ESIP supports the goals of Green India Mission by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits. ICFRE as one of the project implementing agencies of ESIP and implementing the components on measurement and monitoring of forest carbon stocks and capacity building of State Forest Departments, and scaling-up of sustainable land and ecosystem management best practices in to prevent land degradation and desertification and to increase above-ground forest carbon stocks.

This National Workshop on 'Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management' was organised under the ESIP with the objective to develop the suitable strategies/frameworks and to provide policy inputs to the Government for addressing issues and challenges for development of agroforestry and farm forestry and achieving India's national targets and international commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation and sustainable development goals, and shifting India towards an innovative, resource efficient and carbon neutral economy.

The workshop was comprised of the four technical sessions viz 'Agroforestry and farm forestry practices for sustainable land and ecosystem management', 'Quality planting materials for scaling up of agroforestry and farm Forestry practices', 'Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry', and 'Certification framework and market mechanism for agroforestry and farm forestry', a parallel session on 'Knowledge sharing and learning session for scaling up of agroforestry and farm forestry practices for sustainable land and ecosystem management in the form of exhibition, poster presentation and documentaries', Panel Discussion on 'Experience sharing by the representatives of

wood-based Industries, farmers and NGOs' and Concluding Session on 'Synthesis and finalization of recommendations'.

In each technical session distinguished and eminent experts/ specialists delivered lead talks followed by session talks. About 152 experts and participants from key Ministries, Departments, Science and Technology Institutions, International Organisations, Universities, NGOs, Industries Farmers and Tree Growers actively participated in the deliberation during the technical sessions and panel discussion of the workshop, and share their vast experience and knowledge in the field of agroforestry and farm forestry for sustainable land and ecosystem management.

**Recommendations of the Workshop:** Following recommendations were made during the workshop for development of agroforestry and farm forestry for sustainable land and ecosystem management in the country:

1. Develop a Digital Agroforestry Management Information System (DAMIS) with geo-referenced database of agroforestry tree species and other species for trees outside forests (including trees growing in farm forestry, roadside, railway trackside, canal side, sacred groves and other) for different agroclimatic zones.
2. ICFRE and ICAR should collaborate closely to extend the ecologically sustainable and economically viable integrated agroforestry models with the defined tree, diversified crops and livestock components developed for different niches and agroclimatic zones to the farmers so as to bridge the demand and domestic supply gap and increase income to farmers.
3. Liberalize the regulatory system for promoting cultivation of high-value long-rotation tree species like teak, mahogany, red sanders, sandalwood, shisham and others species in agroforestry. States to be assisted in developing protection systems for the forest population of these species.
4. Diagnosing and documenting the best agroforestry practices and their scaling-up strategy with a focus on sustainable land and ecosystem management.
5. Defining and documenting parameters of quality planting material for most suitable agroforestry tree species, their sources of availability, and pricing for the end-uses at nominal cost.

6. Developing a framework for accreditation and star-rating of the nurseries for mass production of quality planting material and certification of quality planting materials.
7. Large-scale production of clonal materials of genetically superior and /or certified germplasm of commercially important agroforestry species in collaborative mode by industries, research organisations and growers for enhancement of farmer income and uptake of quality produce by industry.
8. Create awareness among Farmers/ tree growers and related stakeholders regarding new and released clones and varieties for use in agroforestry through appropriate means.
9. Reduce dependency on imported timber by promoting indigenous and underutilized tree species and perennials with a broad gene pool base for agroforestry. Continuously develop new genetically improved material and package of practices for higher yields and productivity in agroforestry.
10. Develop a policy for certification standards and their rolling out for agroforestry and farm forestry products. ICFRE and IIFM may take a lead to develop the Indian Forest Certification Framework for certification of agroforestry produced timber and NTFPs.
11. Develop necessary standards for certification of seeds, plants, quality planting materials and agroforestry and farm forestry produces by engaging all the stakeholders which may include ICFRE & its institutes, ICAR & its institutes, and state agriculture universities, state forest departments, private branded nursery growers and other national and international agroforestry agencies (e.g, CIFOR, ICRAF) operating in the country.
12. Developing and enforcing uniform felling and transit system for agroforestry produce across the country by operationalisation of the online National Transit Permit System being piloted by Ministry of Environment, Forest and Climate Change.
13. Create a domestic market mechanism for agroforestry produce to facilitate the adoption of agroforestry and farm forestry. Such a market system must ensure remunerative prices for agroforestry produce which needs to be higher than the traditional agricultural produce.
14. Develop a standardized cost low-cost methodology for capturing and quantifying the carbon sequestered in agroforestry and develop domestic carbon financing and trade for the same.
15. Promotion of poplars, eucalyptus, Casuarina and Melia species along with multi-purpose tree species in agroforestry under marginal/ degraded/ dry lands of farmers for income generation.
16. Develop strategy and policy framework for fixing minimum purchase price for the tree crops produced by the farmers from agroforestry and farm forestry produce.
17. Develop a technology-based solution for the movement of agroforestry products (timber/ wood) and develop on-farm primary processing technology to reduce transportation costs on agroforestry produce.
18. Develop a mechanism for PPP-driven tools for effective harvesting starting with bamboo. ICFRE may take a lead to collaborate with suitable technological institutions for this purpose.
19. Develop agroforestry entrepreneurship for economic revolution including development of bamboo value chain as a business enterprise.
20. Develop an extension mechanism for sharing of knowledge and its dissemination for the extension of agroforestry-related research findings, best practices, and success stories from lab to land for sustainable land and ecosystem management.
21. Developing and strengthening Van Vigyan Kendras (VVKs) on the pattern of Krishi Vigyan Kendra (KVKs) with trained manpower and demonstration plots for agroforestry extension.
22. Creating a nodal agency and an institutional mechanism for agroforestry at both the central and state levels by roping in the human resources from forest and agriculture ministries and departments.
23. Develop a suitable framework/ mechanism along with suitable safeguards for raising the plantation in the wastelands of the states for increasing tree cover and carbon sequestration, and meeting the industrial requirement of woods in a public-private partnership.
24. Keeping in view the small land holdings of Indian farmers, Farmer Producer Organisations (FPO) and Cooperatives for agroforestry need to be formed under the scheme of Ministry of Agriculture and Farmers Welfare for Formation of FPOs.







## BACKGROUND

India's forest and tree cover which is about 24.62% of its total geographical area, play a vital role in ecological and economic development of the country. However, forests are degraded to meet the increasing demand of fuel, fodder, timber and non-timber forest products. Competing uses of land for agricultural, infrastructure developmental projects, human settlement and industries exerts tremendous pressure on the finite land resources of the country. Rising atmospheric CO<sub>2</sub> concentration and climate change will be additional stress on the forests making more vulnerable in the context of climate change. Despite pressures on the forests for development purposes, India is committed to achieve its National Forest Policy's Goal of having 33% of its geographical area under forest and tree cover. Besides, this there are Nationally Determined Contribution (NDC) targets committed by the country under the Paris Agreement of United Nations Framework Convention on Climate Change, Land Degradation Neutrality (LDN) target of United Nations Convention to Combat Desertification, Biodiversity Targets of Convention on Biological Diversity and

Sustainable Development Goals (SDGs) to be achieved by 2030. NDC forestry target is to create additional carbon sink of 2.5 - 3 billion tonnes of CO<sub>2</sub> equivalent through additional forest and tree cover by 2030.

To reduce pressure on existing forests, to meet increasing demand of forest produces and to achieve national targets and international commitments some alternative actions are required to be taken on forest and non-forest lands. Greening non-forest lands by creating additional tree cover through agroforestry, farm forestry, urban forestry, roadside plantations etc. needs to be developed. Agroforestry and farm forestry generate significant ecosystem services such as watershed protection, soil conservation, biodiversity conservation, carbon sequestration and avoided emissions, and also minimizes climatic and financial risks. Hence, agroforestry and farm forestry have potential for improving soil health, water conservation, carbon sequestration, biodiversity conservation and National Forest Policy Goal as well as having potential scope in achieving national targets and international



commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation, and sustainable development goals. National Forest Policy, 1988 intends to reduce the pressure on natural forests for fuelwood, fodder and industrial raw material and lays emphasis on growing trees outside forests. National Agroforestry Policy (2014) also emphasized the environmental contribution of agroforestry through preventing deforestation, promoting carbon storage, conservation of biodiversity and reducing pressure on natural forests. International Union of Forest Research Organizations (2016) reported that India is the third largest importer of timber in the world. Between 2010 and 2018 India imported Rs. 388 billion worth of wood and wood products from around the world. Agroforestry and farm forestry also act as an important source for timber and fuel wood to meet the demands of fast-growing population of the country and can save huge amount of the foreign exchequer. There is a need to enhance productivity of agroforestry and farm forestry by adopting best practices.

The potential of agroforestry and farm forestry to contribute to sustainable development has been recognized in international forums such as United Nations Framework Convention on Climate Change and Intergovernmental Panel on Climate Change increasingly acknowledge agroforestry as a component of climate-smart agriculture. In addition, the United Nations Convention to Combat

Desertification acknowledges agroforestry's potential to combating desertification and land degradation. It is also seen as an important practice in the ecosystem approach promoted by the Convention on Biological Diversity and contributes to its Global Strategy for Plant Conservation. Agroforestry and farm forestry can make a significant contribution in achieving Sustainable Development Goals (SDGs) like SDG 2 (hunger), SDG 5 (gender equality), SDG 6 (clean water), SDG 7 (affordable clean energy), SDG 13 (climate action), and SDG 15 (sustainable forestry and restoration). However, inter-connected nature of the SDGs, agroforestry and farm forestry make contributions in achieving an even wider range of goals than immediately apparent, including SDG 1 and SDG 3 (good health and wellbeing).

Agroforestry and farm forestry are considered as the real game changer in extension of green cover for sustainable land and ecosystem management. Agroforestry and farm forestry provide ample opportunity for the bio-economy and for support of forest-based industries, hence, play an important role in achieving India's national targets and international commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation and sustainable development goals; and shifting India towards an innovative, resource efficient and bio-based carbon neutral economy.

Despite a number of efforts by the Government to promote agroforestry and farm forestry in the country,

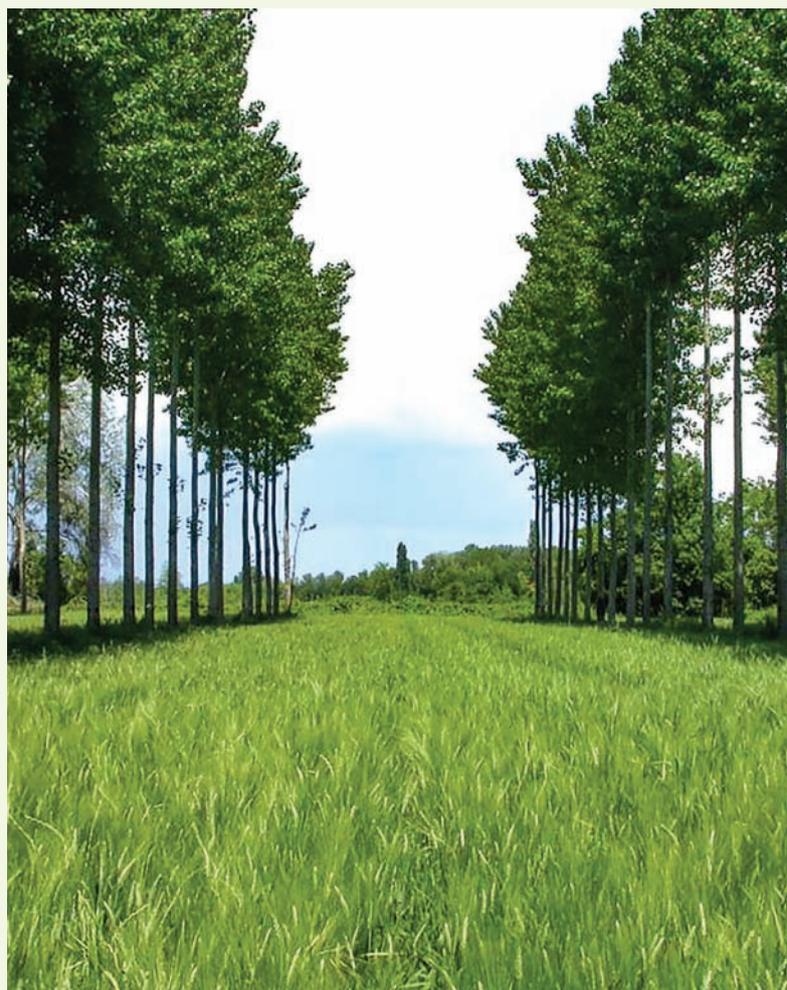
there are still some issues and challenges for its development and expansion such as complicated procedures for obtaining felling permit and transit pass, non-availability of organized trade in wood, lack of well-developed markets for agroforestry and farm forestry products, predominant buyers' market, absence of locally available wood processing units, non-availability of quality planting material, inadequate network of forest nurseries, pests and diseases, lack of proper agro-economic model and their proper demonstration, no buy back guarantee from wood based industries, lack of entrepreneurship among farmers and their tendency of risk-avoidance, lack of investments, inadequate knowledge dissemination, lack of coordination among the line departments of the Governments etc. The development of agroforestry and farm forestry is often impeded by legal, policy and institutional arrangements. There is a need to remove policy and legal barriers for promoting agroforestry and farm forestry. Institutional frameworks and domestic market mechanism that facilitate the adoption of agroforestry and farm forestry need to be developed to recognize the contribution of agroforestry and farm forestry in the national development.

The World Bank is supporting Ecosystem Services Improvement Project (ESIP) with an overall objective to improve forest quality, sustainable land management and NTFP benefits for forest dependent communities in selected landscapes of Madhya Pradesh and Chhattisgarh. ESIP supports the goals of Green India Mission by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits.

Indian Council of Forestry Research and Education (ICFRE) as one of the project implementing agencies of ESIP. National Workshop on 'Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management' was organised under the Ecosystem Services Improvement Project with the objective to develop the suitable strategies/ frameworks and to provide policy inputs to the Government for addressing issues and challenges for development of agroforestry and farm forestry and achieving India's national targets and international commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation and sustainable development goals, and shifting India towards an innovative, resource efficient and carbon neutral economy on 5-6 January 2023 at Dehradun. Following themes were covered under the national workshop:

1. Agroforestry and farm forestry practices for sustainable land and ecosystem management.
2. Quality planting materials for scaling up of agroforestry and farm forestry practices.
3. Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry.
4. Certification framework and market mechanism for agroforestry and farm forestry.
5. Knowledge sharing and learning session for scaling up of agroforestry and farm forestry practices for sustainable land and ecosystem management.

Agenda of the National Workshop is placed at Annexure – I. About 152 experts and participants from key ministries, departments, science and technology institutions, academic institutions, international organisations, NGOs, farmers and tree growers have participated in the national workshop. List of the participants is placed at Annexure – II.





## SESSIONS OF THE NATIONAL WORKSHOP

### 2.1. INAUGURAL SESSION

The Inaugural Session of the workshop started with the address of Dr. Renu Singh, Director, ICFRE-Forest Research Institute. She welcomed the delegates and gave the overview and importance of the workshop. She highlighted that humanity depends on land use practices which provide food and water security.

Further, she highlighted that some forms of land use degrade ecosystems and adversely impact human wellbeing through the loss of biodiversity and ecosystem goods & services and the emission of greenhouse gases leading to climate change.



**Dr. Anupam Joshi**, Senior Environmental Specialist, the World Bank highlighted the importance of agroforestry and farm forestry practices for sustainable land management and in meeting the domestic woods requirement of the country. He also proclaimed that the 48% revenue that was used in imports of woods in the country can be brought down by producing more woods through scaling up of the agroforestry and farm forestry practices in the country and thereby boosting the Indian economy. Agroforestry and farm forestry also act as an important source for timber and fuel wood to meet the demands of fast-growing population

of the country and can save huge amount of funds. Further, he stated that there is a need to enhance productivity of agroforestry and farm forestry by adopting better management and planting practices. Agroforestry provides ample opportunity for achieving national target of the Forest Policy and international commitments related to Nationally Determined Contribution, Land Degradation Neutrality, Sustainable Development Goals, global goals on biodiversity, Global Forest Goals of United Nation Forum on Forest and Bonn Challenge Commitment by 2030.



**Sh. A. S. Rawat**, Director General, ICFRE, Dehradun highlighted that India's forest and tree cover are 24.62% of the total geographical area and play a vital role in ecological and economic development of the country. However, forests are degrading to meet the increasing demand of fuel wood, fodder, timber and non-timber forest products. Climate change is posing the additional stress on the forests and making them more vulnerable. Forest sector is net sink of carbon dioxide in India and removed about 15% of the India's GHG emissions. Forests provide climate change mitigation opportunity at relatively lower costs along with other significant co-benefits. He further stated that to reduce the pressure on the existing forests, to meet the increasing demand of forest produces and to achieve national targets and international commitments some transformative actions are needed to be taken on forest and non-forest lands. He also stated that agroforestry and farm forestry generate significant ecosystem services and also minimizes climatic and financial risks.

Hence, agroforestry and farm forestry have potential for improving soil health, water conservation, carbon sequestration, biodiversity conservation and meeting national targets and international commitments related to climate change, biodiversity conservation, combating desertification and land degradation, and sustainable development goals. National Forest Policy, 1988 intends to reduce the pressure on natural forests for fuelwood, fodder and industrial raw material and lays emphasis on growing trees outside forests. Agroforestry is an established nature-based activity that can aid carbon-neutral growth. In 2014, India became the first country to adopt an agroforestry policy to promote employment, productivity, and environmental conservation. As per the estimates of ITTO - 2021, the total roundwood demand in the country for the year 2020 was 57 million cum out of which 2 million cum came from forests, 45 million cum came from tree outside forests and 10 million cum came from imports. It is also projected that roundwood

demand in the country will be 98 million cum by 2030. Agroforestry systems can sequester large amounts of above and below ground carbon compared to treeless or pure agriculture farming systems. At national level, existing agroforestry systems are estimated to mitigate about 109 million tonnes of carbon dioxide annually, which may offset about 33 % of the total greenhouse gas emissions from agriculture sector. Further, he highlighted that research organizations like ICFRE, ICAR and universities are continuously working towards development of high yielding, disease and

pest resistant clones and varieties of trees for higher returns to the farmers. Introduction of these varieties with different agroforestry models is encouraging farmers to introduce tree crop in farming systems. Today many successful models are available in agroforestry and farm forestry but more is required to be done. He emphasized that recommendations of this workshop would be worthwhile for providing the concrete inputs to the policy planners and land users for promotion of agroforestry and farm forestry for sustainable land and ecosystem management in the country.



The Chief Guest of the Inaugural session, Sh. Bharat Jyoti, Director, IGNTA in his inaugural address stated that forests are playing a significant role in climate change mitigation and adaptation. National goal of the National Forest Policy 1988 is to have a minimum of one-third of the total land area of the country under forest or tree cover, and in the hills and in mountainous regions, the goal is to maintain two-third of the area under forest and tree over. To achieve this goal, India has been actively pursuing a number of strategies and programmes from the National to local levels. The Government of India has always made positive efforts through framing suitable policies, legislations and regulations and also by amending them time to time to conserve and protect its environment and natural resources including forests.

He also stated that agroforestry, farm forestry and urban forestry which are sub set of trees outside the

forests, have the maximum potential in extension of green cover in the country as well as in achieving the national targets and international commitments. Agroforestry and farm forestry provide ample opportunity for the bio-economy and for support of forest-based industries, hence, play an important role in shifting India towards an innovative, resource efficient, climate resilient and bio-based carbon neutral economy. He emphasized on improving planting stocks, models of agroforestry, classifying and certification of the agroforestry and farm forestry wood products, integration in the economy, medicinal plant cultivation, Forest Right Act, scientific database on region wise biodiversity aspects, techno-scientific knowledge, etc. He also advocated that India should generate their own system and standards in the field of agroforestry and farm forestry, which should be followed by the global partners.





**Ms. Kanchan Devi**, Director (International Cooperation) and Project Director, ESIP, ICFRE proposed the vote of thanks to the Chief Guest, Director General, ICFRE, senior officers from the World Bank, Ministry of Environment, Forest and Climate Change, representatives from state forest departments,

industries, progressive farmers, research organizations, NGO, officers and scientists from ICFRE institutes, members of press and media for gracing the occasion. She also thanked all officers from ICFRE and FRI who were associated with the organisation process of the workshop in various capacities, and at different stages.



2.2.

## TECHNICAL SESSION-I



### AGROFORESTRY AND FARM FORESTRY PRACTICES FOR SUSTAINABLE LAND AND ECOSYSTEM MANAGEMENT

#### PANELLISTS:

- Sh. A.M. Singh, IFS Retd., NCCF
- Dr. Sunita Singh, PCCF (Social Forestry), Maharashtra

#### RAPORTEURS:

- Dr. Krishna Giri, Scientist-D, ICFRE
- Dr. Ashutosh Pathak, Scientist-B, ICFRE-FRI

**Dr. Anupam Joshi**, Senior Environmental Specialist, the World Bank delivered a talk on 'Nature-based solutions: Agroforestry for climate mitigation'. He emphasized on the making of national policy-driven nature-based solutions (NbS) and potential of agroforestry sector in achieving Nationally Determined Contributions (NDCs). Notably, the focus is on the categorization of the issues faced by the agroforestry

into four buckets viz., (1) Technical aspects (quality material for plantations, method of agroforestry models and certification of agroforestry industries); (2) Community organization, aggregation of small land farms for agroforestry, such as Forest Producers Organizations (FPOs); (3) Changes in transit and felling policies; (4) Carbon credit incentives to the farmers and industries.

#### LEAD TALKS:

1. Nature-based solutions: Agroforestry for climate change mitigation: Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank
2. Perspective of agroforestry in India & issues in the implementation: Dr. Devendra Pandey IFS Retd., NCCF, Noida
3. Perspective of agroforestry and farm forestry in India: Dr. Chandrashekhar Biradar Country Director, India, CIFOR-ICRAF, New Delhi

#### SESSION TALKS:

1. Status of agroforestry in Haryana: Sh. Jagdish Chander, PCCF & HoFF, Haryana Forest Department
2. Telanganaku Haritha Haram: Dr. G. Ramalingam, CCF, Social Forestry, Telangana Forest Department
3. Experience sharing status of agroforestry in Jammu & Kashmir: Sh. Roshan Jaggi, IFS, PCCF/Director, Department of Social Forestry, Jammu & Kashmir
4. Agroforestry models/ practices developed by ICAR: Dr. A. K. Handa, Principal Scientist, ICAR-CAFRI, Jhansi
5. Agroforestry models developed by ICFRE: Dr. Rajesh Sharma, ADG (BCC), ICFRE
6. Horti-techniques for making agroforestry more profitable in arid regions: Dr. P. R. Meghwal, Principal Scientist and Head, ICAR- CAZRI, Jodhpur



**Dr. Devendra Pandey**, IFS Retd., NCCF, Noida delivered a talk on ‘Perspective of agroforestry in India & issues in the implementation’. He presented a concise overview of birth of agroforestry system in country’s policies (National Forest Policy, 1988; 20-point program; MGNREGA, Green India Mission, etc.) and organizations, such as ICFRE, ICAR-CAFRI, universities and other institutions of national importance, involved in the development of agroforestry systems in India. The issues highlighted were absence of authentic

and reliable/ time series data of agroforestry related activities, lack of proper institutional setup, urgency of development of more quality planting materials, absence of marketing infrastructure, forest transit and felling regulations, lack of incentives and credit support to the farmers, agroforestry database improvement, adoption of certification system for agroforestry resources, more investment in agroforestry research, and poor extension services responsible for low popularity of agroforestry systems in India.



**Dr. Chandrashekhar Biradar**, Country Director India & Chief of Party- TOFI, CIFOR-ICRAF India/Asia Continental Program, New Delhi delivered a talk on 'Perspective of agroforestry and farm forestry in India'. The emphasis is on tree stewardships that lead to the fulfilment of people demands, green economy transition and governments commitment towards

national and international community. While providing solutions in terms of implementation of agroforestry, he highlighted farms and trees outside forests (TOFs) area to utilize ecosystem plus services, such as water recycling and management, continuous food supply, land management, and carbon sequestration.



**Sh. Jagdish Chander**, IFS, PCCF & HoFF, Haryana delivered a talk on 'Status of agroforestry in Haryana'. He stated that Haryana is a timber surplus state despite of one of the lowest forest cover acreages. Also, discuss about the plywood capital Yamuna Nagar which

get regular supply of wood through species, such as *Eucalyptus*, Poplar and *Melia*-based agroforestry systems and agroforestry practices boosting the socio-economic upgradation in the state.



**Dr. G. Ramalingam** IFS, CCF (Social Forestry), Telangana delivered a talk on 'Telanganaku Haritha Haram'. He presented the outcomes and activities carried out under Telangana ku Haritha Haram scheme to increase the forest cover in the state besides shared the use of digital platform USAID's Forest Plus 2.0 as decision support system for species selection in agroforestry. Since the implementation of scheme in

2015 up to 2021, the state forest and green cover has increased up to 6.85 and 7.70%, respectively. Notably, while providing detailed account of Bamboo, Teak and Sandalwood-based agroforestry models, he mentioned that *Melia dubia*, *Morus alba*, and *Eucalyptus*-based agroforestry models are also adopted and popularized in three agro-climatic zones of the state.



**Sh. Roshan Jaggi**, IFS, PCCF (Social Forestry), Jammu & Kashmir delivered a talk on 'Experience sharing: Status of agroforestry in Jammu & Kashmir'. The impetus given to the state transit policy impacts the economy and livelihood of local people, while quoting success stories of Kashmir willow and poplar-based pencil and fruit box industries. Arguably, the timber

load on forest of Jammu & Kashmir declined in the past few decades and the demand are now fulfilled by the TOFs and agroforestry practices. He also highlighted the challenges of poplar-based agroforestry system faced due to plantation of high yielding apple variety in the region.



**Dr. A.K. Handa**, Principal Scientist, ICAR-CAFRI, Jhansi delivered a talk on 'Agroforestry models/practices developed by the ICAR'. He informed that the Institute is having 37 coordinating units of AICRP on agroforestry representing all agro-climatic zones of the country. Mentioning that agroforestry directly and indirectly addresses nine sustainable Development Goals. He highlighted the achievements of CAFRI in the field of agroforestry research across the nation. Dr. Handa also presented key highlights of successful agroforestry models for the species, such as Poplar, *Eucalyptus*, Teak, *Melia*, Bamboo, *Gmelina arborea*, *Ailanthus*, *Ceiba pentandra*, *Acacia mangium*, *Dalbergia*, Gum and resin trees with sericulture and apiculture aspects in different parts of the country. An overview of *Har Med Par Ped - Boundary Plantation* scheme of

Govt. of India and extension strategies developed by the CAFRI underlined to overcome the key challenges, such as lack of awareness and inadequate reach of agroforestry technologies, transport and marketing of agroforestry products, manpower for extension, infrastructure and incentives and lack of information & sources regarding quality planting materials, etc. in the promotion of agroforestry practices. He suggested probable solutions by multi-directional approaches, namely cluster-based approach, mainstreaming with frontline extension, information and communication technologies enabled extension, collective action, PPP in extension or consortium approach, agri-start-ups, innovative funding mechanism, and convergence, networking and capacity building for the promotion of agroforestry.



**Dr. Rajesh Sharma**, Assistant Director General (Biodiversity and Climate Change Division), ICFRE delivered a talk on 'Agroforestry models developed by the ICFRE' for seven agroclimatic zones of the country, viz., *Salix* and Apple based-agroforestry for Trans Himalayan Region; *Melia*, Poplar, *Eucalyptus* based-agroforestry for Western Himalayan Region and Indo-Gangetic Plains; *Arecanut* and *Gmelina arborea* based-agroforestry in Eastern Himalayan Region; Poplar based-agroforestry in Gangetic Plain Region; Teak, Bamboo, Bach, *Flemingia*,



Ari-lac, Babul and Sandalwood based-agroforestry for Plateaus; *Hardwickia binata*, *Emblica officinalis*, *Colophospermum mopane* and *Prosopis cineraria* agroforestry in Western Dry Region; and *Casurina*, *Acacia*, Teak, based-agroforestry in Coastal Plains and Ghats. While presenting the tree-crop composition

models in various agroforestry types and economic returns from aforementioned models, he informed that ICFRE has released 69 high yielding clones from 2010 up to now having very high potential to upscale the agroforestry contribution in the country's GDP.

**Dr. P. R. Meghwal**, Principal Scientist, ICAR-CAZRI, Jodhpur delivered a talk on 'Horti-techniques for making agroforestry more profitable in arid regions' highlighting the major agroforestry species in arid regions with emphasis on ecological and socio-economic importance of Khejri (*Prosopis cineraria*), Lasora (*Cordia myxa*), Goondi (*C. sinensis*), and improved varieties, such as Maru, Samridhi, Karan Lasora and Thar Bold-based agroforestry systems. He also spoke about the importance of selecting desirable types, clonal propagation, systematic planting and better management under agroforestry systems for earning more profits from aforementioned agroforestry species.



2.3.

## TECHNICAL SESSION-II



### QUALITY PLANTING MATERIALS FOR SCALING UP OF AGROFORESTRY AND FARM FORESTRY PRACTICES

#### PANELLISTS:

- Dr. Suresh Gairola, FSC India Country Director
- Sh. R.K. Sapra, Retd. PCCF Haryana

#### RAPPORTEURS:

- Dr. Gaurav Mishra, Scientist-D, ICFRE
- Dr. Abhishek Verma, Scientist-B, ICFRE-FRI

Panellists started the session with the idea of operational land holding prevalent in India, where average size of 2.28 ha in 1970-71 had been decreased to 1.08 ha in 2015-16. Session was mainly focused on quality planting material (QPM) and its availability for agroforestry and farm forestry, along with the emphasis on QPM nursery.

Dr. Suresh Gairola posed following questions to the speakers of the session to address in their talks:

1. How QPM can make a difference?
2. What are the Impediments in scaling up QPM availability for agro/ farm forestry and how to address them?

#### LEAD TALK:

1. Quality planting materials for productivity enhancement under agroforestry and farm forestry practices: Dr. R.C. Dhiman, MD Retd., WIMCO Seedling Limited

#### SESSION TALKS:

1. Quality planting material and high yielding varieties for agroforestry developed by ICFRE: Dr. Ashok Kumar, Scientist G, ICFRE-FRI, Dehradun
2. Increasing Productivity of Agroforestry and Farm Forestry Plantations High Yielding Varieties Developed by ICFRE for Southern India: Dr. A. Nicodemus, Scientist G, ICFRE-IFGTB, Coimbatore
3. A value chain on industrial agroforestry-consortium approach: Dr. K.T. Parthiban, Dean, Tamil Nadu Agricultural University
4. Bamboo cultivation and its application in Maharashtra: Sh. M. Srinivasa Rao, MD, Maharashtra Bamboo Development Board
5. Industrializing Bamboo: Sh. Sanjay Singh, Director, Green Solution India

3. How QPM know-how can be transferred to the fields? Best model(s) for developing QPM nurseries and uptake?
4. How to develop better synergies between forest and agriculture ministries/ departments?
5. What are the expectations from Govt. of India, State Governments, Private sector industries, Industry Associations, Research institutions, and Agro/ farm forestry practitioners?

**Dr. R.C. Dhiman**, MD Retd., WIMCO Seedling Limited delivered a talk on 'Quality planting materials for productivity enhancement under agroforestry and farm forestry practices'. He emphasized that QPM must



be disease free, physically sound, and physiologically active. According to him, evaluation of QPM should be based on material and performance attributes. For instance, juvenile part of plant is more important

for the development of QPM and recommends that nursery practices should be standardised for the development of QPM.



**Dr. Ashok Kumar**, Scientist G, ICFRE-FRI, Dehradun delivered a talk on 'Quality planting material and high yielding varieties for agroforestry developed by ICFRE'. He emphasized the importance of QPM certification and stated that a total of 69 varieties/clones were already released by ICFRE institutes,

including *Melia dubia*, *Causurina* sp., etc. While advocating Neem tree (Neem oil in coating urea) as a potential commercial crop, Dr. Ashok recommended that procedure for release of cultivars for forest trees and its notification through Gazette of India needs to be clearly defined.



**Dr. A Nicodemus**, Scientist G, ICFRE-IFGTB, Coimbatore delivered a talk on 'Increasing productivity of agroforestry and farm forestry plantations high

yielding varieties developed by ICFRE for Southern India'. His focus was on wood demand and supply in Southern India, major farm forestry species,

varieties released, their commercialization, realized gains, opportunities and challenges. He talked about cooperative tree improvement for optimal use of resources, requirement of new varieties for both industrial wood and ecosystem services. While

emphasizing sustaining yield and declining soil fertility under long-term cultivation, he recommends that there is need to reduce the dependence on exotics, while more focus should be on indigenous species.



**Dr. K.T. Parthiban**, Dean, Tamil Nadu Agricultural University delivered a talk on 'A Value Chain on Industrial Agroforestry Consortium Approach'. His focus was on wood-based industries and demand pattern in Tamil Nadu, approaches and strategies, constraints and challenges, research interventions, technological interventions, promotional models, market interventions, institutional credit for agroforestry

trees, consortium of industrial agroforestry, and impact of agroforestry value chain model. In between the discussion, Dr. Gairola suggested that industrial agroforestry consortium approach as developed by TNAU should be followed by the state forest departments in collaboration with agricultural institutions throughout the country.



**Sh. M. Srinivasa Rao** IFS, Managing Director and Additional PCCF, Maharashtra Bamboo Development Board, Nagpur delivered a talk on the topic 'Bamboo cultivation and its cultivation in Maharashtra'. Sh. Rao demonstrated about Maharashtra Bamboo Development Board and its functionaries. He mainly

emphasized that bamboo is playing an important role in socio-economic elevation of the society and also contributed to the biodiversity enhancement. A bamboo treatment plant has also been installed to treat the bamboos and farmers fair is being organized regularly for various benefits.

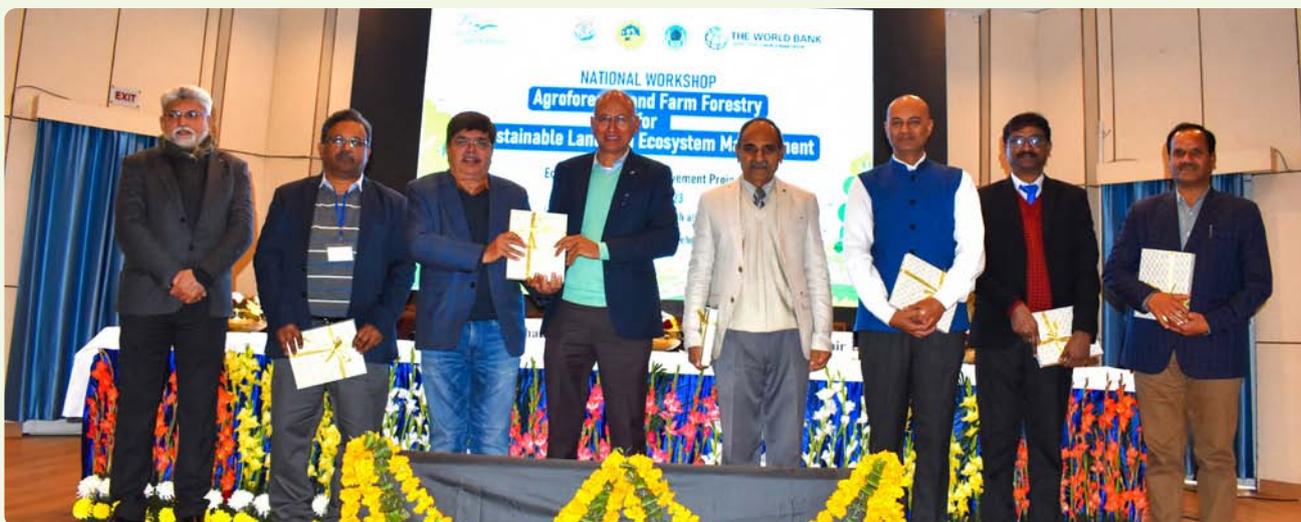


**Sh. Sanjay Singh**, Green Solutions India delivered a talk on 'Industrializing Bamboo'. With focus on the growth of bamboo spp. in Indian forests with its import and export. He illustrated about the bamboo composite wood industries, engineered bamboo and requisites of bamboo for industrial activities. He also highlighted that robust supply chain management system is required to meet the demand of bamboo industries and recommended that appropriate approaches should be adopted to meet the gap between industrial demand and supply.



During the panel discussion of the technical session, Ms. Alka Bhargav, Former PCCF & HOFF, Assam suggested the usage of bamboo certification manual as developed

by the National Bamboo Mission. Dr. Devendra Pandey highlighted the issue of up-scaling the harvesting machinery of bamboos.



2.4.

## TECHNICAL SESSION-III



### RATIONALIZATION OF POLICIES AND REGULATORY REGIMES FOR DEVELOPMENT OF AGROFORESTRY AND FARM FORESTRY

#### PANELLISTS:

- Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank
- Sh. Aditya Kumar IFS, PCCF & HoFF, Manipur Forest Department

#### RAPORTEURS:

- Dr. Krishna Giri, Scientist-D, ICFRE
- Dr. G.S. Uma, Scientist-B, ICFRE-FRI

**Sh. Bivash Ranjan**, Additional Director General of Forest, MoEFCC delivered a lead talk on 'Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry w.r.t. environment and forest sector' and highlighted the efforts of the Ministry for policy issues and transit rules for agroforestry species and trees grown outside the forest.

#### LEAD TALK:

1. Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry w.r.t. environment and forest sector: Sh. Bivash Ranjan IFS, Additional Director General of Forest, MoEFCC

#### SESSION TALKS:

1. Imperative of an industry led agroforestry planning in India: Ms. Alka Bhargava IFS Retd., Former PCCF&HOFF Assam and Former Additional Secretary, MoAFW
2. National Agroforestry Policy implementation status and gaps: Sh. R.B. Sinha IFS Retd., Senior Policy Advisor (Natural Resources) & Project Director GEF Green-Ag Project, FAO



**Dr. Alka Bhargava** IFS Retd., former PCCF & HoFF Assam, and former Additional Secretary, MoAFW delivered a talk on 'Imperative of 'Industry Led' Agroforestry Planning in India'. She flagged the issue of sharp decline from ~10 million cum timber in 1970 to ~3 million cum from forests after 1996, subsequent to the Godavarman judgment which mandated working plans based on forest felling and stressed the cultivation of multipurpose tree species in agroforestry and farm forestry. While advocating a landscape approach and integrated farming system, she focused on enhancement of carbon sequestration and ecosystem services from the degraded ecosystems. In addition, she underlined the opportunities for TOF as mosaic restoration in ~50 Mha area with the

largest potential in rainfed farmlands identified by the "Restoration Opportunities Atlas of India" (WRI, India) specifically in the sunrise sector; new age bamboo paper; medicinal and beauty wellness industry; food and nutrition sector; tree born oil seeds; lac; silk and honey; as potential areas with a proactive role of industry-led Skill Council to address the complete value chain and social and gender inclusion. Dr. Bhargava also suggested establishing primary processing units near bamboo plantations and establishment of CFCs with industries to address the high mill delivered price due to the limitations of transport distance, subsidized transport for agri produce, contract farming, and indigenous production of bamboo pulp to reduce the import.



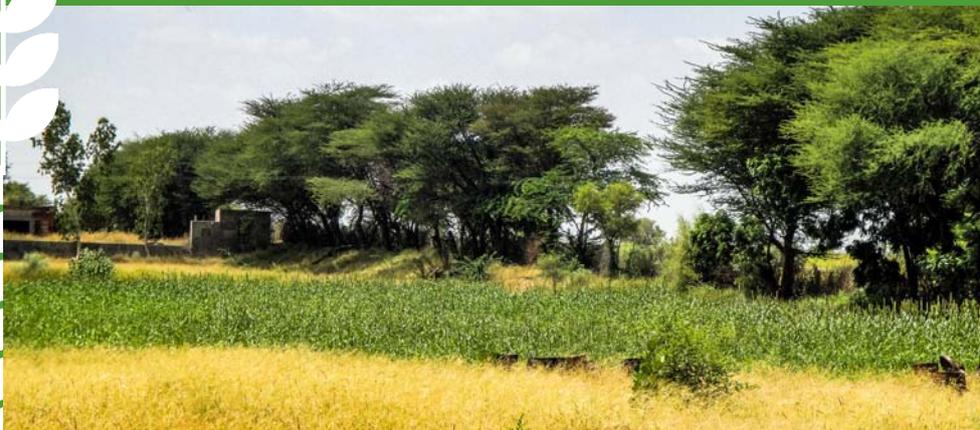
**Sh. R.B. Sinha** IFS Retd., Senior Policy Advisor (Natural Resources) & Project Director GEF Green-Ag Project, FAO delivered a talk on 'National Agroforestry Policy implementation status and gaps' and advocated that the states should create enabling environment and legislation besides simplify the regulations related to forestry, land use & land tenure, especially those linked to harvesting and transportation of trees grown on farms. He suggested promoting market-driven agroforestry models, economic valuation of agroforestry systems for

determining minimum support price for agroforestry produce, and agroforestry research in the government and private sector, particularly for multipurpose indigenous species with higher nitrogen-fixing ability, so as to meet the local needs for fuel, fodder and timber as well as improving the soil health. While highlighting agroforestry as a course curriculum in school education and motivating youths to grow and conserve trees, he emphasized on outreach programs of KVKs for popularizing the high-yielding varieties.



2.5.

## TECHNICAL SESSION-IV



### CERTIFICATION FRAMEWORK AND MARKET MECHANISM FOR AGROFORESTRY AND FARM FORESTRY

#### PANELLISTS:

- Dr. R.C. Dhiman, MD Retd., WIMCO Seedling Limited
- Dr. Alka Bhargava IFS, Retd., former PCCF & HoFF Assam

#### RAPORTEURS:

- Dr. S.S. Bisht, Scientist-E, ICFRE-FRI
- Dr. G. Bala Ganesh, Scientist- B, ICFRE-FRI

#### LEAD TALK:

1. Certification framework for plantations, quality planting material and nurseries: Dr. Suresh Gairola, FSC India Country Director

#### SESSION TALKS:

1. Standards for certification of agroforestry & farm forestry produces: Sh. A.M. Singh, IFS Retd., NCCF, Noida
2. Certification in Indian context-forest and agroforestry: Dr. M.P. Singh, Director, IWST, Bengaluru
3. Carbon market certification for agroforestry and farm forestry: Dr. Lokesh Chandra Dube, Senior Standard Manager, Gold Standard Foundation
4. Supporting market mechanism under agroforestry through carbon finance and minimum support price: Dr. Syed Arif Wali, TERI, New Delhi

**Dr. Suresh Gairola**, FSC, India Country Director delivered a talk on 'Certification Framework for Plantations, Quality Planting Material and Nurseries' and briefed about the certification, accreditation and standardization terminologies. He highlighted the achievements of Forest Stewardship Council in India and informed the house about that FSC has come out with standard for small landholders in India being pilot tested with less than 20 ha. area. Further, he also informed the gathering that 'National Certification System for Tissue Culture Raised Plants (NCS-TCP)' is being implemented by the Department of Biotechnology, Govt. of India, as per the Gazette of

India Notification under the Seeds Act (1966). Notably, NCS-TCP has been instrumental in building capacities of the tissue culture companies for producing quality planting material and also enhancing their market reach through a certification process. While briefing on seed certification and Quality Planting Material (QPM) as an essential input in agriculture and forestry for maximizing revenues, he focused on improving adaptability of QPM to adverse environmental conditions which meet the requirement of markets. He broadly explained about the Organization for Economic Cooperation and Development (OECD), Forest Seed and Plant Certification Scheme, procedure



for certification of nurseries and QPM. During discussion, one of the panelists Dr. Alka Bhargava pointed out that ICFRE and its institutes can work on

the certification, accreditation and standardization framework for plantations, QPM and nurseries.



**Sh. A.M. Singh** IFS Retd., Network for Certification and Conservation of Forest, Noida delivered a talk on 'Standards for Certification of Agroforestry & Farm Forestry Produces' and briefed about India's land use, forest and agroforestry profile, and detailed the standard setting process of the TOF certification scheme in India being followed by the NCCF. While explained the structure and components of the TOF

certification standard and its implementation, he informed that wood-based industries (WBIs) face challenges in procurement of consistent supplies of desired grade and raw material. Moreover, small scale farmers are unable to fetch the supply of certified raw material. He suggested, there is a need for industry and farmer collaboration to grow desired species, ensuring buyback and sustained supply of raw material to WBIs.



**Dr. M.P. Singh**, Director, ICFRE-WST, Bengaluru delivered a talk on 'Certification in Indian context-forest and agroforestry'. The main emphasis of his talk was the certification framework of wood and wood products growing in and outside the forest. Dr. Singh informed that certified wood is not mandatory in many countries but they recognize "Legal wood" by referring to 'Lacey Act' of USA, EUTR and Australian Illegal Logging Prohibition Act, etc., where legitimacy of forest produce should be proved with "due diligence" process. He informed that there are a number of certification systems prevailing across the globe for certifying timber from private forest, most of these certifications are directed towards supply of timber from forest land. However, none of them suit the certification of agri-wood produced from the Indian agroforestry systems as most of the farmers in India are small and marginal. Speaker briefed the sustainable forest management in Indian Scenario, in which he mentioned the paradigm shift from timber production to forest conservation by referring to Forest Conservation Act (1980), National Forest Policy, 1988 and Godavarman case (1996). The delegate emphasized on the need of Indian Certification System by giving an example of Bhopal-India Process (BIP) which is one of the nine global initiatives on Criteria and Indicators approach

for Sustainable Forest Management. While briefing about the relevance of certification of farm grown wood, he informed that WBIs are not getting assured supply of wood which is considered as 'legal' for export purposes. Moreover, timber produced in India is not certified as per the norms of international certifying agencies. Thus, not recognized in the international markets as legally produced timber. Dr. Singh informed that AgriWood® is the standard developed for legality assessment, verification of legality and chain of custody of farm wood through certificate of origin and chain of custody. Speaker given following benefits of AgriWood® standards in the nutshell- Application of Information Technology in AgriWood system provides a platform for better trade opportunities and ease of business. AgriWood provides legality to the farm wood and hence, boost the export wood products to many countries who demand "Legal Wood". Enhance carbon sequestration in farmlands and contribute to India's international commitment of reducing greenhouse gas emissions. It also contributes to satisfy the domestic need and saves foreign exchange. It plays an important role in reducing the pressure on natural forests and indirectly promotes biodiversity conservation for agroforestry wood and wood products.



**Dr. Lokesh Chandra Dube**, Senior Standard Manager, the Gold Standard Foundation delivered a talk on 'Carbon Market Certification for Agroforestry and Farm Forestry'. He talked about the current status of forest-based carbon market, carbon in agroforestry

and farm forestry, applicable certification standards, and how to select a suitable standard with gold standard difference? While explaining about Clean Development Mechanism (CDM), International Carbon Market and Voluntary Carbon Market, he informed



that CDM was established by the UNFCCC during Kyoto Protocol, which is a market-based mechanism that included developing countries as host Parties to implement mitigation projects. VCM aims to balance the emission footprints of activities, products and services of a company, organization or individual by trading Voluntary Emission Reductions to achieve carbon neutrality. The speaker informed about various applicable certification standards, such as Gold Standard, Verified Carbon Standard, American Carbon Registry, Climate, Community and Biodiversity

Standards, and Plan Vivo. He suggested that while selecting certification standards some critical steps need to be considered carefully, keeping in line with national policies and schemes. Explaining the 'Gold Standard as: sets requirements to design projects for maximum positive impact in climate and development to measure and report outcomes in the most credible and efficient way'. Lastly, informed about the Gold Standard Difference, comparison of provisions on environmental and social safeguards to assess impact during sustainable development.



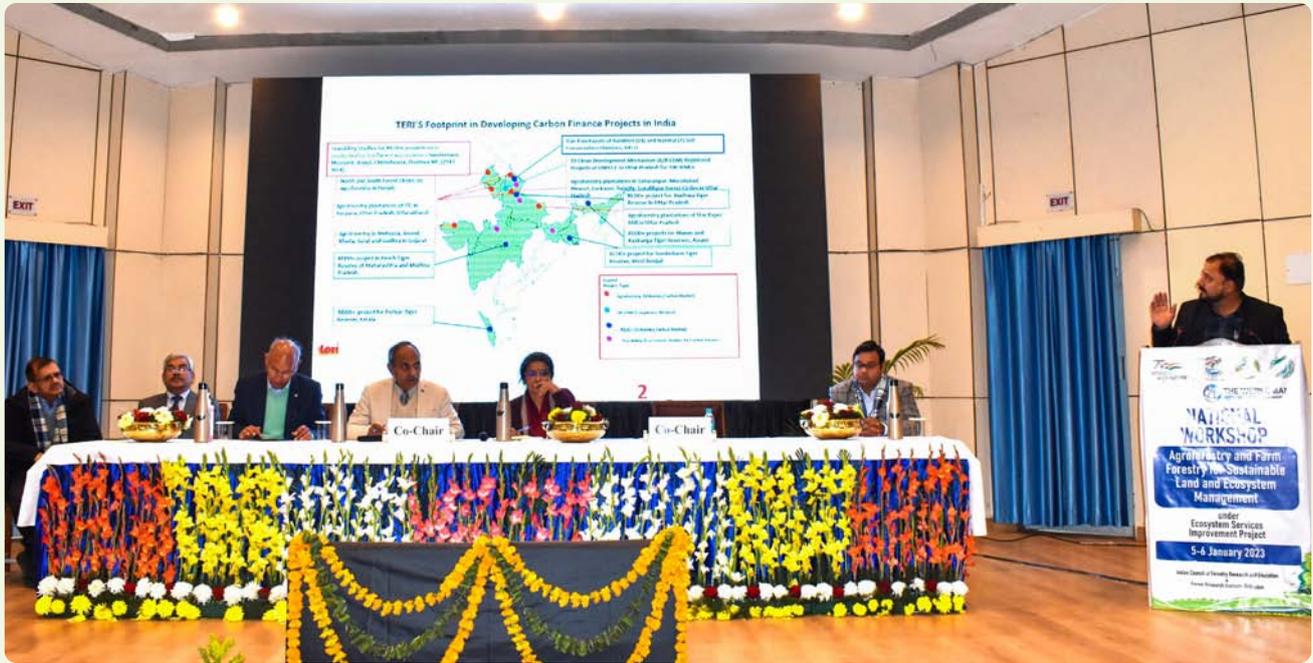
**Dr. Syed Arif Wali**, TERI, New Delhi delivered a talk on 'Supporting market mechanism under agroforestry through carbon finance and minimum support price'. He informed about the role and achievement of TERI in the forestry and biodiversity sector related to climate change issues in different states of India. TERI has been particularly active in studies and research pertaining to carbon financing and organization has successfully implemented and registered Afforestation Reforestation Clean Development Mechanism Project under Uttar Pradesh Participatory Forest Management and Poverty Alleviation Project and Agroforestry carbon Finance Projects in various states. He also explained about carbon finance which aims to reduce the emission in terms of carbon. Carbon Finance is an initiative by which the global community expects to capture the environmental risk in financial terms which allows companies wishing to offset their own emissions to buy carbon credits earned from the sustainable projects. The main focus of carbon finance

is on the idea of carbon trading. He stated various voluntary carbon market platforms, such as Verified Carbon Standard, Social Carbon, CCB Standards VER+, Plan Vivo, etc. He also explained about VERRA, which sets the world's largest voluntary standards for climate action and sustainable development. It is considered to be a universal and base quality standard, having certified reductions of more than 200 million tCO<sub>2</sub> eq. VERRA works with governments, businesses, and civil society to advance the use of standards, including through the development of markets. Dr. Wali talked about various agroforestry projects in different states of the country, such as improving rural livelihood through agroforestry practices in Punjab, voluntary carbon market project for agroforestry plantation in Gujarat, and strengthening rural livelihood through carbon finance: agroforestry practices in Uttar Pradesh. Speaker also highlighted following benefits to the farmers- Farmers will be free to sell timber /wood in the market as per the primary objective of the plantation.

It would promote and support farmers by providing additional assured financial benefits out of carbon sequestration done by the plantations. WBI can be made self-reliant for procuring the indigenously grown timber through agroforestry plantations. This would not only strengthen the livelihood opportunities of

the farmers but also help to improve their income by providing compensation for carbon sequestration in the form of carbon finance as a motivational source.

Presentations made by the speakers of the workshop during the national workshop are placed at Annexure – III.







## PANEL DISCUSSION: EXPERIENCE SHARING BY THE REPRESENTATIVES OF WOOD- BASED INDUSTRIES, FARMERS AND NGOS.

### PANELLISTS:

- Dr. M.P Singh, Director, ICFRE-IWST, Bengaluru: Co-chair
- Sh. R. K. Dogra, Deputy Director General (Administration), ICFRE: Co-chair



This session was primarily based on the experience sharing by the representatives of Wood Based Industries, farmers and NGOs. Following representatives from the wood-based industries shared their experiences regarding agroforestry and farm forestry:

1. Dr. Gajendra Rajput, Vice President, Wood Technologist Association, Yamunanagar
2. Sh. Navneet Gujjar, Kandla Timber Bhawan, Gandhidham, Kutch, Gujarat
3. Sh. P.K. Kullia, J.K Paper Mill Ltd., Odisha
4. Sh. M.V.R. Murti, J.K. Paper Mill Ltd., Odisha

5. Sh. Narayan Swamy, Secretary Coimbatore Herbal and Tree Grower's Association

The following representatives of farmers also shared their experiences regarding agroforestry and farm forestry:

1. Sh. U. Sharnappa, Karnataka
2. Sh. Abhay Chaudhary, Shamli
3. Sh. Shyam Singh, Shamli
4. Smt. Kamla Kaira, President, Mahila Kissan Paudhalay Samuh, Almora
5. Sh. Bhopal Singh, President, Jaivividhta Prabandhan Samiti, Almora







## PARALLEL SESSION: KNOWLEDGE SHARING AND LEARNING SESSION FOR SCALING UP OF AGROFORESTRY AND FARM FORESTRY PRACTICES FOR SUSTAINABLE LAND AND ECOSYSTEM MANAGEMENT

Parallel Session on knowledge sharing and learning session for scaling up of agroforestry and farm forestry practices for sustainable land and ecosystem management was also conducted in the form of an exhibition, poster presentation, and documentaries. A total of 35 stalls were raised by representatives of NGOs, science and technology organizations, wood-based industries and farmers, and tree growers. A survey was done to see various exhibits and found the following firms showcasing their products:

1. Extension Division, FRI, presented various knowledge materials (Books, Publications, and Pamphlets) related to Bamboo cultivation, livelihood, and posters of food from the forest and various agroforestry models based on Aonla, Gamber, and Gmelina arborea.
2. Indian Institute of Petroleum, Dehradun, presented their research activities in the form of a poster presentation and demonstrated their developed products such as novel fuel-efficient domestic cooking burner for PNG, improved biomass stove (*Chullha*), Biodiesel from various Non-edible feedstock, biochar & biomass pellets, etc.
3. ICAR-Indian institute of soil and water conservation, Dehradun, presented posters on Integrated Farm Systems for water harvesting, land degradation problems in India, Vegetative measures of soil and water conservation, and bioenergy measures for torrent control.
4. Patanjali Organic Research Institute, Hardwar, exhibited all organically produced vegetable and crop seeds, and organic fertilizers.
5. JK paper mill, Raigada, Orissa, showcased the posters on how JK Paper Mill has improved the livelihood of people by involving them in their plantation activity and how they are promoting intercrops like lemongrass with ginger, cotton with Casuarina, Casuarinas with tomato and Eucalyptus with Ragi, etc.
6. Green Panel Industries, Udham Singh Nagar, showcased the green panels and MDF made from Eucalyptus that fire retardant, wormproof, and waterproof.
7. Watershed Management, Dehradun, demonstrated various handmade products like handcrafted paintings, slippers made from bhimal, homemade pickles, etc. by involving local communities.
8. ITC Ltd., Secunderabad, Telangana, exhibited different variants of Eucalyptus used for making papers, and horticultural plants being supplied to horticultural departments like guava, apple, etc.
9. National Forest Library and Information Centre, FRI, Dehradun, showcased around 84 publications by FRI, and ICFRE on various topics.
10. Forest Silviculture and Management Division, FRI, Dehradun, exhibited variants of Bambusa, Elaeocarpus, Terminalia, *Acer oblongum*, and Jacaranda, etc. overall 20 spp. Of forestry and medicinal and fruit spp.
11. Forest Genetics and Tree Improvement Division, FRI, Dehradun, presented 8 different genetically modified tree species including *Toona ciliata*, *Shorea robusta*, *Terminalia belerica*, *Delbergia latifolia*, etc.

12. Chemistry and Bioprospecting Division, FRI, Dehradun, exhibited their developed products like Jivikalp (which is a new and improved binder for Agarbatti making), various products from pine needle fiber, Natural dyes for dying cloths, dhoopbati, different types of essential oils, and bio-composite, etc.
13. Forest product Division, FRI, Dehradun, presented five different types of wood-modified products from *Melia dubia*, and also showcased a sensor for detecting hollowness in the tree stem/ bole based on ultrasonic waves.
14. Forest Research Centre, Prayagraj, presented posters on various agroforestry models based on eucalyptus, aonla, teak, poplar, and *Melia dubia*. Also showcase the handcrafted products decorative along with seeds of *Oroxylum*, *Bombax ceiba*, *Bambusa tulida*, and *Terminalia chebula*.
15. Wood Technologist Association, Yamunanagar, Haryana, an organization acting as a bridge between the government of India and industries and well demonstrated various wooden products made by engineer wood.
16. Mahila Uttan Evam Bal Kalyan Sansthan, Dehradun, exhibited products produced by rural communities like Jhanghora, Tea, pickles, honey and pahadi salt, etc.
17. Gramya Vikas Sansthan, Ring Road, Dehradun, exhibited handcrafted products like purses, paper jewellery items, handbags, etc.
18. Krishi Van Research Centre, Dhulkot, Dehradun, presented various organically produced products like different types of honey, jams, pickles, cordyceps mushrooms, oyster mushrooms, vermicompost, eucalyptus oil, various flavored squash, appetizers, etc.
19. Modern Gramodhyog Sewa Sansthan, Tiliapur, Bareilly, exhibited cane products like baskets, lamps, mirror frames, photo frames, trays, and decorative items, etc.
20. Dastakar Bamboo Cane Development Producer Company LTD., Tiliapur, Bareilly, exhibited cane and bamboo products like trays, baskets, etc.
21. Bhartiya Gramotthan Sansthan, Rishikesh, presented handmade products like shawls, coats, sweaters, gloves, etc. all women's group organization.
22. Gangotri Kaushal Vikash Evam Utthan Samiti Shiv Shakti Swayam Sahayatra, Dehradun, exhibited various handmade products by village communities like bags, jakiya, arsey, etc. mainly involved in women empowerment.
23. Unnati Mahila Udyamita Avam Prakshishan Samiti, Vasant Vihar, Dehradun, exhibited eco-friendly products prepared by women communities and included decorative, hand paintings, flower vases, trays, baskets, etc.
24. Society for Educational, Vocational, and Advancement, Rishikesh, presented various jute-based products like various designed bags, slippers, robes, purses, file covers, etc. prepared by the rural community.
25. Bagwan Gramodyog samiti, Shyampur, Dehradun, exhibited various products produced by local people like diffusers, lemongrass oil, Stevia leaves, sugar-free tea, honey, etc.
26. Saraswati Jan Kalyan Evam Swarojgar Sanstan, Vasant Vihar, Dehradun: an organization working for prisoners and presented handcrafted bamboo and cane products like decorative, hanging lamps, trays, flower vases, baskets and carry bags, etc.
27. LIN Farma, Dhulkot, Dehradun, exhibited products like Jam, Jelly, pickles, mushrooms, and vermicompost and also conducts training for students.
28. Himalayan Environment Studies & Conservation Organization, Shuklapur, Dehradun, presented two made-in-India products - 1) a Desi Geyser capable of cooking food and heating 10 L of water simultaneously and 2) a Portable Water heater that can use electricity, fuelwood, or even induction to heat water.
29. AR Ansari & Sons (Forestry and AGRI Instruments) Roorkee, presented tools used in forestry measurements and surveys and exhibited more than 20 such products including increment borer, compass, callipers, etc.
30. Bhoomi Natural, Nagal Shamli, exhibited organic products like different types of organic Basmati rice, honey, moringa powder, pickles, etc.
31. SRI Enterprises, Saharanpur Chowk, Dehradun, exhibited products like pickles, flour of various cereals like mandua, bajra, Makka, and rice apart from handmade products bags, apparels, etc.
32. Nidhi Enterprises, Saharanpur Chowk, Dehradun, presented handmade shawls and other apparels.

- 33. Jaunsar Bawar Biocave, Dehradun, demonstrated various types of dressing materials and their products made by local people.
- 34. Sabina Swayam Sahayatasamoh, Sahaspur, exhibited handmade ready-to-eat meals made from millets, and handmade clothes by women communities.

- 35. VRIKSH, India's Timber Legality Standard, introduced itself as an organization promoting *Melia dubia* as a major timber tree spp. in India and also demonstrated various wood-based products like chairs, tables, outdoor chairs, photo frames, etc.





## CONCLUDING SESSION: SYNTHESIS AND FINALISATION OF RECOMMENDATIONS

The concluding session of the workshop was co-chaired by Sh. A.S. Rawat, Director General, ICFRE and Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank.

Sh. A.S. Rawat, Director General, ICFRE stated that deliberation made and experience shared by experts during the workshop would be worthwhile for providing the concrete inputs to the policy planners and land users for promotion of agroforestry and farm forestry for sustainable land and ecosystem management in the country. Further he stated that recommendations of the workshop will provide necessary inputs for addressing the issues and challenges or promotion of agroforestry and farm forestry in the country.

**Dr. Anupam Joshi**, Senior Environmental Specialist, the World Bank stated that agroforestry and farm forestry has immense potential to contribute to sustainable development and extension of green cover and meeting the wood and timber requirement of the country, and provide ample opportunity for the bio-economy and for support of forest-based industries, would play an important role in achieving India's national targets and international commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation and sustainable development goals.

A Committee of the following members has been constituted under the Chairmanship of Director General, ICFRE for finalizing the recommendations of National Workshop:

1. Dr. Jagdish Chandar, PCCF&HoFF, Haryana : Member
2. Dr. R.C. Dhiman, CIFOR-ICRAF – TOFI : Member
3. Dr. Rajesh Sharma, ADG (BCC), ICFRE : Member
4. Dr. A.K. Handa, Principal Scientist, ICAR-CAFRI, Jhanshi : Member
5. Dr. Dinesh Kumar, Scientist – G, FRI, Dehradun : Member
6. Shri. B.R. Narayanaswamy, Secretary, Herbal and Tree Growers Association, Coimbatore : Member
7. Shri M.V.R. Murty, J.K. Paper Mill Ltd., Odisha : Member
8. Dr. R.S. Rawat, Project Manager, ESIP, ICFRE : Member Secretary



At the end, **Dr. R. S. Rawat**, Project Manager, ESIP, ICFRE proposed a formal vote of thanks to all the delegates especially session chairs, panellists, speakers, experts and delegates for their lively discussions and exchange of knowledge and ideas on agroforestry and farm forestry for sustainable land and ecosystem management in the country. He also thanks to the World Bank and Ministry of Environment, Forest and Climate Change, Govt. of India for providing all kinds of support for organisation of the national workshop. He also thanked all the organisations and their officers and staff including personnel of ICFRE and FRI for their hard work and sincere efforts put in the successful organisation of the national workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management under the Ecosystem Services Improvement Project.





## RECOMMENDATIONS OF THE WORKSHOP

Following recommendations were made during the workshop for development of agroforestry and farm forestry for sustainable land and ecosystem management in the country:

1. Develop a Digital Agroforestry Management Information System (DAMIS) with geo-referenced database of agroforestry tree species and other species for trees outside forests (including trees growing in farm forestry, roadside, railway trackside, canal side, sacred groves and other) for different agroclimatic zones.
2. ICFRE and ICAR should collaborate closely to extend the ecologically sustainable and economically viable integrated agroforestry models with the defined tree, diversified crops and livestock components developed for different niches and agroclimatic zones to the farmers so as to bridge the demand and domestic supply gap and increase income to farmers.
3. Liberalize the regulatory system for promoting cultivation of high-value long-rotation tree species like teak, mahogany, red sanders, sandalwood, shisham and others species in agroforestry. States to be assisted in developing protection systems for the forest population of these species.
4. Diagnosing and documenting the best agroforestry practices and their scaling-up strategy with a focus on sustainable land and ecosystem management.
5. Defining and documenting parameters of quality planting material for most suitable agroforestry tree species, their sources of availability, and pricing for the end-uses at nominal cost.
6. Developing a framework for accreditation and star-rating of the nurseries for mass production of quality planting material and certification of quality planting materials.
7. Large-scale production of clonal materials of genetically superior and /or certified germplasm of commercially important agroforestry species in collaborative mode by industries, research organisations and growers for enhancement of farmer income and uptake of quality produce by industry.
8. Create awareness among Farmers/ tree growers and related stakeholders regarding new and released clones and varieties for use in agroforestry through appropriate means.
9. Reduce dependency on imported timber by promoting indigenous and underutilized tree species and perennials with a broad gene pool base for agroforestry. Continuously develop new genetically improved material and package of practices for higher yields and productivity in agroforestry.
10. Develop a policy for certification standards and their rolling out for agroforestry and farm forestry products. ICFRE and IIFM may take a lead to develop the Indian Forest Certification Framework for certification of agroforestry produced timber and NTFPs.
11. Develop necessary standards for certification of seeds, plants, quality planting materials and agroforestry and farm forestry produces by engaging all the stakeholders which may include ICFRE & its institutes, ICAR & its institutes, and state agriculture universities, state forest departments, private branded nursery growers and other national and international agroforestry agencies (e.g, CIFOR, ICRAF) operating in the country.
12. Developing and enforcing uniform felling and transit system for agroforestry produce across the country by operationalisation of the online National Transit Permit System being piloted



- by Ministry of Environment, Forest and Climate Change.
13. Create a domestic market mechanism for agroforestry produce to facilitate the adoption of agroforestry and farm forestry. Such a market system must ensure remunerative prices for agroforestry produce which needs to be higher than the traditional agricultural produce.
  14. Develop a standardized cost low-cost methodology for capturing and quantifying the carbon sequestered in agroforestry and develop domestic carbon financing and trade for the same.
  15. Promotion of poplars, eucalyptus, Casuarina and Melia species along with multi-purpose tree species in agroforestry under marginal/ degraded/ dry lands of farmers for income generation.
  16. Develop strategy and policy framework for fixing minimum purchase price for the tree crops produced by the farmers from agroforestry and farm forestry produce.
  17. Develop a technology-based solution for the movement of agroforestry products (timber/ wood) and develop on-farm primary processing technology to reduce transportation costs on agroforestry produce.
  18. Develop a mechanism for PPP-driven tools for effective harvesting starting with bamboo. ICFRE may take a lead to collaborate with suitable technological institutions for this purpose.
  19. Develop agroforestry entrepreneurship for economic revolution including development of bamboo value chain as a business enterprise.
  20. Develop an extension mechanism for sharing of knowledge and its dissemination for the extension of agroforestry-related research findings, best practices, and success stories from lab to land for sustainable land and ecosystem management.
  21. Developing and strengthening Van Vigyan Kendras (VVKs) on the pattern of Krishi Vigyan Kendra (KVKs) with trained manpower and demonstration plots for agroforestry extension.
  22. Creating a nodal agency and an institutional mechanism for agroforestry at both the central and state levels by roping in the human resources from forest and agriculture ministries and departments.
  23. Develop a suitable framework/ mechanism along with suitable safeguards for raising the plantation in the wastelands of the states for increasing tree cover and carbon sequestration, and meeting the industrial requirement of woods in a public-private partnership.
  24. Keeping in view the small land holdings of Indian farmers, Farmer Producer Organisations (FPO) and Cooperatives for agroforestry need to be formed under the scheme of Ministry of Agriculture and Farmers Welfare for Formation of FPOs.



## AGENDA OF THE NATIONAL WORKSHOP

| Day 1: 05 January 2023  |
|---|
| Registration of the Delegates: 0900 - 0930 Hrs  |
| <b>Inaugural Session: 0930 - 1030 Hrs</b>   |
| <ul style="list-style-type: none"> <li>● Lightning of the Lamp</li> <li>● Welcome and introduction to the workshop: Dr. Renu Singh, Director, ICFRE-FRI</li> <li>● Address: Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank</li> <li>● Address: Sh. A.S. Rawat, Director General, ICFRE</li> <li>● Address by the Chief Guest: Sh. Bharat Jyoti, Director, IGNFA, Dehradun</li> <li>● Vote of Thanks: Ms. Kanchan Devi, Director (IC) &amp; Project Director, ESIP, ICFRE</li> </ul>  |
| Group Photo followed by Inaugural Tea 1030 - 1100 Hrs   |
| <b>Technical Session I: Agroforestry and farm forestry practices for sustainable land and ecosystem management: 1100- 1300 Hrs</b>  |
| <p><b>Panellists:</b></p> <p style="padding-left: 20px;">Sh. A.M. Singh, IFS Retd., NCCF - Co-chair<br/>Dr. Sunita Singh, PCCF (Social Forestry), Maharashtra - Co-chair</p>  |
| <p><b>Lead Talk:</b></p> <ol style="list-style-type: none"> <li>1. Nature-based solutions: Agroforestry for climate change mitigation: Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank</li> <li>2. Perspective of agroforestry India and issues in the implementation: Dr. Devendra Pandey IFS Retd., NCCF, Noida</li> <li>3. Perspective of agroforestry and farm forestry in India: Dr. Chandrashekhar Biradar Country Director, India, CIFOR-ICRAF, New Delhi</li> </ol>   |
| <p><b>Session Talk:</b></p> <ol style="list-style-type: none"> <li>4. Status of agroforestry in Haryana - A case study: Sh. Jagdish Chander, PCCF &amp; HoFF, Haryana Forest Department</li> <li>5. Telanganaku Haritha Haram: Dr. G. Ramalingam, CCF, Social Forestry, Telangana Forest Department</li> <li>6. Experience sharing status of agroforestry in Jammu &amp; Kashmir: Sh. Roshan Jaggi, IFS, PCCF/ Director, Department of Social Forestry, Jammu &amp; Kashmir</li> <li>7. Agroforestry models/ practices developed by ICAR: Dr. A. K. Handa, Principal Scientist, ICAR-CAFRI, Jhansi</li> </ol> |
| <b>Lunch Break: 1300-1400 Hrs</b>   |
| <b>Technical Session I Continue: 1400-1500 Hrs.</b>   |
| <ol style="list-style-type: none"> <li>1. Agroforestry models developed by ICFRE: Dr. Rajesh Sharma, ADG (BCC), ICFRE</li> <li>2. Horti-techniques for making agroforestry more profitable in arid regions: Dr. P.R. Meghwal, Principal Scientist and Head, ICAR- CAZRI, Jodhpur</li> </ol>   |
| <b>Tea Break: 1500- 1515 Hrs</b>  |



**Technical Session II: Quality planting materials for scaling up of agroforestry and farm Forestry practices: 1515- 1700 Hrs**

**Panellists:**

Dr. Suresh Gairola, FSC India Country Director- Co-chair  
Sh. R.K. Sapra, Retd. PCCF Haryana- Co-chair

**Lead Talk:**

1. Quality planting materials for productivity enhancement under agroforestry and farm forestry practices: Dr. R.C. Dhiman, MD (Retd.), WIMCO Seedling Limited

**Session Talk:**

1. Quality planting material and high yielding varieties for agroforestry developed by ICFRE: Dr. Ashok Kumar, Scientist G, ICFRE-FRI, Dehradun
2. Increasing Productivity of Agroforestry and Farm Forestry Plantations High Yielding Varieties Developed by ICFRE for Southern India: Dr. A. Nicodemus, Scientist G, ICFRE-IFGTB, Coimbatore
3. A value chain on industrial agroforestry-consortium approach: Dr. K.T. Parthiban, Dean, Tamil Nadu Agricultural University
4. Bamboo cultivation and its application in Maharashtra: Sh. M. Srinivasa Rao, MD, Maharashtra Bamboo Development Board
5. Industrializing Bamboo: Sh. Sanjay Singh, Director, Green Solution India

**Technical Session III: Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry: 1700- 1730 Hrs**

**Panellists:**

Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank – Co-chair  
Sh. Aditya Kumar, PCCF & HoFF, Manipur Forest Department - Co-chair

**Lead Talk:**

1. Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry w.r.t. environment and forest sector: Sh. Bivash Ranjan, Additional Director General of Forest, MoEFCC, Govt. of India

**Day 2: 06 January 2023**

**Technical Session III: Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry.... Continue: 0930- 1100 Hrs**

**Session Talk:**

1. Imperative of an industry led agroforestry planning in India: Ms. Alka Bhargava, IFS Retd., Former PCCF&HOFF Assam and Former Additional Secretary, MoAFW
2. National Agroforestry Policy implementation status and gaps: Sh. R.B. Sinha IFS Retd., Senior Policy Advisor (Natural Resources) & Project Director GEF Green-Ag Project, FAO

**Tea Break: 1100- 1115 Hrs**

**Technical Session IV: Certification framework and market mechanism for agroforestry and farm forestry: 1115- 1300 Hrs**

**Panellists:**

Sh. Ashutosh, PCCF&HOFF, Bihar - Co-chair  
Dr. R.C. Dhiman, MD Retd., WIMCO Seedling Limited - Co-chair

**Lead Talk:**

1. Certification framework for plantations, quality planting material and nurseries: Dr. Suresh Gairola, FSC India Country Director

**Session Talk:**

1. Standards for certification of agroforestry & farm forestry produces: Sh. A.M. Singh IFS Retd., NCCF, Noida
2. Certification in Indian context-forest and agroforestry: Dr. M.P. Singh, Director, ICFRE-IWST, Bengaluru
3. Carbon market certification for agroforestry and farm forestry: Dr. Lokesh Chandra Dube, Senior Standard Manager, the Gold Standard Foundation
4. Supporting market mechanism under agroforestry through carbon finance and minimum support price: Dr. Syed Arif Wali, TERI, New Delhi

**Lunch Break: 1300-1400 Hrs**

**Panel Discussion: Experience sharing by the representatives of Wood Based Industries, farmers and NGOs.: 1400-1515 Hrs****Panellists**

- Dr. M.P. Singh, Director, ICFRE-IWST
- Sh. R. K. Dogra, DDG (Admin), ICFRE

**Tea Break: 1515- 1530 Hrs.**

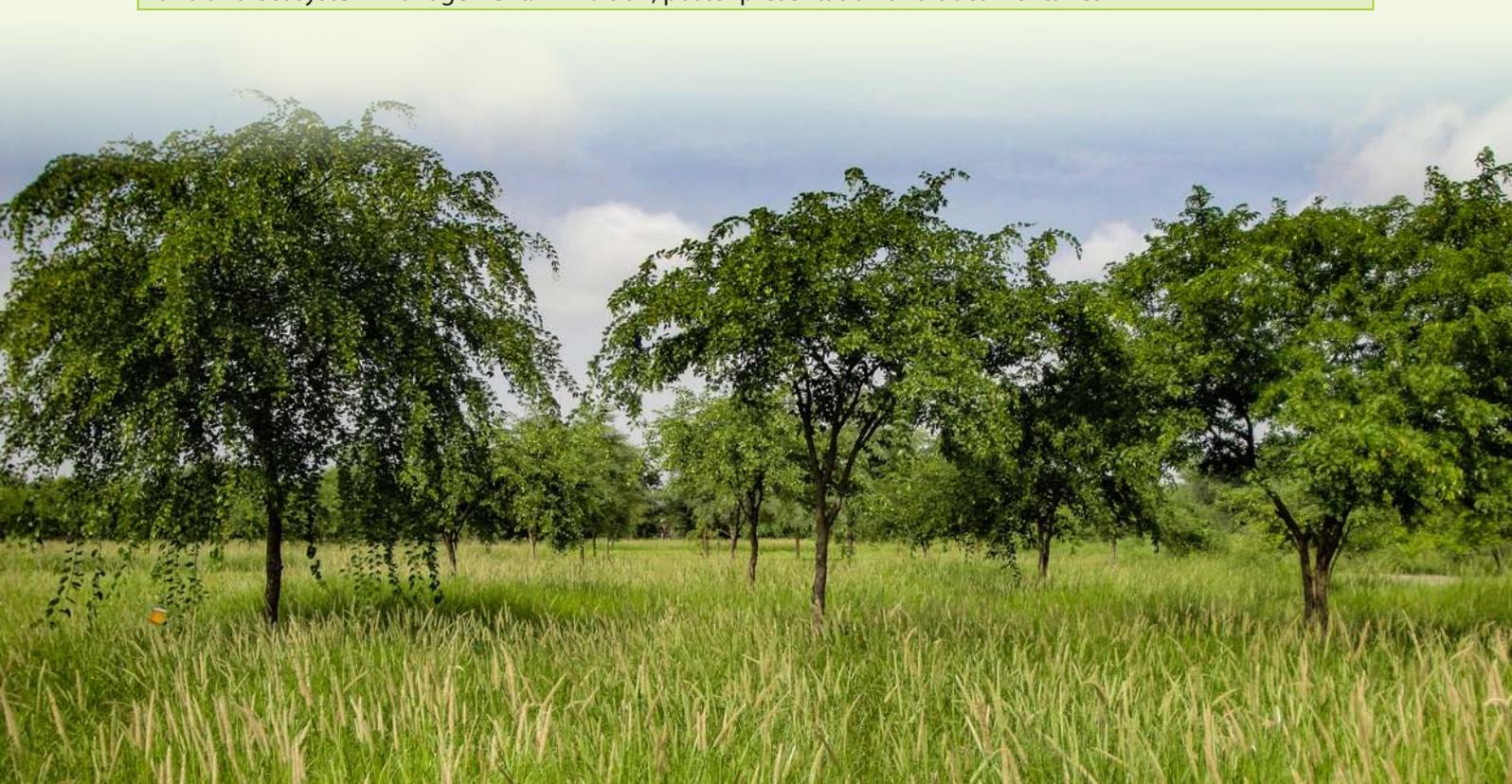
**Concluding Session: Synthesis and finalization of recommendations: 1530-1700 Hrs****Panellists**

- Sh. A.S. Rawat, DG, ICFRE
- Dr. Anupam Joshi, the World Bank

**Vote of thanks** by Dr. R. S. Rawat, Project Manager, ESIP, ICFRE

**Parallel Session (Day 1 & 2: 05 & 06 January 2023)**

Knowledge sharing and learning session for scaling up of agroforestry and farm forestry practices for sustainable land and ecosystem management: Exhibition, poster presentation and documentaries



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# PRESENTATIONS OF THE WORKSHOP SPEAKERS

## 1. Nature-based solutions: Agroforestry for climate change mitigation: Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank



### AGROFORESTRY

Nature-based Solutions for Climate Change Mitigation

**Dr. Anupam Joshi**  
Senior Environmental Specialist



NbS provide multiple benefits




**Afforestation/Restoration**

- Ecosystem Services
- Support to economy and human welfare
- Cultural values and mental relief

**Agroforestry**

- Livelihood support to farmers
- Support demand for industrial wood
- Could generate additional carbon credit \$\$

### Potential of Agroforestry

- Agroforestry could contribute nearly 25% of NDC sequestration target
- Agriculture Statistics at a glance 2021 = 37.33 Mha land available for tree cover enhancement (TOF)

| Land Use System    | EX-ACT model Rates of Carbon sequestration for South Asia tC/ha/year |                               | Literature based estimates of carbon sequestration rates for Semi-arid regions of India in tC/ha/year |                          |
|--------------------|--|-------------------------------|---|--------------------------|
|                    | AGB: Mean Above ground Biomass                                       | SOC: Mean Soil Organic Carbon | AGB: Above ground Biomass   | SOC: Soil Organic Carbon |
| Forest plantations | 7.45   | 0.43                          | 3.99  | 1.41                     |
| Agro-forestry      | 2.70   | 0.40                          | 1.26  | 0.59                     |
|                    | High Growth Scenario   |                               | Moderate Growth Scenario  |                          |

- HGS: Approx. **7 Mha required for agroforestry** & 8 Mha for afforestation
- MGS: Approx **17 Mha required for agroforestry** & 12 Mha for afforestation

### Rethinking Approaches for Promoting Agroforestry

- **Overhaul policy and institutional set up**
  - Review regulations and improve ease doing of business for agroforestry
- **Focus on technical aspects**
  - Ensure quality planting material at nominal cost in potential agroforestry areas and develop easy to understand package of practices
- **Strengthen outreach and support**
  - Rethink and rebuild Forest Extension Services and certification
- **Develop end-to-end market linkages**
  - Enroll private sector for setting up agroforestry value chains

## Thank you

|  |                    |   |
|--|--------------------|---|
| More Income for Marginal Farmers                   | <b>R</b> esilience | ✓ |
| Overcoming Industrial Wood Deficit and Fuel Crisis | <b>A</b> daptation | ✓ |
| NDC and Carbon Sequestration                       | <b>M</b> itigation | ✓ |



## 2. Perspective of Agroforestry in India & Issues in the Implementation: Dr. Devendra Pandey IFS Retd., NCCF, Noida

### Perspective of Agroforestry in India & Issues in the Implementation

**National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management**  
5-6 Jan 2023, ICFRE, Dehradun

**Dr. Devendra PANDEY IFS (retd)**  
Fmr PCCF (HoFF), Arunachal Pradesh & Fmr DG, FSI

### Practice of Agroforestry in India

- Agroforestry has been practiced in India since ages in traditional land-use system
- Launch of Social Forestry in 1970s gave a big boost
- National Forest Policy (NFP) 1988 gave further impetus- WBI to meet their requirement by self.
- Govt of India launched many programs/schemes to promote agroforestry/ farm forestry /tree planting
  - 20 point program,
  - MGNREGA
  - Green India Mission, etc.

- Erstwhile FRI & Colleges /ICFRE its institutes has been researching on various aspect of agroforestry.
- Organized effort in research by ICAR since 1983 by launching All-India Coordinated Research Project (AICRP) on Agroforestry
- Later establishment of the National Research Centre for Agroforestry (NRCAF)
- Finally upgraded to Central Agroforestry Research Institute (CAFRI) in 2014 in Jhansi
- Many State/ Central Agricultural Universities participate in agroforestry Research
- **Launch of the National Agroforestry Policy (NAP) in 2014 by Govt of India**

### Estimated Area Under Agroforestry and Farm Forestry

- ❑ Practiced in private land and no formal mechanism to assess the area or production of timber
- ❑ **Authentic and reliable /time series data is not available**
- ❑ CAFRI in collaboration with ICRAF mapped agroforestry area using moderate/coarse resolution satellite imageries
- ❑ Estimated under agroforestry/farm forestry is 26.32 mn ha
- ❑ FSI regularly estimates GS of Trees outside Forests (ToF)
- ❑ Guesstimated area of ToF including tree cover =29.5 mn ha (includes 6-7 mn ha horticulture crops, mango, coconut,rubber, cashewnut, tea/coffee estates)
- ❑ FSI has estimated the potential production of timber from ToF as 85.5 mn cubic meter.

### Issues in Implementation

- ❖ **Despite immense efforts by Govt to promote agroforestry in the country, there are still issues and challenges due to which NAP has not been able to make the desired impact.**
- ❖ **1. Lack of proper institutional setup at State/District and local level. Agriculture is State subject, the implementation of the NAP depends on states initiatives and financial resources.**  
--SFDs implementing SMAF but generally without a dedicated set up specially at local/ district level and as additional work.
- ❖ **2. Quality planting material is extremely important for high productivity & high economic return** commonly not available, resulting in low productivity and low economic return to farmers (presently ≈ 10% QPM).
- ❖ **3. Absence of appropriate marketing infrastructure:** Marketing of the trees grown by farmers is unorganised, thus problems in getting genuine price. Largely a buyer's market and middlemen get major share in profit. There is also lack of market information system for agroforestry products.

### Issues in Implementation

- ❖ **4. Cumbersome regulations relating to felling and transporting farm-grown timber within and outside states** and lack of uniform policies.
- The States which have least restriction on short rotation tree spp like Eucalyptus, Poplar, Casuarina, Melia, Acacia auriculiformis, Gmelina, Kadam, are very successful in raising large scale agroforestry.
- Directions issued by MoEF&CC has made impact countrywide but a lot of hiccups still exist
- ❖ **5. Lack of Incentives and credit support:** No incentives and institutional credits, input subsidy or insurance cover for agroforestry practice.
- --Basic reason is lack of technical and economic data different agroforestry models needed for financial evaluation.
- ❖ **6. Poor extension services,** agroforestry could not be popularized owing to inadequate awareness and lack of institutional support

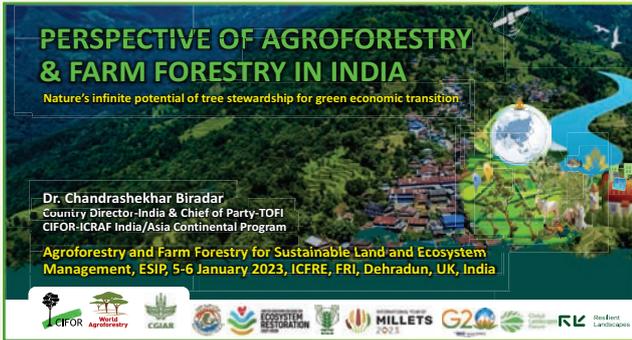
### Issues in Implementation

- ❖ **7. Improving Database of Agroforestry** -Being in informal sector, database on annual planting/harvest of trees, growing stock, annual production of wood and consumption by WBI is extremely week.
- ❖ **8. Adoption of Certification system for Agroforestry resources**  
Due to international regulations wood produced from agroforestry are not acceptable **unless certified**. NCCF has recently finalized one such scheme.
- ❖ **9. More investments in the field Research**  
Development of doable region specific Agroforestry models with suitable tree species which farmers can directly adopt for high return.
- ❖ **10. Promotion of High-value Tree species like teak, mahogany, red sanders, sandalwood in Agroforestry by liberalising restrictions**

**Agro-forestry is a typical win-win formula for many challenges that India is facing today- in increasing tree cover, meeting needs of industrial wood, carbon sequestration, enhancing farmers income etc.**

**Thank You**

### 3. Perspective of agroforestry and farm forestry in India: Dr. Chandrashekhar Biradar Country Director, India, CIFOR-ICRAF, New Delhi



**Focus points on prospects of agroforestry and farm forestry;**

- TREES SAVE TREES:** growing trees outside the forests and inside the farms save forests and contributes NDC targets, mission LIFE including UN SDGs, UNCCD, COPs, CBDs, ERAs...
- BREAKING SILOS:** breaking the silos through system approach for economically viable & ecologically sustainable models, regenerative, multilayer, multifunctional agroforestry (land use) and functional forestry (land cover)
- TREE STEWARDSHIP:** how agroforestry and TOF restore one health one system one world, collective action for restoration lead to more health and wealth per acre; and also both reducing and removal of CO2 equivalents
- ECOSYSTEM SERVICES PLUS (PES+):** REGENERATIVE CAN BE REVENUE GENERATIVE AS WELL: Tree based system for green economic transition- how can we turn regenerative agroforestry can be revenue generation agroforestry- economically viable and ecologically sustainable, PES+PLUS, Low Carbon Ag, Biodiversity Again, One-Health for all.
- LAND, WATER AND LIFE:** production follows functions, system approach to 'break working in silos' to restore interconnected clear cut linkages between land, water and life and co-benefits and mutualism



**Context specific prospects**

- The holistic system approach require **breaking the silos to meet growers' needs** (economically viable & ecologically sustainable).
- The **"#treestewardship"** is key to "breaking the silos" through nexus of right trees, crops, livestock, living soil and people to achieving **green economic transition**, NDC, LIFE and SGDs from baseline
- Success mantra for **#treestewardship**: the day at least **15% tree-deficit land-use becomes tree-surplus landscapes** for achieving NDC@2030, Vision@2047 and NetZero@2070,...
- Establish interconnectedness of different elements of the **#treestewardship** through **enabling environment- policies, incentives, investment**
- Collective action health of landscape (one-health) and provide adequate incentive for the ecosystem services provided by tree-stewardships



**TREES for Self-reliance & Green Economic Transition (GET)**  
The right tree for the right place and for the right purpose

**A. Timber** **B. Trees for Non-Timber TOF Products**

**C. Trees for Ecosystem Services**

[http://www.worldagroforestry.org/our\\_products/databases/switchboard](http://www.worldagroforestry.org/our_products/databases/switchboard)

**Tree of Life: Why Tree based systems**

trees are the sources of healthy life and planetary health

**RAIN MAKER** Source of water...  
**ENERGY BALANCE** temperature and evapotranspiration...  
**ELIXIR OF LIFE** fodder, fuel, energy...  
**PROVIDE SHADE** A single row of trees...  
**CARBON** Life matter low-cost...  
**WATER** Most product technology...  
**PEST CONTROL** Insect and disease control...  
**ONE-HEALTH** Source of...  
**SOIL HEALTH** For soil life...



### SYSTEM TRANSFORMATION

Restoration of Functional Agroecosystems

- Enabling environment**  
Steps in enabling regulations, standards, incentives for limited backwash effect
- Economic and investment**  
Incentives to invest in agroforestry, business & value chain support @ quality planting material
- Information access**  
Steps in enabling advisory services @ model suitability, monitoring @ data driven evidence

**Indicators of tree stewardship and resilience**

Ecological Scaling  
Economic Scaling

### LAND, WATER & LIFE

Degenerative to Regenerative

Compact Soil, Dead soil, Floods, Droughts, Degradation, Desertification

Return to functional agroecosystems

### Effects of Tree Cover on Water Cycle, Ecosystems, Climate Change at local, regional and continental scales

**Finding water amid the trees**

1. Precipitation is recycled by forests and other forms of vegetation and transported across terrestrial surfaces to the other end of continents. (2) Upward fluxes of moisture, volatile organic compounds and microbes from plant surfaces (yellow dots) create precipitation tethers. (3) Forest driven air... (4) Precipitation recycling at regional and continental scales (1 & 2). (5) Humidity and transpiration tethers (1 & 2). (6) Atmospheric moisture transport (1 & 2). (7) Local and global scale heating and cooling (1 & 2). (8) Fogcloud interception (1 & 2). (9) Infiltration and groundwater recharge (1 & 2). (10) All of the above processes naturally disperse water, thereby moderating floods.

NEWS <https://forestsnews.cifor.org/40702/finding-water-amid-the-trees>

### Trees for Water Security >>> Ecosystem Services

Intermediate tree cover can maximize groundwater recharge in the seasonally dry tropics

et al. Sci. Rep.

<https://www.nature.com/articles/srep21930>

### Evidence based system transformation

### Agroforestry for Enhancing On Ecosystem Services

Study finds that forest protection is key for reliable rainfall

Livelihoods Security, income and employment generation, benefit migratory farmers

More information: Anastassia M. Makarieva et al, Vegetation impact on atmospheric moisture transport under increasing land-ocean temperature contrasts, *Heliyon* (2022). DOI: 10.1016/j.heliyon.2022.e11173

### Round the Year Availability of Nutritious Food

**Agroforestry Nutrient Profile**

### Trees Based Systems for Green Economic Transition

Basics of regenerative practices

Structure, Functions, Production, Services, Wellbeing

• Diversity of crops, trees and animals is the source regenerative system and the basis of restoring natural resources  
• Growing in harmony with nature  
• Synchrony with economy  
• Benefits for all: producers, consumers, culture and nature.

«««Grow more Health per Acre»»»

Read: HEALTH PER ACRE: Wealth Per Acre by V. Shiva and V. Singh, 2014.  
• Health of Plants, Soil, Animals, People & Planet

### Untapped potential for new system and consumerism

Indigenous Knowledge and Inclusive Development

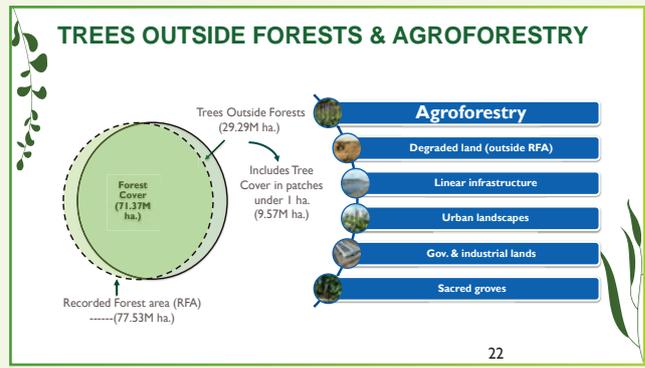
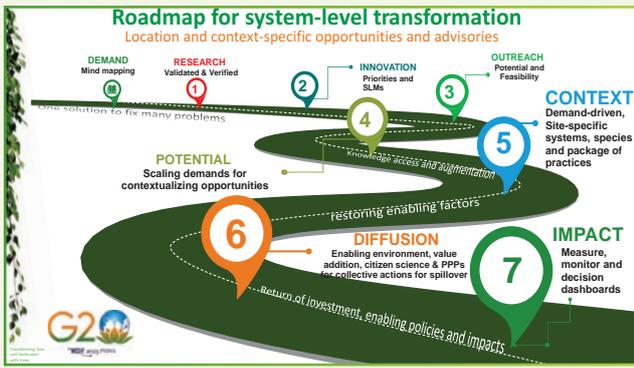
Conventional food systems vs Tree based integrated Agroecosystems

Inputs guzzling depleted foods VS Rare & Resilient Nutritious Indigenous Fruits, Vegetables, Spices and Condiments

Water & Resource guzzling foods to resource-use efficient production systems  
Less chemicals, less water, less energy, less labor, less carbon footprint  
Increasing demand for traditional fruits and vegetables- tremendous market potential

### Breaking the myth of long gestation period of agroforestry

Increase Income and Resilience with Incremental Growth while ensuring environmental flows and contributes to NDC and SDGs



### Trees Outside Forests in India (TOFI) Program

Significantly expand the area under trees outside the forests while enhancing landscapes, livelihoods and ecosystem services

- Enabling environment strengthened for expansion of trees outside forests.
- Expansion of area of trees outside forests economically incentivized and risks reduced.
- Improved access to quality and actionable information about trees outside forests.

**2.8M NEW HECTARES** of land under Trees Outside Forests  
**420M TONS** of carbon dioxide (CO<sub>2</sub>) equivalent sequestered  
**13.1M PEOPLE** to benefit from improved livelihoods & environmental services

[cifer-icraf.org/tofi](http://cifer-icraf.org/tofi)

Together for global challenges

### STRATEGIC APPROACH

Multi-partner working groups - Innovation Platforms: Collective action **Community Engagement**

... and spearhead promising site and context specific opportunities for catalysing the **expansion of TOF for sustainable use and compounding productivity**

TOF Enterprise Incubation & Extension Hubs, FPOs, SHGs,

... with complementary efforts to strengthen the enabling environment for incremental benefits

Champion farmers (for stepping down training & demonstrations)

Payment for Ecosystem Services (particularly for incentivising "public good" learning CO<sub>2</sub> Seq., Groundwater recharge)

Community Nurseries to ensure ready access to QPM (high-quality planting materials)

Mainstreaming of agroforestry ad TOF to Contributes to NDC-India and UN SDGs

Knowledge Dissemination Platforms (TOF App, Chatbots, Dashboard, & Virtual Call Centre; SVC, Market Linkages);

Measuring Impact from the Baseline

### Tree Deficit landscapes to Tree-Surplus production systems

Shift in paradigm toward resilient landscapes through bringing more trees into mainstream agriculture and land uses

83% tilled farming  
68% farms have tree deficits  
60% seasonal single crop

CREATE NATURAL ECONOMIC ZONES, GI and Agroeco types through tree species niche modelling, markets and TOF expansion potential

### Opportunities for AFS/TOF Expansion

#### Tree Deficit to Tree Surplus Landscapes

Land Use and Land Cover 3,08,888 sqf (100%)

|                      |                    |
|----------------------|--------------------|
| Forest Cover         | 87,446 sqf (27%)   |
| Trees Outside Forest | 5,208 sqf (1%)     |
| Forest + TOF         | 73,346 sqf (24%)   |
| Other LULU.C         | 48,339 sqf (15%)   |
| Treeless Landscape   | 1,48,099 sqf (48%) |

1/7/2023

### Potential of Agroforestry & Tree Fruits and Vegetables

Fingerprinting of the production systems to make informed decisions

Mapping length of the farm boundaries for bund planting of fruits and vegetable species

Dewas District, Madhya Pradesh

- Geographical Area = 702,000 ha
- Cultivable Area = 624,500 ha
- Length of Farm Boundaries = 295,679 km
- Trees on bunds with 4m canopy cover = 18.93% TOF

Potential of TOF planting across the India

- Road and rail networks = 5.89 million km
- Length of major rivers and canals = 2,28,681 km
- Degraded lands = 130 million hectares

5.89 million km

Food, Fodder, Fuel, Fiber, Manure, Medicines, Resilience, 'Peaco of Mind'

- Harvest BIS of over 3000 economically viable species
- Traditional crops and recipes
- Indigenous Knowledge

Return of recipes

Growing Wellness Industry

Change in individual behavior

Regenerative Systems

Mainstreaming Tree Based Regenerative Practice- source of prosperity and resilience

Bridging the gaps with evidence-based scaling

"Urban <-> Periphery <-> Rural"

Multi-functional agroforestry systems

Reducing loss of nutrition, food miles, water, carbon footprints and human induced climate change impacts

### Tree based production is the future of the one-health and planetary health

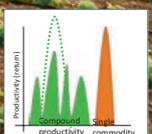
Nurture Our Soil, Water, Food

Nature Care, People Care, Faire share

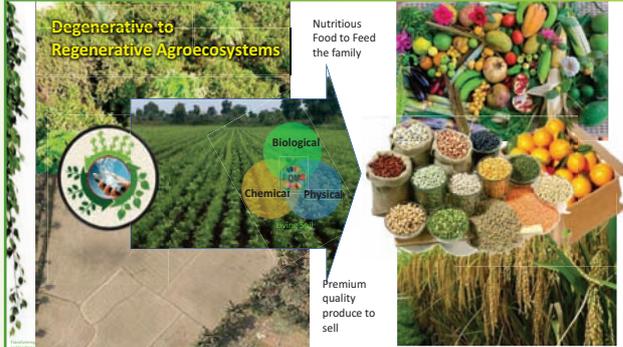


**Mainstreaming Agroforestry: source of wood, food, nutrition, income**  
 Planting multiple crops for monthly income while main crop continue to grow with trees as insurance  
 Example 1- Growing monthly harvestable crops like salad greens (arugula), red radish, leafy amaranth, coriander, dill, spinach in main cotton crop: high resource use efficiency, less chemical use and high return per unit area with monthly income throughout the season





**Degenerative to Regenerative Agroecosystems**



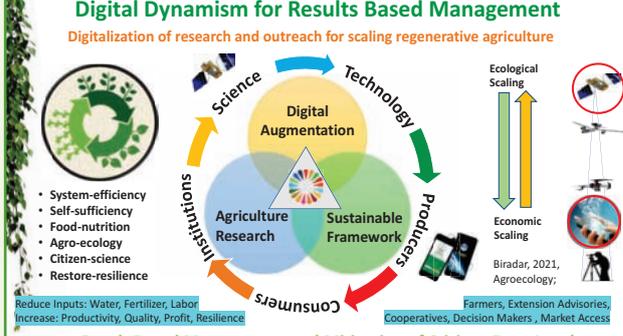
Nutritious Food to Feed the family

Premium quality produce to sell

**Green Gold Food Forest**  
 Urban Agroforestry in 40\*60 feet site



**Digital Dynamism for Results Based Management**  
 Digitalization of research and outreach for scaling regenerative agriculture



Reduce Inputs: Water, Fertilizer, Labor  
 Increase: Productivity, Quality, Profit, Resilience

Result Based Management and Mitigation of Crisis at Farm Level

**Why Invest in AFS for Restoring Ecosystem Services**

Investments in regenerative (with **revenue generative**) production systems are **growing with recognition** of nourishment, carbon-neutral, net-zero, wellbeing, climate-resilience

Agroforestry can return **8-13 times** more profit than conventional agriculture with **increased ecosystem services**

Restoration Alliance to **Break Silos**

Investors say agroforestry isn't just productive and climate friendly — it's also **profitable** (Hanes, 2020)

- ve 1-1x conventional
- +10x**  
Every \$1 invested in CGIAR yields up to \$10 in benefits
- +30x**  
Every \$1 invested in landscape restoration yields up to \$30 in benefits
- +50x\***  
Every \$1 invested in agroecology yields up to \$50 in benefits

**Vision 30:30:30 | 50:50:50**  
 A paradigm shift in system transition to diet diversity and lifestyle  
 Mission LiFE begins @Food plate



By 2030 at least 30% of population eating at least 30% of fruits and vegetables as their daily diets derived from tree-based agroecosystems

By 2050 at least 30% of population eating at least 30% of fruits and vegetables as their daily dietary needs derived from tree-based agroecosystems

**Diverse choices of food with great flavor, taste and nutrition**



**Production follows functions**  
 Let's leverage technology, diversity and local intelligence, indigenous wisdom to rebuild broken food systems for healthy living and planetary health

Thank You  
 c.biradar@cgiar.org



Tree based system for nourishing livelihoods and landscapes

4. Status of agroforestry in Haryana: Sh. Jagdish Chander, PCCF & HoFF, Haryana Forest Department

### Status of Agroforestry in Haryana

Jagdish Chander, IFS, PCCE,  
Haryana

### Forest Scenario in Haryana

- Geographical Area **44,21,200 ha**
- Forest Area **1,59,400 ha (3.8%)**
- Forest & Tree Cover **3,00,300 ha**  
(As per FSI Report 2020) **6.83 %**
- Protected Area: **30,362 ha**

**The natural forests are limited.**

**Half of our forests are along rail, roads and canals**

### Traditional Agroforestry

The Shivalik *Prosopis juliflora*

*Cedrella toona* with *Colocasia* & Paddy

Morni Hills *Grewia optiva* with *Oryza sativa*

*Eucalyptus* and Poplar have revolutionized agroforestry

आवश्यकता आविष्कार की जननी है

**Eucalyptus farming has become synonymous with agriculture farming.**

Sugarcane with poplar is most common combination during initial years

### Commensalism



## Clonal Forestry in Haryana

### History of Clonal Forestry in Haryana

- Poplar was introduced in 1975.
- Sissoo clones from Gonda, Bareilly & Haldwani were introduced in late 1990s.
- The aim was to get higher yield, superior quality timber and tolerance / resistance to *Fusarium solani* & *Ganoderma lucidum*.
- Eucalyptus clone culture in 2000.
- This was followed by setting up of Mist chambers.
- *Melia dubia*/*M. composita* clones have been recently introduced.

### About *Eucalyptus* clonal culture

- **VMG/CMA raised in 2001-2002.**
- C-3, C-7, C-10, C-71, C-152, C-83, C-130, C-99, C-411.
- These clones stayed upto 2010 or but were later replaced by better clones.
- Were also attacked by *Leptocybe invasa*.
- C-10 was most affected by Gall Wasp- so removed
- **C-288 proved tolerant to Gall Wasp & Witches Broom disease.**
- **Now *Cylindrocladium quinqueseptatum* Causing blight, is taking a big toll.**

### *Eucalyptus* VMG



### Mist chambers at Seonthi



### How many plants of *Eucalyptus* ?

- Our annual requirement is about 80 lakh plants per year.
- We raise 20 lakh plants of different clones in our mist chambers.
- We procure another 30 lakh plants of different clones from private sources.
- The rest 30 lakh plants are of seed origin and we raise in our nurseries.

### Ramets put in chambers at 42 degrees & 90% humidity



### Four loadings: About 20 lacs *Eucalyptus* plants are raised



# Eucalyptus: Backbone of Haryana's Timber Production



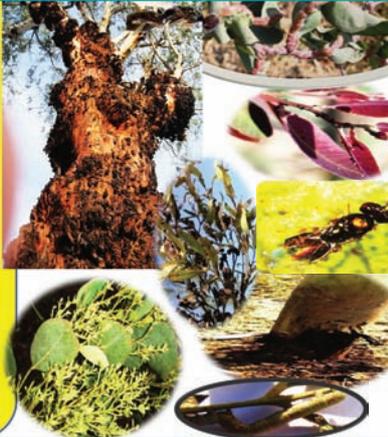
## Status of *Eucalyptus* culture

- 30000 hectares of *Eucalyptus* plantations are raised annually which accounts for about 40% of the total plantation.
- About 50,000 cubic meters of *Eucalyptus* wood is traded every year. Annual net profit generated is around 150 crores.
- In 2010, unprecedented attack of Gall Wasp (*Leptocybe invasa*) caused loss to the tune of about 50 crores annually.
- Little Leaf Disease, *Cylindrocladium Leaf and Twig Blight*, Gummosis, and attack of defoliator are new problems.
- About 75000 hectare area remains under *Eucalyptus* on rotation basis.
- The highest MAI noticed in the state is 50 cum in the case of clones.
- Average productivity for seed route and clonal plantations is 15cm/ha/yr and 20-50 cm/ha/yr respectively.

**Eucalyptus:** No longer a pest free species

### >Aphids

- Eucalyptus Gall Wasp (*Leptocybe invasa*)
- Little Leaf/ Witches Broom
- Cylindrocladium quinqueseptatum* Leaf & Twig Blight.
- Gummosis
- Bark Split & Canker: *Botryosphaeria dothidea*
- Defoliator (*Ascostis selenaria*)



## *Leptocybe invasa* and its devastation



### Problems of clonal forestry

- > Monoculture within monoculture.
- > Even department also develops craze for selected clones.
- > Clone specific diseases: Bark Split & Canker Disease by *Botryosphaeria dothidea* is creating problems in Eucalyptus clone-413.
- > No support from the govt. like support price.
- > Eucalyptus clones are not pollinator friendly.
- > High costs
- > Bent towards easily propagated clones.



*Status of popular culture...*

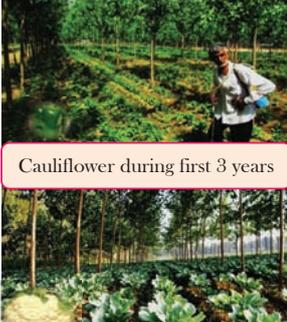
## Poplar Based Agroforestry

Egg plant (*Solanum melongena*) with 3 yrs. Poplar during kharif



Looks good but there is about 30 per cent reduction in sunflower seed yield and damaged by birds cannot be overlooked.

Bell Pepper (*Capsicum annum*) with 3 yrs. Poplar during kharif



Cauliflower during first 3 years

## Three tier farming with poplar



Poplar+Mango+Turmeric

**Status of poplar culture & improvement**

- > Was introduced in Haryana by WIMCO .
- > Grown only in northern part of the state.
- > Poplar culture was started with IC & D121 clones.
- > Harvested at the age of 3 to 5 years.
- > About 50000 ha always remains under it.
- > About 800 poplar based industries in Ynr.
- > Pests like defoliator (*Clostera fulgurita*), Stem Borer (*Apriona cineri*), Shoot Borer (*Eucosoma glaciata*), Bark Borer (*Indarbella quadrinotata*) and Leaf Blight (*Bipolaris maydis*) are posing big problems.
- > G-48. It still constitutes about 60% of poplar stock.
- > Main clones being raised are: WSL-22,32,39, Udai, WIMCO- 109, 110.



**Heart wood Rot**

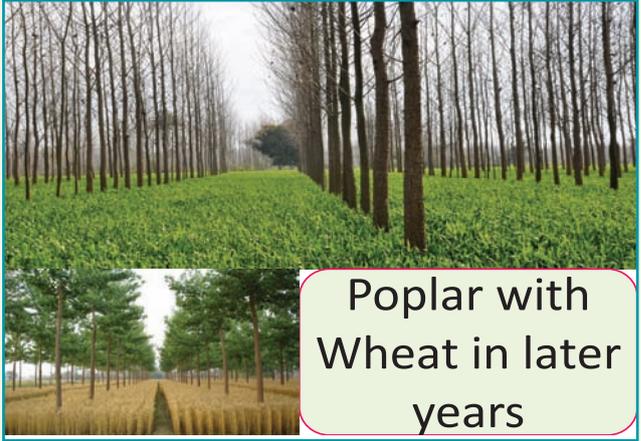
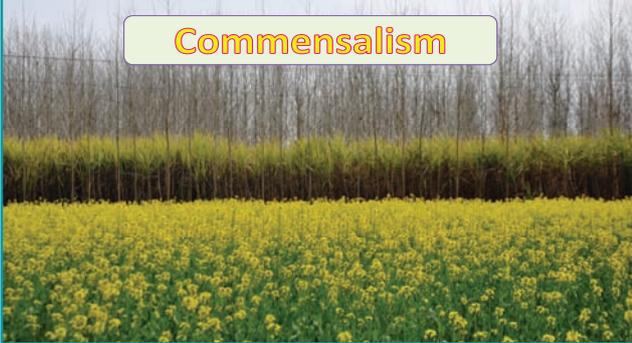
*Earliella scabrosa*



**Typical of G-48**

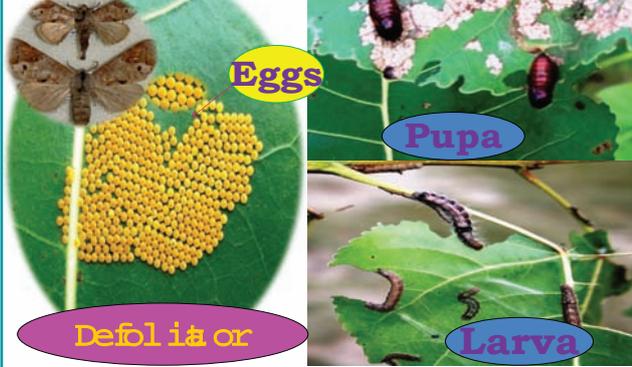
Sugarcane with poplar is most common combination during initial years

**Commensalism**



**Poplar with Wheat in later years**

**Leaf Defoliator (*Clostera fulgurita*)**



*Foliar Diseases: leaf blight (*Bipolaris maydis*), *B. spicifera*, *B. deltoides*, leaf rust (*Melampsora ciliata* and *M. populina*), *Alternaria* leaf spot & twig blight (*Alternaria* sp.)*



Propiconazole, CuOCl<sub>2</sub>, Tridemefon, Dithane M-45, Bordeaux etc.

**We have all recent clones in our nurseries.**



**Sissoo (*Dalbergia sissoo*)**

### ❖ Status of Shisham (*Dalbergia sissoo*) culture & improvement

- ❖ Number one timber species of the state. Farmers love to grow it.
- ❖ Have introduced clones from Gonda, Bahraich, Malibabad, Gorakhpur & Haldwani
- ❖ About 15 lakh plants are raised every year.
- ❖ 15000 trees die every year.
- ❖ *Fusarium solani* and *Ganoderma lucidum* are a threat.
- ❖ We have introduced clone no. FRI-DS-14 which is blend of high productivity, resistance to die back and excellent bole form. It is under watch.
- ❖ For management deep ploughing/harrowing is avoided.
- ❖ Copper sulphate & lime solution is applied in the pits and stem.



In danger

### Vanishing *Dalbergia sissoo*



*Fusarium*
*Ganoderma lucidum*

### CuSo4+ Lime treatment



### Introduction of *Melia dubia* (*M. composita*)

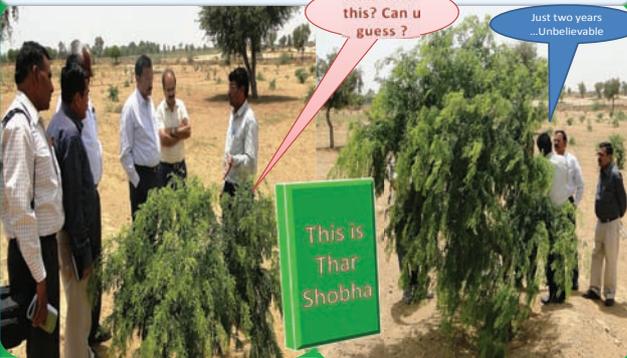


बर्मा डेक भी बोलते हैं इसे

### Improvement work done in *Melia composita*

- Superior genetic material was introduced from many places.
- Forty thousand plants were raised at two locations in the state by direct seed sowing in nurseries beds of 10mx10m for the selection of best plants based on the growth and shape parameters.
- Ten plants were selected each from the huge population at both the locations.
- FRI Dehardun had also initiated All India Coordinated Provenance Trial on the species.
- We also collected superior seed from the best performing individuals from all these sources.
- Farmers on their own also brought some material from elsewhere.
- From all these selections we have established seed orchards which will hopefully start producing seed from 2017 onwards.
- FRI has also evaluated its trial in 2016 and has released two varieties for growing in Haryana.

### *Khejari* (*Prosopis cineraria*) magic



How old is this? Can u guess?

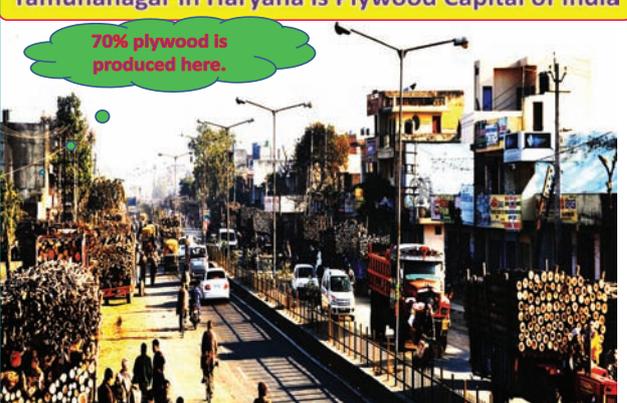
Just two years...Unbelievable

### Performance of *Salix* clones...not well



The quest for widening AF base.

### Yamunanagar in Haryana is Plywood Capital of India



70% plywood is produced here.



### The Magic of Spindle less Peelers

Can peel upto one inch diameter.  
Has reduced rotation to 3 years.



### Our problems & demands...

- Narrow base. Our AF is mainly based only on *Eucalyptus* & Poplar.
- No suitable fast growing species for semi arid region.
- *Ailanthus* is yet to take off.
- Long pending demand of industries to free plywood from taxes.
- Demand for “No Mandi Tax” on farm grown wood.

### Recent Developments

- TOFI project in Haryana
- Very high demand for poplar ETPs this year.
- WBI permitted in Saharanpur.
- Impact on Plywood industries.
- They fear that the plywood prices will crash to bottom low.

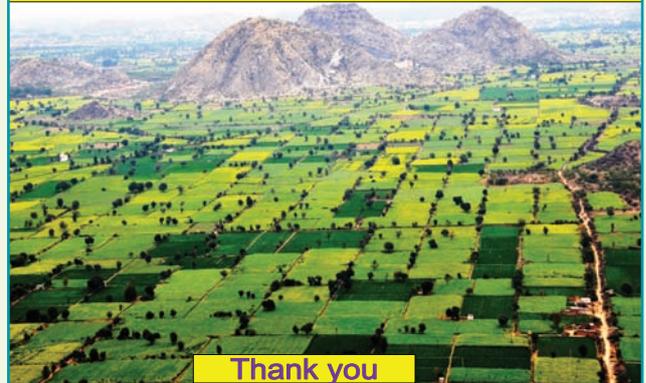
### Our Farmer & industry friendly atmosphere

- We provide plants free of cost.
- We carry out plantations on farmers fields free of cost.
- We do not have “Timber Transit Rules”.
- There is free movement of timber.
- Farmers are not required to seek permission for the felling of farm grown wood.

### We are counting each every tree outside forests

- Each and every tree outside forest is being counted, photographed and geotagged.
- DBH is also being recorded. Only for trees with > 30 cm girth.
- Huge data- five crores trees are expected.
- Many interesting things likely to emerge.
- The work is likely to be over by this March end.
- This will help to plan our activities for each village/urban area.

### Agroforestry in semi arid Haryana



Thank you

## 5. Telanganaku Haritha Haram: Dr. G. Ramalingam, CCF, Social Forestry, Telangana Forest Department



Telanganaku Haritha Haram  
Government of Telangana



### WELCOME



**Telangana State Forest Department  
Aranya Bhavan, Hyderabad**

Presentation by:  
Dr. G. Ramalingam IFS, CCF (SF)

### Telanganaku Haritha Haram TKHH

- Goal:**
  - To increase the green cover from 24% to 33% in tune with National Forest Policy
- Strategy:**
  - Taking up extensive plantation **outside the notified forest**
  - Planting **inside the notified forests**,
  - Rejuvenation** of Degraded Natural Forests
- Plan :** Plant 230 Crores seedlings in 4 years
  - 130 crore seedlings outside the forest area
    - 120 Crs other areas
    - 10 Crs in GHMC / HMDA areas
  - 100 crore seedlings / saplings inside the notified forests
    - 20 Crs by planting inside Forests
    - 80 Crs by Rejuvenation of degraded forests

### Implementation Strategy

- All Government Departments participate in the programme
- All sections of the society are involved
- Every department prepares its Annual Action plan for planting
- Forest Department coordinates & provides technical guidance
- A hierarchy for monitoring at state and district level
- Adequate budget provision is made

### Best Practices in Haritha Haram

- Hon'ble Chief Minister launched the programme in 2015
- Nurseries have been established in every
  - Gram Panchayat
  - Municipality
  - Municipal Corporation – ward wise
- End to end approach: Nursery – planting – protection – watering – casualty replacement
- Close Monitoring to Ensuring minimum survival (85%): New PR & Municipal Acts
- Provision for "Green budget"
- Peoples participation
- Telangana Haritha Nidhi - Funds received so far **Rs.28.32 Crores**



Telanganaku Haritha Haram  
Government of Telangana

| Activities Inside the Forests  | Activities Outside the Forests  |
|--|---|
| <ul style="list-style-type: none"> <li><b>Linear planting :</b> <ul style="list-style-type: none"> <li>Peripheral trench bunds, RF boundary lines</li> </ul> </li> <li><b>Block planting (AR):</b> <ul style="list-style-type: none"> <li>Semi-Mechanical Method (SMM)</li> <li>Labour Intensive Method (LIM)</li> </ul> </li> <li><b>Assisted Natural Regeneration (ANR):</b> <ul style="list-style-type: none"> <li>Peripheral deep trenches</li> <li>Fire lines</li> <li>Cultural Operations</li> <li>Soil and Moisture Conservation works (SMC)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li><b>Linear planting :</b> <ul style="list-style-type: none"> <li>Avenue planting, Canal bunds, Tank bunds, Farm bunds</li> </ul> </li> <li><b>Block planting :</b> <ul style="list-style-type: none"> <li>Community lands, Farm lands, Tank beds, Government lands</li> </ul> </li> <li><b>Institutional planting :</b> <ul style="list-style-type: none"> <li>Government offices, Local bodies, Colleges, Schools, Housing colonies, Hospitals, Other institutions, religious institutions, grave yards, market yards, others</li> </ul> </li> <li><b>Home stead planting :</b> <ul style="list-style-type: none"> <li>Houses, Colonies, back yards</li> </ul> </li> <li><b>Industrial planting:</b> <ul style="list-style-type: none"> <li>Industries, Vacant industrial lands</li> </ul> </li> <li><b>Municipalities and Urban areas :</b> <ul style="list-style-type: none"> <li>Municipalities, Municipal Corporation, Cities</li> </ul> </li> </ul> |

### ACHIEVEMENT UNDER TKHH SO FAR

| S. No.                       | Description                                   | Target | No. of seedlings planted (Achievement) |               |               |               |               |               |               |               |                | Total          |
|------------------------------|---|--------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|
|                              |   |        | 2015-16                                | 2016-17       | 2017-18       | 2018-19       | 2019-20       | 2020-21       | 2021-22       | 2022-23       |                |                |
| 1                            | In -side Forests (by Artificial Regeneration) | 20     | 2.933                                  | 3.993         | 3.939         | 2.898         | 3.537         | 2.054         | 2.313         | 2.866         | <b>24.533</b>  |                |
|                              | In -side Forests (by Rejuvenation)            | 80     |  |               | 25.970        | 4.570         | 4.727         | 6.150         | 9.753         | 0.000         | <b>51.170</b>  |                |
| 2                            | Out -side Forests                             | 120    | 12.667                                 | 25.862        | 28.469        | 27.777        | 33.043        | 19.801        | 15.662        | 8.653         | <b>171.934</b> |                |
| 3                            | GHMC  | 3      | 0.001                                  | 0.849         | 0.768         | 0.431         | 0.717         | 2.119         | 0.839         | 0.723         | <b>6.447</b>   |                |
| 4                            | HMDA  | 7      | 0.260                                  | 0.970         | 0.903         | 0.876         | 0.881         | 3.338         | 1.322         | 3.388         | <b>11.938</b>  |                |
| <b>TOTAL HARITHA HAARAM</b>  |   |        | <b>230</b>                             | <b>15.861</b> | <b>31.674</b> | <b>60.049</b> | <b>36.552</b> | <b>42.905</b> | <b>33.462</b> | <b>29.889</b> | <b>15.630</b>  | <b>266.022</b> |
| No. of Seedlings distributed |   |        |  |               |               |               |               |               |               | <b>4.626</b>  | <b>4.626</b>   |                |
| Grand Total                  |   |        |  |               |               |               |               |               |               | <b>20.256</b> | <b>270.648</b> |                |

### TKHH Planting Achievement

- Inside Forests:**
  - Through Direct Planting : 24.533 Crs.
  - Through Rejuvenation : 51.170 Crs.
- Outside Forests:**
  - Hyderabad Metro Development Authority (HMDA) : 11.938 Crs.
  - Greater Hyderabad Municipal Corporation (GHMC) : 6.447 Crs.
  - Rural & Municipal Areas : 171.934 Crs.
  - Distribution of plants : 4.626 Crs.
- Total Planting so far : 270.648 Crs.**

### District wise targets for 2023 & 2024 planting season

| Sl. No.            | District                | Year wise Planting target |        | Sl. No. | District            | Year wise Planting target |                 |
|--------------------|-------------------------|---------------------------|--------|---------|---------------------|---------------------------|-----------------|
|                    |                         | 2023                      | 2024   |         |                     | 2023                      | 2024            |
| 1                  | Adilabad                | 45.092                    | 44.169 | 18      | Nagarkurnool        | 45.933                    | 40.907          |
| 2                  | Bhadradri Kothagudem    | 65.404                    | 65.738 | 19      | Nalgonda            | 65.505                    | 66.062          |
| 3                  | Hanumakonda             | 22.457                    | 17.187 | 20      | Narayanpet          | 22.872                    | 11.500          |
| 4                  | Jagtial                 | 24.263                    | 46.067 | 21      | Nirmal              | 50.869                    | 58.757          |
| 5                  | Jangoan                 | 28.469                    | 26.278 | 22      | Nizamabad           | 47.978                    | 42.061          |
| 6                  | Jayashankar Bhupalpally | 27.330                    | 26.129 | 23      | Peddapally          | 31.646                    | 27.008          |
| 7                  | Jogulamba Gadwal        | 14.925                    | 15.098 | 24      | Rajanna Sircilla    | 15.943                    | 7.591           |
| 8                  | Kamareddy               | 28.117                    | 26.471 | 25      | Rangareddy          | 78.570                    | 82.498          |
| 9                  | Karimnagar              | 43.126                    | 43.476 | 26      | Sangareddy          | 41.136                    | 35.880          |
| 10                 | Khammam                 | 32.477                    | 31.060 | 27      | Siddipet            | 21.253                    | 21.626          |
| 11                 | Komaram bheem Asifabad  | 53.037                    | 53.207 | 28      | Suryapet            | 52.497                    | 53.452          |
| 12                 | Mahabubabad             | 49.967                    | 46.745 | 29      | Vikarabad           | 40.490                    | 40.485          |
| 13                 | Mahabubnagar            | 55.480                    | 55.248 | 30      | Wanaparthy          | 17.832                    | 18.392          |
| 14                 | Mancherial              | 45.170                    | 45.045 | 31      | Warangal (R)        | 25.951                    | 25.583          |
| 15                 | Medak                   | 36.019                    | 34.082 | 32      | Yadadri Bhuvanagiri | 21.034                    | 17.447          |
| 16                 | Medchal                 | 63.700                    | 63.700 | 33      | GHMC                | 100.000                   | 50.000          |
| 17                 | Mulugu                  | 14.793                    | 13.445 | 34      | HMDA                | 600.000                   | 750.000         |
| <b>GRAND TOTAL</b> |                         |                           |        |         |                     | <b>1929.334</b>           | <b>2002.394</b> |

**Department wise TKHH Planting Targets for 2023 & 2024 Planting Season** In lakhs

| Sl. No.            | Name of the Department                   | Year wise planting Target |          | Sl. No. | Name of the Department                      | Year wise planting Target |                 |
|--------------------|--|---------------------------|----------|---------|---|---------------------------|-----------------|
|                    |  | 2023                      | 2024     |         |   | 2023                      | 2024            |
| 1                  | EF&T                                     | 136.129                   | 134.562  | 14      | Energy                                      | 25.998                    | 25.976          |
| 2                  | R & B                                    | 5.223                     | 4.884    | 15      | Women, Children, Disabled & Senior Citizens | 1.157                     | 1.161           |
| 3                  | PR & RD                                  | 651.511                   | 637.642  | 16      | Social Welfare                              | 0.478                     | 0.423           |
| 4                  | Irr. & CAD                               | 26.000                    | 26.560   | 17      | SC Dev.                                     | 0.119                     | 0.118           |
| 5                  | Agri. & Co.op                            | 81.627                    | 78.956   | 18      | BC Welfare                                  | 0.352                     | 0.347           |
| 6                  | Revenue                                  | 20.572                    | 20.489   | 19      | Tribal Welfare / ITDA                       | 3.081                     | 2.593           |
| 7                  | MA & UD                                  | 914.915                   | 1009.238 | 20      | Minority Welfare                            | 0.431                     | 0.470           |
| 8                  | Home                                     | 8.594                     | 8.710    | 21      | Youth Advancement, Tourism & Culture        | 0.114                     | 0.105           |
| 9                  | Education                                | 10.599                    | 10.405   | 22      | Consumer Affairs, Food & Civil Supply       | 0.441                     | 0.402           |
| 10                 | Animal Husbandry, Dairy Dev. & Fisheries | 3.337                     | 3.271    | 23      | Labour, Employment, Training & Factories    | 0.008                     | 0.008           |
| 11                 | Ind. & comm.                             | 15.196                    | 14.255   | 24      | Govt. Offices/ Insti.                       | 0.110                     | 0.110           |
| 12                 | Mines & Geology                          | 2.846                     | 2.869    | 25      | Railways                                    | 0.020                     | 0.020           |
| 13                 | Health, Medical & Family Welfare         | 3.139                     | 3.121    | 26      | Others                                      | 17.341                    | 15.701          |
| <b>GRAND TOTAL</b> |  |                           |          |         |   | <b>1929.334</b>           | <b>2002.394</b> |

**TKHH - Nurseries established for the year 2022**

No. of seedlings in lakhs

| S.No.        | Dept.   | No. of Nurseries | Target         | Achievement    |
|--------------|---------|------------------|----------------|----------------|
| 1            | PR & RD | 12769            | 2016.00        | 2016.00        |
| 2            | Forest  | 550              | 627.06         | 528.56         |
| 3            | MA&UD   | 1002             | 360.00         | 203.34         |
| 4            | HMDA    | 44               | 500.00         | 426.89         |
| 5            | GHMC    | 600              | 125.00         | 125.00         |
| <b>TOTAL</b> |         | <b>14965</b>     | <b>3628.06</b> | <b>3299.79</b> |

**Telangana Haritha Haram**  
Government of Telangana

**Impact of the Programme**

- Huge carbon sink being created in the state
- Rejuvenation of degraded forests : 5.113 Lakhs Ha.
- Approximate Root Stocks Treated: 51.170 Crores
- Peripheral Cattle Proof Trench Dug: 10,886 Kms
- Block plantations inside Forests : 56,750 Ha
- Forest Fire Lines Created: 8,740 Kms
- Avenue plantations by Forest Dept: 7,974 kms
- Urban Forest Parks being developed : 109 Nos. (71 parks completed and 53 open for public)
- 1.60 Lakh Acres of forest area being developed in and around Hyderabad – Huge urban lung space
- Large scale awareness created about greenery in the state
- As per the Forest Survey of India Reports Cumulative increase from ISFR 2015 to ISFR 2021 in
  - Forest Cover (FC) : 6.85% increase
  - Green Cover (GC) : 7.70% increase

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Government of Telangana

**Expenditure so far (Rs. in Crores.)**

- Forest Department : Rs. 2677.187
- Rural Development Department : Rs. 5114.052
- HMDA : Rs. 683.000
- GHMC : Rs. 116.040
- 10% Green Fund : Rs. 1477.298
- Total : Rs.10067.577**

**Telangana Haritha Haram**  
Government of Telangana

**Telangana Haritha Mithra Awards**



**District Level Awards**

- Individual : 5
- Institutional : 11

**State Level Awards**

- Individual : 5
- Institutional : 16

**Award Money**

- Individual : from 1 to 2 lakhs
- Institutional : from 2 to 15 lakhs

**Telangana Haritha Haram**  
Government of Telangana

**TKHH – Monitoring and Geo Tagging**

- State Level Steering Committee
- State Level Monitoring & Coordination Committee
- District Level Monitoring & Coordination Committee
- Haritha Rakshana Committee
- District Collector is the nodal officer in the District
- All departments are participating in the programme
- All sites and plants planted are being geo-referenced
- Facilities for uploading data and geo-referencing
- Forest Department Website: [www.tgfmis.com](http://www.tgfmis.com)

**Online monitoring – tgfmis.com**



- Website – [www.tgfmis.com](http://www.tgfmis.com)
- Dashboard for districts
- Information on public domain
- Provision for Geo tagging
- Individual plantations can be viewed
- Daily Progress Reports
- Weekly Progress Reports
- District Action Plans
- Nursery Progress

**Telangana Haritha Haram**  
Government of Telangana

**Telangana Haritha Nidhi (Telangana Green Fund)**

- Consultations with various political parties and stake holders
- Announcement by Hon'ble Chief Minister on the floor of the Legislative Assembly on 01.10.2021
- Fund to support various activities under Telanganaku Haritha Haram programme
- The contribution received in Telangana Haritha Nidhi as on 31.12.2022 is 28.33 Crores

Telanganaku Haritha Haram  
Government of Telangana

### Activities for which the fund shall be utilized

|   |  |
|---|--|
| a | Establishment of Nurseries   |
| b | Raising of plantations   |
| c | Watering, watch and ward (need based) & Protection of plantation   |
| d | Capacity building  |
| e | Evaluation   |
| f | Communication, Education, awareness activities & Exposure visits   |
| g | Any other activity towards strengthening of planning, implementation, monitoring etc. of Telanganaku Haritha Haram Programme |

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### AMENDMENT TO THE ACTS

The Panchayat Raj and Municipal Act have been suitably amended in 2018, in order to ensure –

- Section 52(1) (B) –GP shall make provision for establishment of nurseries
- Planting minimum 40,000 saplings per year
- Section 43 (6) : Panchayat secretary shall be responsible for raising of nursery for the Gram Panchayat as per the demand survey
- Section 31 (1)(f) : Sarpanch shall be responsible for taking up plantation and maintaining green cover
- Section 51(10)(a) : Extension Officer (PR&RD) shall be responsible for inspection of plantations in GP once in six months
- Establishment of one nursery per Gram Panchayat
- 85% survival of the plants planted under Section 43 (6)
- 10% Green Budget allotted under Municipal Act, 2019
- Section 52(1)(C)(a) : GP to achieve model village through planning clean and green village
- Monitoring and maintenance of plantations
- Section 6(8) (C) : Gram sabha to monitor plantation activities under different schemes and its maintenance.

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### Aided Natural Regeneration (ANR)

**Operations:**

- Sample analysis - GIS
- Deep Peripheral Trench
- Planting *Caesalpinia bonduc* on trench mounds
- Fire lines
- Removal of invasive weeds
- Cultural operations
- SMC Works
- Gap planting

**Area Treated:** 5.113 Lakh Ha.  
**Total Seedlings:** 51.170 Crs



Telanganaku Haritha Haram  
Government of Telangana

### Artificial Regeneration (AR) – Plantations



**Total Area : 56,750 Ha**

Telanganaku Haritha Haram  
Government of Telangana

### Avenue Plantations: 8,071 Kms by Forest Department



### URBAN FOREST PARKS BEING DEVELOPED IN THE STATE

| Agency                     | No. of Locations | Completed | Open for Public (Out of tot. no. 3) | Work commenced & in Progress |
|----------------------------|------------------|-----------|-------------------------------------|------------------------------|
| 1                          | 2                | 3         | 4                                   | 5                            |
| <b>WITHIN HMDA LIMITS</b>  |                  |           |                                     |                              |
| FOREST                     | 27               | 19        | 17                                  | 8                            |
| HMDA                       | 16               | 16        | 6                                   | 0                            |
| TSIIC                      | 7                | 2         | 0                                   | 5                            |
| TSFDC                      | 4                | 1         | 1                                   | 3                            |
| GHMC                       | 3                | 3         | 1                                   | 0                            |
| HMR                        | 2                | 2         | 0                                   | 0                            |
| <b>TOTAL</b>               | <b>59</b>        | <b>43</b> | <b>25</b>                           | <b>16</b>                    |
| <b>OUTSIDE HMDA LIMITS</b> |                  |           |                                     |                              |
| FOREST                     | 50               | 26        | 26                                  | 24                           |
| <b>GRAND TOTAL</b>         | <b>109</b>       | <b>69</b> | <b>51</b>                           | <b>40</b>                    |

Telanganaku Haritha Haram  
Government of Telangana

### TSFA Dulapalli - Trainings



### Haritha Pathashala-Haritha Telangana



- Haritha Pathashala – Haritha Telangana organized on 25.08.2018
- All educational institutions involved
- 39 Lakhs children involved in High Schools alone
- 14.85 Lakhs students in 6,304 Govt. High Schools
- Green Brigades constituted
- Nearly 68 Lakhs Plants planted
- TSFA organized the training



## Vana Darshini – Awareness Programme



- 728 programmes involving 776 Schools
- 50,435 Students covered so far
- DFO Coordinating in each district
- Govt. High Schools targeted
- 9<sup>th</sup>, 10<sup>th</sup> class students targeted
- One day programme
- Education, Forest and TSRTC deptt involved



## Vana Darshini – Awareness Programme



- Guest Lectures
- Snakes show etc
- Field Trials
- Planting Activity
- Botanisation
- Awareness about forests and wildlife



## Seed Collection of Local Native Species



## Plantation on Community Lands



Telanganaku Haritha Haram  
Government of Telangana



## Farmers' fields - Agro Forestry



Bamboo →

← Sandal

↓ Teak



## Planting in Farmers Fields



## Planting in Institutions and Offices





## Urban Forest Parks

### VISION:

Urban Forest Parks for a greener, healthier and happier Cities and towns

### OBJECTIVE:

- To protect forest blocks from biotic interference, invasive weeds, and forest fires
- To develop resilient forests by improving the forest density and enhancing biodiversity
- To secure and replenish all the water bodies
- To engage and involve communities in sustenance of the forest blocks
- To improve the ecosystem and livability index of the Cities and towns by providing outdoor avenues for interactions, recreation and destressing
- To create ecosystem consciousness among the citizens and encourage them towards conservation and sustainability
- Contribute to the State and National sustainable development goals
- To create awareness about forest, environment and ecosystem services

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## Strategy

- Secure forest by putting up walls, see thru fencing- prevent encroachments, conserve local biodiversity
- Lay a network of pathways inside – for walkers as well as for inspection, act as fire lines
- Take up planting on saturation basis
- Remove all invasive weeds and take up Soil and Moisture Conservation works
- Create public amenities:
  - Watch towers, drinking water facility, toilets, gate, ticket counter, inspection huts, awareness centers, etc,
- Environment awareness programmes: Vana Darshini for Children
- Declare these parks as Plastic Free Zones
- Collect gate fee and make the unit financially sustainable  
(Create a stake for public to make conservation sustainable)

## Urban Forest Blocks - At a glance

- Total Forest Blocks – 238 Nos.  
(in 179 Locations)
- Urban Parks proposed to be open for public – 109 (139 blocks- 75,740 acres)
- Conservation blocks – 70 (99 blocks- 1,01,139 acres)
- Total Area of 179 Locations – 71610 Ha.  
(1,76,876 Acres)
- Total budget – Rs. 700 Crores

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## URBAN FOREST PARKS – Physical & Financial

| Agency                     | No. of Blocks | No. of Locations | Completed | Work commenced & in Progress | Open for Public (Out of col. no. 4) | Total expenditure so far (Rs. in lakhs) |
|----------------------------|---------------|------------------|-----------|------------------------------|-------------------------------------|---|
| 1                          | 2             | 3                | 4         | 5                            | 6                                   | 7                                       |
| <b>WITHIN HMDA LIMITS</b>  |               |                  |           |                              |                                     |   |
| FOREST                     | 38            | 27               | 19        | 8                            | 17                                  | 10826.28                                |
| HMDA                       | 25            | 16               | 16        | 0                            | 6                                   | 9664.51                                 |
| TSIC                       | 11            | 7                | 2         | 5                            | 0                                   | 2873.70                                 |
| TSFDC                      | 7             | 4                | 1         | 3                            | 1                                   | 1797.00                                 |
| GHMC                       | 6             | 3                | 3         | 0                            | 1                                   | 1508.21                                 |
| HMR                        | 2             | 2                | 2         | 0                            | 0                                   | 830.32                                  |
| <b>TOTAL</b>               | <b>89</b>     | <b>59</b>        | <b>43</b> | <b>16</b>                    | <b>25</b>                           | <b>27500.013</b>                        |
| <b>OUTSIDE HMDA LIMITS</b> |               |                  |           |                              |                                     |   |
| FOREST                     | 50            | 50               | 28        | 22                           | 28                                  | 8403.82                                 |
| <b>GRAND TOTAL</b>         | <b>139</b>    | <b>109</b>       | <b>71</b> | <b>38</b>                    | <b>53</b>                           | <b>35903.833</b>                        |

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## AGRO-CLIMATIC ZONES OF TELANGANA

### 1. Northern Telangana Zone:

Adilabad, Nirmal, Komurambheem Asifabad, Jagityal, Mancherial, Peddapally, Karimnagar, RajannaSircilla, Nizamabad, Kamareddy

### 2. Central Telangana Zone:

Sangareddy, Medak, Siddipet, Jangoan, Warangal (U & R), Mahabubabad, Bhadradi Kothagudem, Khammam, Jayashankar Bhupalpally.

### 3. Southern Telangana Zone:

Vikarabad, Hyderabad, Yadadri Bhuvanagiri, Mahabubnagar, Wanaparthy, Jogulamba Gadwal, Nagarkurnool, Nalgonda, Suryapet, Malkajiri-Medchal, Rangareddy, Narayanpet

MAP SHOWING AGRO-CLIMATIC ZONES



## Land Utilization Pattern in Telangana State

- Total Geographical area - 276.96 lakh acres
- Forest area - 66.67 lakh acres (24 .07%)
- Barren and un cultivable land - 15.00 lakh acres (5.42%)
- Land put to non-agril. Uses - 20.61 lakh acres (7.44%)
- Cultivable Waste - 4.44 lakh acres 1.60
- Permanent pastures and other grazing lands - 7.39 lakh acres 2.67
- Land under Misc. tree crops, Groves not included in Net area sown - 2.77 lakh acres (1%)
- Other fallow lands 18.56 lakh acres 6.71%
- Current fallow lands 26.37 lakh acres 9.52%
- Net Area sown 115.15 lakh acres (41.57%)
- Gross Area sown 142.68 lakh acres (51.52%)
- Net irrigated area 54.61 lakh acres (19.72%)
- Gross irrigated area 77.37 lakh acres (27.93%)

## Number of Holdings and their Percentage

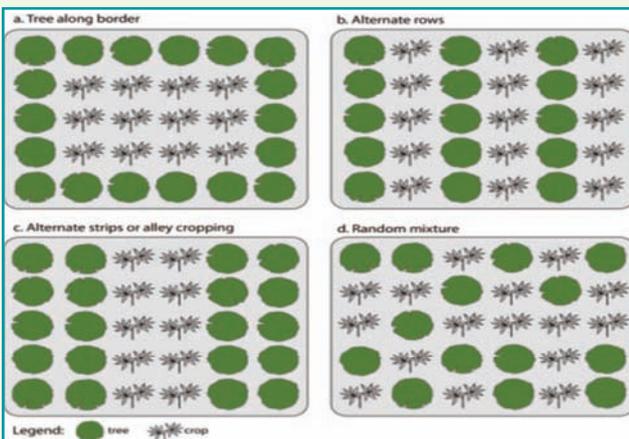
1. Marginal (below 0.5 to 1.0 ha)-38.40 lakhs (64.56%)
2. Small (1 to 2.0 ha) - 14.09 lakhs (23.69%)
3. Semi Medium(2-4 -ha) - 5.64 lakhs (9.48%)
4. Medium (4-10 ha) - 1.26 lakhs (2.12%)
5. Large (>10 ha) - 0.09 lakhs (0.15%)

**Total 59.48 lakhs (100%)**

- ❖ Farm forestry, which refers to tree planting on farmers' fields, mostly for the purpose of establishing woodlots.
- ❖ Agroforestry, which put the interactive association between woody perennials and crops or animals for diversification and sustainability of production and profits.
- ❖ Agroforestry is the intentional planting or retention of trees on fields through spatial or temporal arrangements.
- ❖ Together with forest management, several viable alternatives to unsustainable management of natural resources that has been proposed for tropical forest ecosystems.
- ❖ The use of two or more species of animals or plants, and one of the latter is a woody perennial.

### Examples

- Livestock + woody perennial (trees)
- Crops + woody perennial (trees)
- Livestock + crops + woody perennial (trees)



## Selection of Species (4 F's)

- 1. Furniture:** Teak, Rosewood, Bijasal, Gmelina, Neem, Mahagani, Dirisinam (*Albizia* sp), Babool, *Melia dubia*, etc.)
- 2. Fruits:** Amla, Ber, Tani, Neredu, Seethaphal, Tamarind, Velaga, Marking Nut (Jeedi), Sapota, Soapnut, Pongamia, *Buchnania lanzan* etc.
- 3. Fodder:** Subabul, *Acacia nilotica*, Sesbania, Tella tumma, Are, *Gliricidia* sp., Raavi, Juvvi etc.
- 4. Fuel:** Babool, Bamboo, Causurina etc.

## Agroforestry and farm forestry in Telangana



## Points to consider when developing Agroforestry Systems

1. Use of woody perennials adapted to the locality.

2. Species that benefit ecologically & economically.

3. All stakeholder should be involved.



1. Silvi pastoral system



2. Agri-silvi system



3. Horti-Silvi system



4. Agri - Horti. System

## MAIN AGROFORESTRY SPECIES IN TELANGANA

### Woody Perennials:

Teak, Babool, Khamer, Eucalyptus, Amla, Safed Siris, Arjun, Bamboo sp, Shisham (*Dalbergia sissoo*), Neem (*Azadirachta indica*) Khair (*Acacia catechu*), Subabul (*Leucaena leucocephala*) Mahua (*Madhuca latifolia*), Palas (*Butea monosperma*), Ratanjot, Drumstick (*Moringa oleifera*), Karanj (*Pongamia pinnata*), Kala Siris (*Albizia lebbek*), Arjuna (*Terminalia arjuna*) Wood apple (*Aegle marmelos*), Ber (*Zizyphus* sp), Amla, Mango etc.,

### Annual Crops:

Wheat, paddy, sugarcane, soybean, maize, gram-red, green and black, mustard, medicinal plants-Aswagandha, (*Withania somnifera*) Safed Musli (*Chlorophytum borivilianum*) etc.

### Sandal Wood nursery at COE Mulugu



Agriculture Production Commissioner and Director of Horticulture  
Inspected Sandal Wood nursery at COE, MULUGU

### PREVAILING AGROFORESTRY SYSTEMS IN TELANGANA

- ❖ **Stream and river bank planting** – State has large areas situated on the lands of perennial rivers and seasonal streams. – Good plantations of Teak, Khamer, Bamboo etc have been raised on the banks of rivers & streams.
- ❖ **Block Planting** – Apportioning a certain part of the land for growing trees in blocks – Spacing varies from species to species and also depends on the object of management. – Preferred by large land holders and absentee landlords. – Preferred species are Teak, clonal Eucalyptus, Khamer, grafted Amla, etc.
- ❖ **Homestead Plantations** – Preferred species are edible fruit bearing, ornamental, medicinal plants etc.

### PREVAILING AGROFORESTRY SYSTEMS IN TELANGANA

- **STRIP ALLEY CROPPING** – Crop strips alternate with single or multiple widely spaced rows of closely spaced tree species. – Alley width varies from 3 mt to 10 mt – Most common tree species are Teak and Khamer (*Gmelina arborea*).
- **BOUNDARY SYSTEMS/PERIPHERAL PLANTING** – Field bund planting – Boundary planting/Live fence – Can easily accommodate more than 200 plants/ha – Popular among small farmers – Preferred woody perennials are: Teak, Bamboo, Eucalyptus, Khamer, Babool, Safed Siris (*Albizia procera*), Ratanjot (*Jatropha curcas*), Palmyra palm (*Borassus flabellifer*), Date palm (*Phoenix sylvestris*), Arjun (*Terminalia arjuna*).

### Agroforestry Plantations from 2016-17 to 2022-23 in (32) districts of the State of Telangana under MGNREGA Scheme

The PR&RD Department has been taking up the Eucalyptus and Malabar Neem plantations since 2016-17 onwards in the lands of the farmers under Telanganaku Haritha Haram Programme under MGNREGS.

#### Eucalyptus and Malabar Neem plantations:

- SC, ST, Small and Marginal Farmers are eligible for the plantations.
- Pitting, planting, Eucalyptus Clone cost, transportation charges of clones will be paid from the MGNREGS.
- The spacing followed is 3m x 3m
- For each surviving plant Rs.1/- (for Eucalyptus) and Rs.3/- (for Malabar neem) per month is paid as maintenance charges.
- Maximum 1000 plants will be given to each Beneficiary.

#### Seedlings planted so far:

1. Malabar Neem – 15.35 lakh seedlings
2. Eucalyptus – 203.05 lakh seedlings

### Teak - bund/Block Plantations

- SC, ST Marginal Farmers
- Pitting, planting transportation of plant from MGNREGS
- Plant free of cost
- Maximum 1000 plants per beneficiary
- Each surviving plants Rs. 5/- per month as maintenance charges
- Maximum Rs. 3000/- per month per beneficiary



### Horticulture Plantations

- SC, ST Marginal Farmers
- Pitting, planting transportation of plant from MGNREGS
- Each surviving plants Rs. 15/- per month as maintenance charges
- Maximum Rs. 3,000/- per beneficiary
- Maximum 350-550 plants per beneficiary

### Eetha Plantations

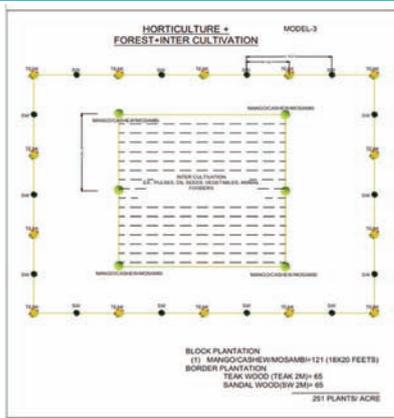
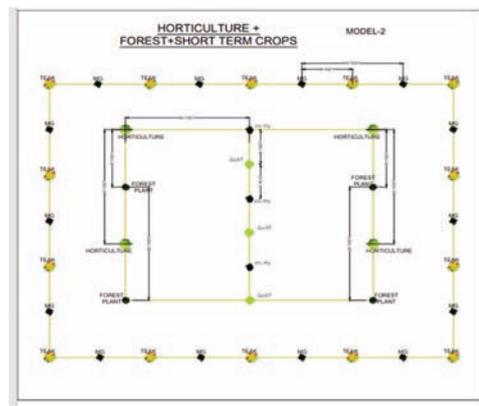
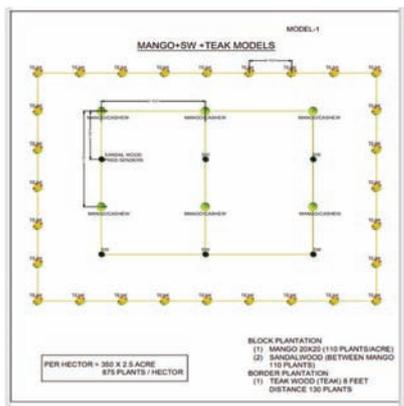
- MGNREGS Job card holders of Toddy tapper community are the beneficiaries
- Each farmer – Maximum 1,000 plants
- Each surviving plants Rs. 5/- per month as maintenance charges
- Maximum 3,000 will be paid to one farmer in one month
- Each surviving plant Rs. 5/- will be paid per month subject to maximum of Rs. 5,000/-

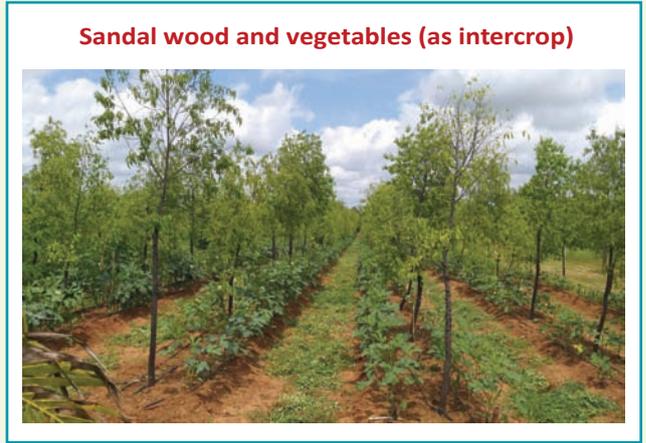
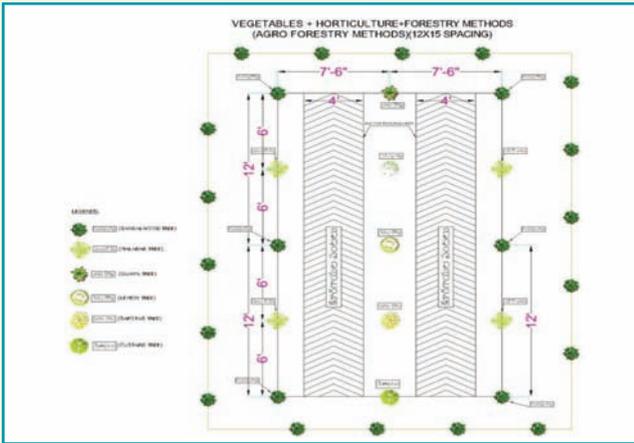
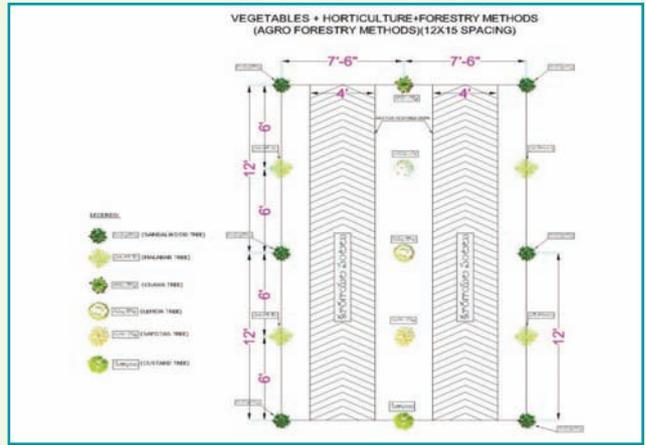
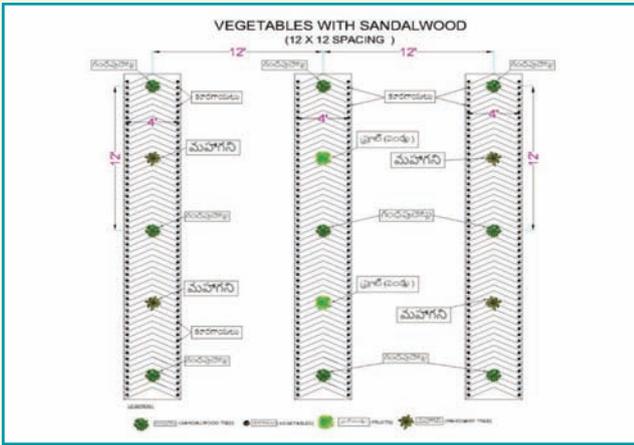
### Eetha Plantation on Toddy Tappers Lands and Tank bunds



### Mulberry bush Plantations

- SC, ST Marginal Farmers are eligible
- Pitting, planting, plant cost, transportation charges from MGNREGS
- Each surviving plants Rs. 1/- per month as maintenance charges maximum of Rs. 3,000/-
- Maximum 5,445 plants per acre







### CONTOUR PLANTING ON SLOPING TERRAIN

- ❖ Lands cultivated by small/marginal farmers (especially tribals) in several districts are situated on sloping terrain.
- ❖ These lands are not much productive for raising of sole agricultural crops.
- ❖ Cultivation practices are leading to soil erosion and nutrient loss.
- ❖ Contour planting of tree species which require good drainage, such as Teak, is an ideal solution.
- ❖ Most effective on lands with moderate slope of 2-7 %
- ❖ Contour furrows form multitude of mini barriers across the flow path of run off.

**Barren Hill Afforestation with contour trenches**



### Impact of Agroforestry

- ❖ Agro forestry based cultivation can change Indian and world's farmers economic and social life.
- ❖ Agro forestry is the only platform to generate more employment in agriculture as well as rural livelihoods.
- ❖ Significant contributions in the field of Agroforestry can be made directly by interacting with marginalized farmers and help them evolve by educating and helping them in implementing the latest and emerging new techniques.
- ❖ AF for the welfare of small and marginal farmers and empower them through agro forestry based cultivation.

### Sustainable Development Goals

- Promote environmental stewardship
- Enhance quality of life for farm families and communities
- Increase production for human food and fiber needs
- Using a multidisciplinary approach, our water access and management programs encompass varied themes of water solutions for agriculture.
- Engage farmers in the development and adoption of practices that are profitable and environmentally sound
- Support research and education intended to help farmers to mitigate and adapt to climate change impacts
- Improve production efficiency, productivity, and profitability
- Address threats from pests and diseases
- Improve the quality of surface water and groundwater resources
- To encourage and motivate Agro forestry based Sustainable agriculture programs
- To facilitate sustainable natural resource utilization and equitable access and sharing of financial resources.
- To focus on improving market linkages and access to finance for small, marginal farmers, which are critical factors to stimulate livelihood and sustainability, enhancing investments in agriculture.

### Activities from Govt. side (Agri and Horticulture Dept.):

- Identify small and marginal farmers scientifically. Empowering rural communities towards climate action & sustainable development.
- Provide advice and training in Agro forestry based cultivation, Soil Conservation, best plantation practices and use of environmental friendly technologies by Technical experts.
- Arrange seedlings produced from Seeds, Air layering method or Grafted technology to the farmers to raise high density as well multiple plantations.
- Promote farmer-industry partnerships with buy back arrangements to purchase Pulp-paper, Timber and Non timber wood Species.
- Encourage farmers to go for agro-forestry practices such as inter-cropping during the first year to meet their subsistence costs.
- Develop and strengthen the capacity of small and marginal farmers, SHG Groups, govt, Farmers Community, FPOs and NGOs.
- Production of raw material to the paper, plywood and other related industries locally thereby reducing the cost of transportation and consumption of fossil resulting in reduced emissions.
- Development of suitable agro forestry models through research in collaboration with Govt institutions and private organization.
- Enhancing Rural livelihood through Carbon Credits (or) Carbon Finance.

### Decision Support System-Agroforestry

- i. Decision Support System-Agroforestry (DSS-Agroforestry) is a web-based platform developed under USAID's Forest-PLUS 2.0 program to enable informed decision making for species selection for plantations on lands outside the recorded forest area.
- ii. The species database of the DSS-Agroforestry is designed considering multiple criteria such as native species, availability of quality planting material, ecosystem services, and livelihood benefits for communities.
- iii. The tool uses geospatial and biophysical parameters like rainfall, temperature, topography, soil properties that help in identifying appropriate species and agroforestry models for a particular location and land parcel defined by the user.
- iv. The DSS-Agroforestry tool has been piloted in Medak district with a focus on promoting agroforestry practices, diversifying farm-based livelihood options, and enhanced ecosystem-based landscape management.



**6. Experience sharing status of agroforestry in Jammu & Kashmir: Sh. Roshan Jaggi IFS, PCCF/Director, Department of Social Forestry, Jammu & Kashmir**

**“Experience sharing Status of Agro Forestry in Jammu & Kashmir”**



**NATIONAL WORKSHOP**  
5<sup>th</sup>-6<sup>th</sup> January, 2023  
ICFRE, Dehradun  
Roshan Jaggi, IFS, Pr. CCF  
J&K Social Forestry Department,

**Background and context**

- ▶ Jammu and Kashmir's Economy has remained majorly impacted by Forests & Forestry Activities since pre-independence times.
- ▶ Before 1990s Natural Forests were major source of wood/ wood based products and revenue in the state.
- ▶ Situation under went transition. TN Godavarman Judgement of 12.12.1996 and related developments .
- ▶ Restrictions on wood from Natural Forests triggered transition to other sources like *Trees outside Forests (ToF) and Import of Wood.*

**Special Factors Defining The Role Of Alternate System of Production Forestry in Jammu & Kashmir**

- Heavy dependence on wood resources due to cultural/climatic factors.
- Livestock population is almost equal to human population with 50% of sheep & goats.
- 50% shortage of fodder, which causes excessive grazing and main driver of the degradation of natural forests (National Livestock Census-2019).
- Rapid industrialization and spurt in developmental activities ( Special Policies/focus of GOI).

**Special Factors Defining The Role Of Alternate System of Production Forestry in Jammu & Kashmir**

- Heavy tourist influx, beyond carrying capacity of forest based tourist spots.
- Wider gap between demand and supply of wood resources. (Improt doubled between 2012 & 2022)/
- 50% of Forests are in “ Open Category”.

Therefore role of Farm forestry/ Agro-forestry assumes special Significance in Socio- Economic Development & Environmental security.

**Initiatives to promote Farm Forestry/Agro-forestry in J&K**

- J&K State Forest Policy-2011, lays due emphasis on:
  - Extending tree cover outside forests by encouraging farm forestry/ agro-forestry
- **Active involvement of PRIs**
  - Each Panchayat has Village Panchayat (Plantation) Committee (VPPC) which steer the afforestation programme including farm forestry and agro forestry.
  - Under Green J&K Drive. “ Har Gaon Haryali” program is taken up in all 6800 Villages under 4291 Gram Panchayats. VPPCs lead this programme.
- **Promotion of Private Nurseries by Farmers.**
  - Nursery registration mechanism under Establishment for 3<sup>rd</sup> party accreditation to ensure quality planting material to farmers/growers.
  - Focus on R&D by J&K FRI & SKAUST Universities for improved clonal germ plasm of Poplar, Eucalyptus and Salix.

**Initiatives to promote Farm Forestry/Agro-forestry in J&K**

- **Opening of Restrictions on export of timber/Forest Produce**
  - Khair and Poplar are now free for export (As per Hon'ble Supreme Court Orders) to help farmers for better price discovery.
- **Social Forestry** is promoting contractual arrangements between farmers and wood based industries. Encouraging response to Govt's industrial incentives.
- **UT Agroforestry Policy** under preparation to incentivise growers/farmers on the lines of Gujrat & Bihar in Light of NAF policy 2014.
- **Institutional reforms.** Eucalyptus, Poplar, Bamboo already exempted from transit permit. For all other species e-way challan under GST to be treated as transit permit.

**Comparative Scenario**

| S. No.       | Source   | Before 1990s        | As on 2022                                      |
|--------------|--|---------------------|---|
| i.           | <b>Timber from Forests</b> (direct supply to local zamindars and extraction by Forest Development corporation) | 80% of total supply | 3.49% (0.92 lac m <sup>3</sup> = 32.49 lac cft) |
| ii.          | <b>Import</b>  | Negligible          | 3.76% (0.99 lac m <sup>3</sup> = 34.96 lac cft) |
| iii.         | <b>Non Forest Lands</b> i.e. Farmer's lands + Social Forestry plantation + others                              | 20%                 | 92.75% (24.43 lac m <sup>3</sup> = 863 lac cft) |
| <b>Total</b> |  |                     | 26.34 lac m <sup>3</sup> = 930.45 lac cft).     |

Thus above scenario highlights the Growing Importance of Farm Forestry/ Agro Forestry in J&K context.

**Main Agro Forestry/ Farm Forestry species and utilization pattern**

| Poplar                            | Willow | Eucalyptus                  | Bamboo | Khair |
|-----------------------------------|--------|-----------------------------|--------|-------|
| Temprates (Mostly Kashmir Valley) |        | Sub-tropics of Jammu region |        |       |

**Poplar**

- ✓ Important TOF species in valley (31% of total ToF).
- ✓ Contributes to about 600 crores of economic activity in J&K (FSI Report)
- ✓ About 15 lakh Poplar plantation annually . 90% of this is On Private lands.
- ✓ One tree of 4 feet girth produces
  - ✓ 140 fruit boxes
  - ✓ Livelihood of > 5 mandays
  - ✓ Rs 15000 of cash returns -at different levels of supply- Chain
  - ✓ 1.59 Kgs of carbon locked/tree

**Main Agro Forestry/ Farm Forestry species and utilization pattern**

UTILIZATION

**Poplar**

- **Fruit boxes** -Out of 55M fruit boxes, about 60% met from Poplar wood annually.
- **Plywood/Playboard Industry.**
- **Pencil making-** About 90% of pencil making raw material met from some villages in Pulwama District.
- **Construction** (Roof trusses).
- **Bat Handles**
- **Charcoal/Fire wood.**
- Adds to beauty and aesthetics of Kashmir Landscape.



*Poplar Plantation  
Gunjahangir, Naidkhat*

**Main Agro Forestry/ Farm Forestry species and utilization pattern**

UTILIZATION

**Willow (Salix-alba)**

- ✓ Bat making (Kashmir willow bats)-About 500 bat-making units in South Kashmir, more than one lakh people get livelihood.
- ✓ Used in Traditional handicrafts like boxes , baskets, Picknic items
- ✓ Plywood/Playboard making.
- ✓ Charcoal/ Fire wood
- ✓ Adds to beauty and aesthetics of Kashmir Landscape.



*Poplar Logs ready for taking out to use in veneers*



*Poplar veneers*



*Poplar Chip Logs*



*Poplar Small Wood*



*Poplar as construction timber*



**POPLAR TIMBER AS SUBSTITUTE TO CONIFER TIMBER**

On an average 200 - 300 Cfts of poplar is used for making truss for one newly constructed house thereby reducing pressure on forest resources.

**REDUCING PRESSURE ON NATURAL FORESTS BY SUPPLEMENTING TIMBER NEEDS**



**APPLE BOX MAKING INDUSTRIES IN KASHMIR**

The wood used in making apple boxes is exclusively of poplar. On an average about 35 lac apple boxes are annually prepared from poplar wood there by saving more than 3 lac Cfts of Fir timber since poplar has been used in place of Fir

**SUPPORT TO APPLE INDUSTRY... PACKING BOXES OF POPLAR WOOD.**



**Success Story**



**Pulwama in South Kashmir turning into pencil slate production hub**

**POPLAR BASED PENCIL MAKING PLANTS IN OOKHOO KASHMIR**

The above pencil making unit at Ookhoo Pulwama is providing job to more than 200 people. The raw material is exclusively used of poplars and on average more than 3 lac CFTs of poplar in raw form is used annually to meet out the demand of said unit.



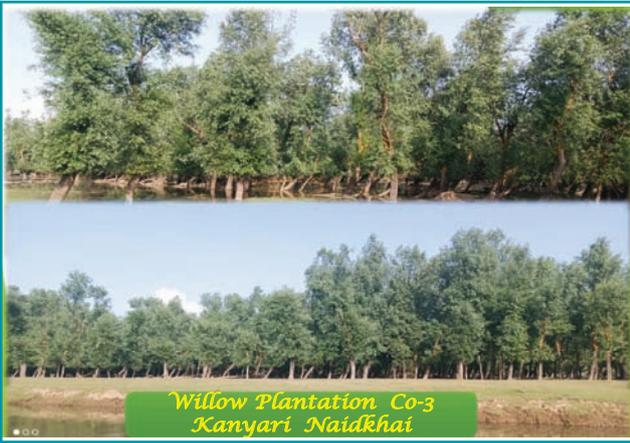
**PROCESSING OF POPLAR BASED RAW MATERIAL FOR MAKING PENCIL SLATES**

**Poplar in pencil Industry**



**Willow planting...**





*Willow Plantation Co-3  
Kanyari Naidkhai*



*Baseball bats*



*Cricket bats*



*Important  
handicrafts Wicker-Willow*



*Important  
handicrafts(Willow )*



*Poplar Nursery*

**Distribution under Farm Forestry**

- Progressive Farmers encouraged to grow economically important species viz. Poplar, Eucalyptus, Bamboo.
- Increases income of Farmers.

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*Khair plantation on Private Lands.*

## PROMOTING APICULTURE WITH PLANTATIONS



### Avenue Plantations



- Highways.
- Roads
- Canals and River Banks
- Yield tangible benefits and 75% contribution to the Village fund of concerned Gram Panchayat.
- Environmental & Aesthetic benefits.

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### Hon'ble LG Giving Cheques To GPs



- Money realized on sale of Mature Plantations-75% share goes to Gram Panchayat Committees.

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*Thank you*

## 7. Agroforestry models/ practices developed by ICAR: Dr. A. K. Handa, Principal Scientist, ICAR-CAFRI, Jhansi



### Agroforestry models /practices developed by ICAR



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Principal Scientist  
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ICAR- Central Agroforestry Research Institute – Jhansi (UP)  
Natural Resource Management Division of ICAR, New Delhi

AICRP on Agroforestry - 1983  
Coordinating Unit : CAFRI  
Total centres : 37 representing all agro-climates of India



Himalayan : 08; Indo-Gangetic : 05; Humid & sub-humid : 06; Arid & semi-arid : 10 and Tropical : 08

**Vision**  
To improve quality of life of rural people by integrating perennial crops in the agriculture landscape for harnessing social, economic and environmental benefits.

### Need to move towards Climate Smart Agriculture

**Agriculture that sustainably:**

- Increases **productivity**
- Enhance **resilience** (adaptation)
- Reduces **GHG** (mitigation)

ensure achievement of **National Food Security** and **Sustainable Development Goals**

### Efficient utilization of natural resources




### Agroforestry addresses 9 out of 17 SDGs



International Institute of Sustainable Development Report 2018

### Achievements

- Identified requirements of local farmers/industry Through Diagnosis and Design Exercise
- Prioritized suitable tree Species
- Quality Planting Material and Tree Improvement
- Developed compatible agroforestry models for different regions
- Upscaling of the system through Concept of Consortium
- Knowledge Sharing
- Capacity Building
- Contributing to National Sub-Mission on Agroforestry



### MPTS Evaluation and Tree Improvement

- Establishment of MPTS arboretum in each centre.
- A collection of 184 species made by the centres.
- Identification of priority tree species of AF research for various agroclimates.
- Each centre allocated 02 tree species for germplasm collection and provenance trials.

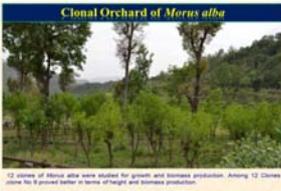


### Explore Natural variation






### Quality Planting material



Quality Planting Material of Agroforestry Species

Co-ordination and Editorial Editing  
A. K. Hazra, S. K. Dey and Javed Rizvi

Jointly Published by  
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and  
South Asia Regional Programme of  
World Agroforestry (ICRAF)

Out of 10 strategies to achieve the goals of *National Agroforestry Policy 2014*, improving farmers' access to quality planting material is one such strategy.

## Key highlights on successful models and its economics

### Poplar-based Agroforestry System

- Poplar is planted at a spacing of 8 m x 2.5 m keeping tree rows in north-south direction
- Potential Area: Upper and trans gangetic plains region; Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Uttarakhand and some extent in Bihar and West Bengal
- Rotation : 6 years
- Tree productivity: 150 t/ha
- Economics: The overall net income per hectare per year from poplar based agroforestry is Rs. 97534/- compared to Rs. 34,268/- (from sole crop)



### Eucalyptus based system

- Clonal eucalyptus grown as block plantation at a spacing of 4 m x 2 m or 3 m x 3 m.
- Potential Area: lower, middle, upper and trans gangetic plains region; eastern and central plateau and hills region; Punjab, Haryana, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, West Bengal, Andhra Pradesh, Tamil Nadu and Maharashtra
- Rotation: 3-4 years for poles and 6-7 years for timber.
- Crops can be cultivated successfully for initial two years only in above mentioned spacing.
- Tree productivity: 260 t/ha.
- Economics: Overall net income per hectare per year with eucalyptus based system ranged between Rs. 95000 to Rs. 126072/- under irrigated condition.



### Teak based Agroforestry System

- Spacing 8 x 2 or 12 x 2 m
- Potential Area: middle gangetic plains region and plateau and hills region; Maharashtra, Chhattisgarh, Bihar, Madhya Pradesh, Uttar Pradesh, Kerala, Tamil Nadu, Orissa Andhra Pradesh, Telangana and Karnataka
- Rotation 20-25 years
- Suitable Intercrops: Black gram, soybean, cotton, pigeon pea and sesame
- Economics :Teak - First 50% thinning at 7th year Rs.6,000/ha, second (25%) thinning at 12th year Rs. 22,890 /ha, final harvesting Rs. 26,00,000 /ha at 20-22 years
- BC Ratio for Teak based Agrisilvicultural system: 2.11:1



### Melia based Agroforestry System

- Suitable for irrigated and rainfed conditions
- Rotation period: 10 – 12 years depending on the purpose (pulp and plywood)
- Potential Area: southern and central plateau & hill region, Gujarat plains and hill region; Tamil Nadu, Karnataka, Telangana, Andhra Pradesh, Gujarat, Some parts of Haryana, Punjab and Uttar Pradesh
- Marketable produce: 14 – 15 cubic feet
- Leaves: Good source of fodder during lean period
- Grown on bund, border and block plantations
- BC Ratio for Melia based agroforestry systems: 2.18:1(Pulpwood); 3.94:1(Plywood); 2.92:1 (ply and pulpwood)



### Bamboo based Agroforestry system

- Spacing: 3 m on boundary and 5x5 m in block plantations
- Potential Area: plains of pan-India except for the water-logged areas N-E parts of India, West Bengal, Odisha, Jharkhand, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Kerala, Maharashtra, Karnataka, Tamil Nadu and Bihar
- Rotation Age: 4 years old culms are harvested as recurrent yield every year for next ~20 years.
- Different crops viz. initially wheat, soybean, mustard, pulses; shade loving crops viz. ginger, turmeric may be taken from third year on-wards.
- Economics : Overall net income per hectare per year with bamboo based system ranges between ₹ 95000/- to ₹ 200000/- after four year under irrigated condition.
- BC Ratio for Bamboo based Agrisilvicultural system 1.41:1



*Dendrocalamus strictus* + cowpea

*Bambusa balcooa* + cowpea



*Bambusa bambos* + cowpea



*Dendrocalamus asper* + cowpea

### Bamboo based Silvopasture systems

- Green grass @ 7.1 t/ha/year - stabilized gully slopes.
- After 7 years of plantation, 30% of the total culms per clump (1000 bamboo poles/ha/year) are harvested
- Soil loss is reduced to less than 1 t/ha/yr from about 20t/ha/year.
- Benefit cost ratio- 2.09.



*D. strictus + guini grass*



*D. strictus + lemongrass*

### Ailanthus based Agroforestry Systems

Potential Area: semi-arid and arid tract of north-western India; Gujarat, Rajasthan, Haryana, Punjab, Tamil Nadu, Some part of Uttar Pradesh  
 Rotation: 6-8 years for match-splints and 15-20 years for toys and sawn timber  
 Spacing: 3m x 3m, 5m x 5m for block; 10m x 5m under agroforestry and paired-row (zig-zag pattern) or 3m apart on field boundary  
 Tree Productivity: timber - 100 to 120 t ha<sup>-1</sup>; fodder - 5 to 6 t ha<sup>-1</sup> yr<sup>-1</sup> (200-300 kg tree<sup>-1</sup>); fuelwood - 5 to 7 t ha<sup>-1</sup> yr<sup>-1</sup>  
 Economics: net returns of Rs. 38, 800 ha<sup>-1</sup> yr<sup>-1</sup> receives from the degraded land from block plantation over 13-15 years of rotation



### Gmelina arborea based system

- Spacing: *Gmelina arborea* : 8 x 2.5 m
- Potential Area: Eastern and central plateau and hills region; Odisha, West Bengal, Assam, Chhattisgarh, Jharkhand, Madhya Pradesh, Tamil Nadu, Kerala and Maharashtra
- Intercrop: Legume/maize/vegetable crops - mustard
- Rotation : 25-30 years
- Yield: Timber: 1000 cft and firewood 100 t/ha after 10 years
- Economics: Overall net income ha<sup>-1</sup> year<sup>-1</sup> with *Gmelina* legume/maize/vegetable crops - mustard about ₹ 30000/-
- BC ratio for Agrisilvicultural systems: 2.33:1



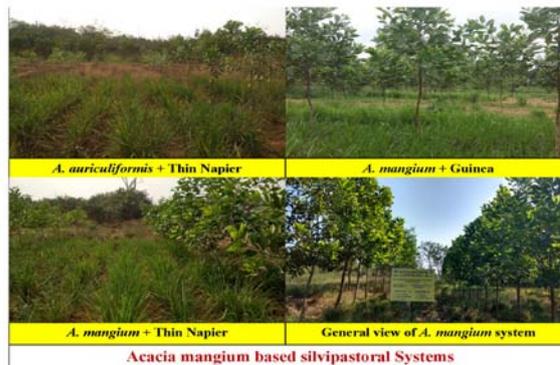
### Ceiba pentandra based system

- Potential Area: southern plateau and hill region; Rainfed regions of Tamil Nadu, Tetangana, Andhra Pradesh, Karnataka, Chhattisgarh and Southern Maharashtra
- Spacing: 6m x 6m and 8m x 5m under agroforestry
- Rotation: 20-25 years for light timber, 4-5 years for matchsticks and starts producing floss after 3-4 years up to 40 years
- Tree Productivity:
- Pod yield - single tree under optimal conditions yields 330-400 fruits year<sup>-1</sup> and gives 15-18 kg fibre. About 98,000 pods ha<sup>-1</sup> from the 9th year; Floss yield - 495 kg ha<sup>-1</sup> from 9 years of plantation; Wood - 1-3 m<sup>3</sup> tree<sup>-1</sup> of 70 cm diameter trees after 15-years
- Economics: net profit of Rs. 37,800 to 4,01,700 ha<sup>-1</sup> from the 5th year to 25 years of plantation at 6m x 6m



### Acacia mangium based system

- Acacia mangium* planted at a spacing of 8 x 2m under sub-humid climate
- At the end of 12 years the system produced 4238 cft. /ha of timber and 30 t / ha of firewood.
- In the alleys sesame can be grown up to 5th year, arrowroot from 6<sup>th</sup> to 8<sup>th</sup> year and pineapple from 9<sup>th</sup> to 12<sup>th</sup> year.
- BC ratio for *Acacia mangium* based Agri-silvicultural System: 3.34:1



Acacia mangium based silvopastoral Systems



Gram crop with *A.mangium*



Mustard crop with *A.mangium*

### Dalbergia based Agroforestry System

- Spacing: 4 m on boundary and 6x4 m in block plantations
- Potential Area: middle and upper gangetic plains region and central plateau & hill region; Uttarakhand, Uttar Pradesh, Punjab, Haryana, Maharashtra, Tamil Nadu, Rajasthan, Gujarat, Madhya Pradesh and Bihar
- Rotation Age: 20 - 25 years
- Suitable intercrops: Wheat, paddy, soybean, mustard and pulses
- Economics: Overall net income per hectare per year with Shisham + paddy Rs 41,000/- and Shisham + wheat Rs. 35,000/- under irrigated condition
- BC ratio for *Dalbergia sissoo* based Agri-silvicultural System: 2.35:1



## Silvipasture System

- ▶ The silvipasture system is most suitable for degraded lands in semi-arid, arid regions. It generates on an average 120 mandays/ ha/ yr employment and yields a B:C ratio of 1.52.
- ▶ Biomass yield from degraded lands could be successfully enhanced to more than 10 t ha<sup>-1</sup> y<sup>-1</sup> from hardly 0.5 t ha<sup>-1</sup> y<sup>-1</sup>.



## Gum and Resin based AFS

- 60 % of Forest revenue comes from MFP including gum and resins.
- The sector supports about 50 million population inhabiting forest and fringe areas providing 70% employment (1.6 million man days)
- India annually produces about 2,24,000 t gums, 55,500 t of resins & 1500 t of gum-resins
- Largest producer of Guar and Karaya gum
- *Acacia senegal* and *Boswellia serrata* potential gum yielding AF tree species for region.



## Sericulture & Apiculture

- Promise for Tasar & mulberry silk
- *Terminalia tomentosa*, *T. arjuna*, *Sal* host for tasar insect
- *Morus alba*, *M. indica*, *M. serrata* and *M. latifolia* for mulberry insect
- India produces about 70,000 t of honey, generating foreign exchange through exports.
- 4 out of 6 type of honey bees in India
- *Apis dorsata*, *A. cerana*, *A. mellifera* important for the region along with no. of host tree and crop species.



## Natural Resource conservation through agroforestry

Kisan Mitra Project , 7 districts of Bundelkhand

- Cost effective design of Rainwater Harvesting Structures (RWHS)
- Teak plantation: 150000 on bunds and block
- Fruit trees: 7000 on bunds & 7000 in high density
- Demos on IFS models at 21 locations
- Crop demos in AF: 100/ district/ year
- Homestead: 150 families/year/district (Lemon, guava, aonla, moringa, bael, sarifa. Availability of fruits through out the year for nutritional security)

## Pilot Villages: Scaling up initiative

| District   | Block          | Villages                                |
|------------|----------------|---|
| Lalitpur   | Talbehat       | Pana-Khurdi, Boidha, Jhavar             |
| Jhansi     | Babina, Bamour | Imliya, Rajapur, Amarpur, Singar, Sutta |
| Jalaun     | Mahiva         | Noorpur, Naseerpur, Hyalpur             |
| Hamirpur   | Sumerpur       | Saukhar, Nazarpur, Karimati             |
| Mahoba     | Kabarai        | Chandpura, Nathupura, Baniyatala        |
| Banda      | Thindwari      | Benda, Amlikaur, Jauharpur              |
| Chitrakoot | Karwi          | Rowli-Kalyanpur, Rasin                  |



No of Villages: 22; No of HHs = 24,000; Population = 100,000; Area covered: 40,000 ha



About 4.0 lakh agroforestry plantation at all sites

## Other RWH interventions



## Field Bunding and drainage structures



### Agroforestry interventions



### Har Med Par Ped – Boundary Plantation

- Farmers motivated to plant timber / fodder and fruit trees on farm boundaries.
- Space constrained agricultural landscapes
- Bunds and boundaries- excellent options
- Internal bunds, borders of farms, agricultural fields, rivers, canal bunds, around ponds and lakes
- Benefits like food, timber, fruits, fiber, fuelwood, fodder, manures, medicine
- Soil and water conservation
- Ecorestoration of agricultural lands



### Success Stories

Mahendra Singh, Vill-Parasai, Jhansi



- Small Farmer (1 ha)
- Guava, Lemon and teak based Agroforestry
- Improved fodder on bunds
- Two buffaloes and one cow
- Net annual income increased from Rs. 40,000 to 1,26,00 in a span of four years

Farmer : Sri. Manjunath Kalaj at Honnapur village of Dharwad taluk



|                    |  |
|--------------------|--|
| Name of the Farmer | Sri. Manjunath Kalaj   |
| Land Holding       | 2.50 acres at Honnapur Village, Dharwad  |
| System Adopted     | Mango + Teak + Vegetables and Napier grass + Teak  |
| Spacing            | 6 x 6 m  |
| Year of Planting   | 2011   |
| Total Income       | Rs. 2.85 lakhs<br>(Rs. 0.75 lakhs : Mango + Rs. 1.10 lakhs : vegetables + Teak poles Rs. 1.00 lakhs) |

Md Harej Ali, Nalbari  
Arecanut, Guava, Mango, Pineapple, Banana plantation in dyke of fish pond.  
Banana and napier grass as intercrop in *Syzygium cumini*



Other components diary and duckery.

Annual Income  
Rs 1,25,000/-

### SILVIPASTURE MODEL ESTABLISHED IN FARMER'S FIELD – SUCCESS STORY

Name of the beneficiary with address : Mr. Vijayarangan, Kuthanoor village, Kancheepuram district  
Experience in agriculture : Four years  
No. of animals : 16 goats and 6 cows  
Agroforestry model : Silvopasture  
Inputs supplied : Co (CN) 4 fodder slips (16,000 No.)  
Gliricidia stem cuttings - 200 nos.  
Area allotted for fodder cultivation : One acre  
Option : For feeding cows / goats  
Benefit : Increased milk yield, improved reproduction



### Carbon sequestration potential and Mapping area under Agroforestry

2020

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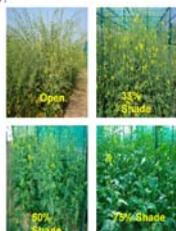
View Publication →

ICAR-Central Agroforestry Research Institute  
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### EVALUATION OF SHADE TOLERANCE OF CROP SPECIES FOR AGROFORESTRY SYSTEMS

Low Incident sun light or shade is one of the most important component limitations under agroforestry system that poses challenge to system productivity. Thus, to address one of such major constraints for agroforestry, following achievements made so far;

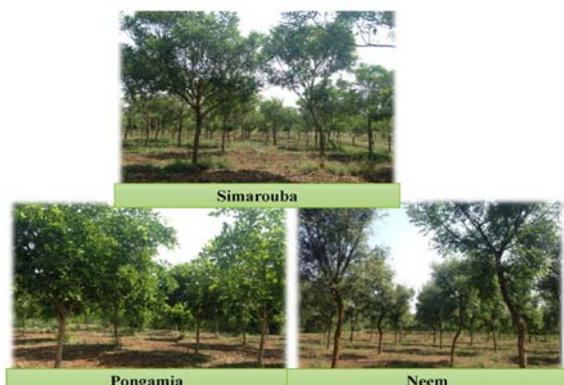
- It has been established that 33% shade of incident light would be critical limit for growing crops for agroforestry system and deeper shade beyond this would be detrimental for the crops.



Crop phenology of mustard as affected by various regimes of shade

### Agroforestry for Biofuel and Bioenergy

#### Prosopis juliflora – Value Chain



### TREE LEAF MEAL

After pollarding, the tree leaves were separated from the stem, allowed to dry to constant weight under shade, ground in hammer mill and stored in air tight bags to be included in livestock ration

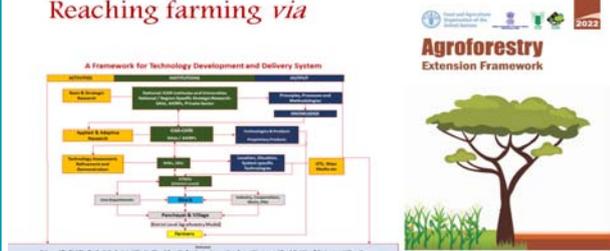


### Tree fodder based silage



## Field level strategies to promote agroforestry

### Reaching farming via



### FarmTree App launched

- 23<sup>rd</sup> May, 2020, the English Version - Launched by DDG, NRM
- 24<sup>th</sup> January, 2021, the most awaited Hindi version of the Farm Tree App – Launched by a Progressive Farmer; Shri Kamal from Village Parasai

Google Play Store Rating 4.73

- Android-based mobile app covering 25 promising agroforestry tree species of India
- Dalrypleta, Teak, Poplar, Mahogany, Neem, Mahanera, Karanj, Sisham, Gliricidia, Kadamb, Bamboo, Gundar, Siris, Simal, Mangum, Casuarina, Arjun, Khejri, Arjun, Malabar rosem, Subabul, Chandan, Rakt chandan, Gmelina and Bimal
- Covers species description, package of practices, nursery techniques, plant protection and material availability supported with photographs
- Highlights suitable agroforestry models for agro-climatic regions of India and success stories on agroforestry
- Information accessible in both English and Hindi languages (Bilingual app)
- User friendly with two-way communication (discussion on public forum or ask query with experts)
- Compatible with all android mobile devices, freely available on google play store



## Options for promoting agroforestry



## Agroforestry in the new Millennium

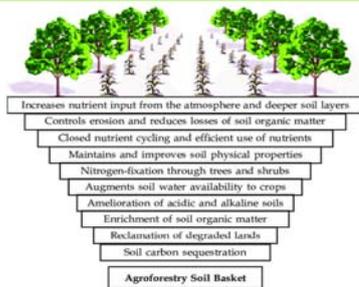
- Shift from Annual to perennial farming –Green to Evergreen Revolution
- Inputs needed for the shift towards Evergreen Revolution – Research, Training, outreach, convergence between programmes, and Policy
- World's First country to come out with National Agroforestry Policy
- Largest network of Research Institutions and other organizations involved in the sector
- Region specific Traditional Ecological Knowledge including AF
- Demand for Wood and Non wood products
- Need to strengthen Outreach Activities in Forestry and AF- changing roles for stakeholders- Researchers , Development department, NGO.

## Challenges in promotion of agroforestry



**Agroforestry entrepreneurship for growing money on trees: to spark a new economic revolution for India**

## Soil Health



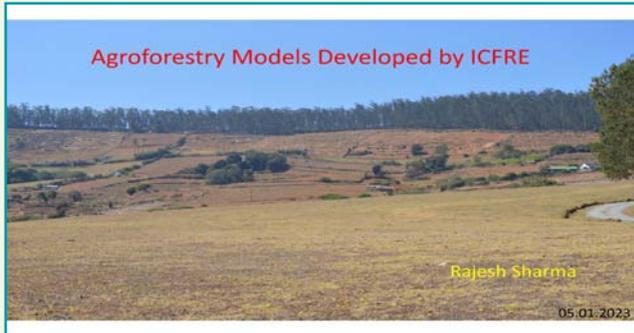
## The need of the hour.... Conserve the Environment

A targeted program/project to enable the whole process of reconciliation and consolidating the agroforestry recommendations in line with the ground reality



**THANKS**

## 8. Agroforestry models developed by ICFRE: Dr. Rajesh Sharma, ADG (BCC), ICFRE



**Background**

- Forest (71.38 m ha) and tree cover (9.57 m ha) are 24.62% of the GA (ISFR 2021)
- Govt. of India aims at 33% of its GA under forest and tree cover




- Supporting 16 % of the World's human population and 18 % of the world's cattle population, the new draft Forest Policy 2018 aims to address the recent realities of climate change, human-animal conflict and declining green cover
- Total projected roundwood demand by 2030: 57 million cum (ITTO, 2021)
- India's imports pulp of 510 million USD and wood/ wood products of 1,950 million USD in 2019 (ITTO, 2021)

Agroforestry as a collective land use system where woody perennials use the same land management units as agricultural crops and/or animals in some form of spatial arrangement




- helps protect and sustain agricultural productive capacity
- ensures food diversity and seasonal nutritional security
- diversifies rural economies
- provides ecosystem goods and services
- strengthens resilience to climatic fluctuations
- major source of wood for wood-based industries

Agro and Farm Forestry helps in achieving international commitments related to UNFCCC, UNCCD, CBD, Bonn Challenge and SDGs



- Agroforestry and farm Forestry helps in achieving Sustainable Development Goals
- AF systems can sequester large amounts of above and below ground carbon compared to tree-less or pure agriculture farming systems
- In India, average carbon sequestration potential in agroforestry has been estimated to be 19 t/ha over 25 m ha
- Agroforestry provides ample opportunity for the carbon neutral economy and support forest based industries, hence, play an important role in shifting India towards an innovative, resource efficient and carbon neutral bio-based economy



Agroforestry models developed by ICFRE for various agro-climatic zones of India

- Agroforestry in Trans Himalayan Region: 02
- Agroforestry in Western Himalayan Region and Indo-Gangetic Plains: 06
- Agroforestry in Eastern Himalayan Region: 02
- Agroforestry in Gangetic Plain Region: 05
- Agroforestry in Plateaus : 08
- Agroforestry in Western Dry Region: 04
- Agroforestry in Coastal Plains and Ghats: 07

Agroforestry in Trans Himalayan Region

Salix (*Salix fragilis* and *S. alba*) and poplar (*P. euphratica*, *P. alba*, *P. nigra*) based agroforestry model



Salix and poplar based agroforestry

Apple based horti-medicinal model



Apple (*Pyrus malus*) based Horti-medi model

**Economics of the model**  
Total expenditure (sowing to harvest): Rs. 1.10 lakhs  
Income : A. *heterophyllum*: Rs. 2.626 Lakhs (2.02 t/ha @ Rs. 1300/kg); A. *glauca*: Rs. 1.38 Lakhs (2.3 t/ha @ Rs. 60/kg), *Picrorhiza kurroa*: Rs. 1.40 Lakhs (0.7 t/ha @Rs. 200/kg) and *Valeriana jatamansi*: Rs. 1.44 lakhs (1.2 t/ha @ Rs. 120/kg)

Agroforestry in Western Himalayan Region and Indo-Gangetic Plains

- Melia (*Melia dubia*)-Aonla (*Emblica officinalis*) based agri-silvi-medicinal model
- Poplar (*Populus deltoides*) based agri-silviculture model
- Poplar (*Populus deltoides*) based silviculture-medicinal model
- Melia (*Melia dubia*) based agri-silviculture model
- Eucalyptus (*Eucalyptus teriticornis/camaldulensis*)-Wheat (*Triticum aestivum*)/paddy (*Oryza sativa*) based silvi-block model
- Poplar (*Populus deltoides*)-Wheat agroforestry model

- Melia-Aonla based agri-silvi-medicinal agroforestry system performed better in degraded lands in Uttarakhand and Punjab
- Model helped to evaluate the productivity of some important medicinal plants under tree species in degraded lands
- Two plots (one acre) each at both sites (Punjab and Uttarakhand) used for block plantation of Melia and Aonla (var. NA-7) and intercropped with *Rauwolfia serpentina* and *Withania somnifera* and seasonal agriculture crops of wheat (*Triticum aestivum*), masoor (*Lens culinaris*) and groundnut (*Arachis hypogaea*)






Melia-Aonla based Agri-silvi-medi model    Melia with Wheat model    Groundnut collection under Melia    Groundnut collection under Aonla

**Rotation period and yield**

| Species                                   | Yield (Q/ha)  |
|---|---------------|
| Melia (8 <sup>th</sup> year)              | Timber: 1215  |
| Aonla (8 <sup>th</sup> year)              | Fruit: 506.02 |
| Masoor ( <i>Lens culinaris</i> )          | 7.9           |
| Wheat ( <i>Triticum aestivum</i> )        | 15            |
| Groundnut ( <i>Arachis hypogaea</i> )     | 3.5           |
| Sargganda ( <i>Rauwolfia serpentina</i> ) | Root: 14.15   |
| Ashwagandha ( <i>Withania somnifera</i> ) | Root : 5.53   |

**Economics of the models (per hectare basis)**

| Model (block plantation)          | Expenditure | Income generated | Net profit |
|-----------------------------------|-------------|------------------|------------|
| Melia-Sarggandha-Masoor           | 7,87,755    | 20,96,858        | 13,09,103  |
| Aonla-Sarggandha-Masoor           | 7,87,508    | 21,65,393        | 13,77,885  |
| Melia-Ashwagandha-Groundnut-Wheat | 9,38,235    | 22,15,628        | 12,77,393  |
| Aonla-Ashwagandha-Groundnut-Wheat | 9,31,510    | 22,99,939        | 13,68,429  |

- Model suitable for alluvial and sandy loam soils in Indo-Gangetic alluvial plains of U.P, U.K., Haryana and Punjab
- Model helped improve the local environment by increasing tree cover over a large area and reducing biotic pressure on natural forests
- Model tested on 1 acre plot in five villages each in Yamunanagar district of Haryana and Haridwar district of Uttarakhand
- Models included block plantation of *Populus deltoides* with intercrop Turmeric, Sugarcane, Wheat, Paddy, Potato, Bajra/millet, Chari and Barseem





Poplar turmeric silvi-medicinal system    Poplar with Chari    Poplar with Wheat

### Rotation period and yield

| Species                       | Yield (Q/ha)    |
|-------------------------------|-----------------|
| Poplar (6 <sup>th</sup> year) | Timber: 1992.60 |
| Turmeric (dry)                | 22.52           |
| Sugarcane                     | 665             |
| Wheat                         | 30              |
| Paddy                         | 35              |
| Potato                        | 180             |
| Bajra                         | 20              |
| Chari                         | 250             |
| Barseem                       | 760             |

### Economics of the models (per hectare basis)

| Model  | Expenditure | Income generated | Net profit |
|--|-------------|------------------|------------|
| Poplar-Sugarcane-Turmeric                        | 1,81,711    | 5,55,807         | 3,74,096   |
| Poplar-Sugarcane-Wheat-Chari                     | 1,90,750    | 4,53,150         | 3,22,400   |
| Poplar-Sugarcane-Wheat-Chari-Potato-Maize-Bajra  | 2,18,083    | 5,61,985         | 3,43,902   |
| Poplar-Sugarcane-Potato-Barseem-Chari            | 1,71,067    | 5,15,095         | 3,44,028   |
| Poplar-Paddy-Wheat boundary plantation           | 1,25,862    | 3,04,291         | 1,78,429   |
| Poplar-Sugarcane-Wheat-Paddy boundary plantation | 1,20,862    | 3,30,539         | 2,09,677   |

### Melia (*Melia dubia*) based agri-silviculture model

Two plots (1 acre) each at two sites at Handesra and Hukuran in Punjab with intercrop of Wheat (*Triticum aestivum*) and Maize (*Zea mays*)

### Rotation period and yield

| Species                                | Yield (Q/ha)                   |
|--|--------------------------------|
| Melia (8 <sup>th</sup> year 400 trees) | Timber: 1360, fuelwood: 554.60 |
| Wheat ( <i>Triticum aestivum</i> )     | 371.31 (grain); 482.70 (straw) |
| Maize ( <i>Zea mays</i> )              | 327.29 (grain); 818.22 (straw) |

### Economics of the models

| Model             | Expenditure | Income generated | Net profit (8 years) |
|-------------------|-------------|------------------|----------------------|
| Melia-wheat-maize | 3,54,939    | 27,97,111        | 24,42,172            |



### Poplar (*Populus deltoides*) based silviculture-medicinal models

Two plots (1 acre) each at two sites in Haridwar and Premnagar (Dehradun) with clone G-48 clones planted with under storey crops of Chitrak (*Plumbago zeylanica*) and Satavar (*Asparagus recemosus*)

### Rotation period and yield

| Species                                | Yield (Q/ha)   |
|--|--|
| Poplar (6 <sup>th</sup> year)          | Timber: 1992.6 (irrigated), 972 (rainfed)                                  |
| Satavar ( <i>Asparagus recemosus</i> ) | 30 (irrigated), 20 (rainfed)   |
| Chitrak ( <i>Plumbago zeylanica</i> )  | Biomass: 7.5 (irrigated); 5 (rainfed)<br>Seed: 10 (irrigated); 6 (rainfed) |

### Economics of the models

| Model          | Expenditure                                | Income generated       | Net profit            |
|----------------|--|------------------------|-----------------------|
| Poplar-Satavar | 3,24,716 (irrigated)<br>3,04,516 (rainfed) | 21,98,550<br>11,75,450 | 18,73,834<br>8,70,934 |
| Poplar-Chitrak | 2,55,274 (irrigated)<br>2,35,074 (rainfed) | 19,67,300<br>7,65,376  | 17,12,026<br>4,70,302 |



### Eucalyptus (*Eucalyptus teriticornis*)-Wheat-Paddy silvi block model

Model performs better in well drained clayey alluvial soil, red alluvial soil and sodic soil with optimum irrigation during first and second year

### Rotation period and yield

| Species   | Yield (Q/ha)                     | Net Profit     |
|---|----------------------------------|----------------|
| Eucalyptus block (3x2 m) (5-6 <sup>th</sup> year) | Timber: 3523<br>fuelwood: 554.60 | Rs. 13.8 Lakhs |
| Eucalyptus-Wheat bund model                       | Eucalyptus: 325<br>Wheat: 192    | Rs. 4.49 Lakhs |
| Eucalyptus-Paddy bund model                       | Eucalyptus: 325<br>Paddy: 210    | Rs. 5.12 Lakhs |

### Poplar (*Populus deltoides*)-Wheat agroforestry model

The model performs well in clayey alluvial soils and sandy loam soils. The site specific clones developed by FRI and WIMCO used by farmers

Poplar-wheat model (2.5 x 2.5 m) gives around 3375 Q/ha with net profit of Rs. 15.21 lakhs at six year rotation period



### Agroforestry in Eastern Himalayan Region

- King chilli (*Capsicum annuum*)-Arecanut (*Areca catechu*) based model
- Gmelina (*Gmelina arborea*) based agri-silvi model

- King chilli-Areca nut based model for hot and humid conditions of Northeast region of India
- King Chilli (*Bhoot jolokia*), used as a food and spice is the most preferred intercrop under areca nut trees with better survival and growth
- The model (1333m<sup>2</sup>) expenditure: Rs. 25,000. The income from King chilli: Rs. 55,000 (@200/Kg) and areca nut: Rs. 54,000 with net profit of Rs. 84,000



Gmelina (*Gmelina arborea*) based agri-silvi model laid on abandoned agricultural land with soybean and cowpeas as intercrop during rainy season and wheat and mustard during winter season

### Agroforestry in Gangetic Plain Region

The Gangetic Plain Region (Uttarakhand, U.P, Bihar, Jharkhand, West Bengal, Punjab and Haryana) is dominated by cereals; rice-wheat cropping system occupies more than 70% of the gross cropped area and pulses around 7%.

The agroforestry models for these regions developed by IFP, Ranchi are:

- Poplar-Wheat agri-silviculture
- Poplar-Maize agri-silviculture
- Poplar-Banana silvi-horticulture
- Poplar-Turmeric agri-silviculture
- Poplar-Jimikand silvi-horticulture



### Rotation period and Yield:

Poplar trees to be harvested at the age of 2-3 years for paper and pulp, 6-8 years for plywood and timber @ Rs. 5000/ton

### Agroforestry in Plateaus

The agroforestry models for plateaus developed by TFRI, Jabalpur, IFB, Hyderabad and IWST, Bengaluru and are:

- Teak (*Tectona grandis*)-Turmeric (*Curcuma domestica*) silvi-medicinal model
- Bamboo (*Dendrocalamus* species) based silvi-agri model
- Bach (*Acorus calamus*)-Paddy (*Oryza sativa*) agri-medicinal model
- Flemingia (*Flemingia macrophylla* and *F. semialata*) based model
- Agri-lac culture model
- Babul (*Acacia nilotica*)-Paddy (*Oryza sativa*) model
- Sandalwood-Teak-Eucalyptus-Redsanders based silvi-agri model
- Sandalwood (*Santalum album*) based agroforestry model

### Bach (*Acorus calamus*)-Paddy (*Oryza sativa*) agri-medicinal model

- Beneficial for paddy growers to utilize waterlogged land by intercropping Bach
- Bach plant harvested after 10 months, yield 3.5 t/ha of dried rhizomes and 1 lakh propagules of fresh rhizomes for 1 ha
- Total expenditure: Rs. 1.20 Lakhs. The income from paddy: Rs. 50,000/ha and Bach Rs. 2.0 lakhs (market rate). Net income: Rs. 1.30 lakhs/ha/yr



### Flemingia (*Flemingia macrophylla* and *F. semialata*) based model

- Source of fuelwood, fodder, tannin, dyestuff and medicines, very promising for lac cultivation
- F. semialata* plants are ready to inoculate brood lac within a year after its planting and farmers can maintain the model and get lac up to 8 years
- Total expenditure: Rs. 75,000/ha and the income from lac and *Cajanus cajan*: Rs. 2 Lakhs/ha/yr with Rs 1 Lakh for each crop



### Agri-lac culture model

- Beneficial for farmers who intercrop agriculture crops viz. *Cajanus cajan*- *Asha variety* (Ahar) with Lac
- Farmers can grow lac on *C. cajan* for two years with an expenditure of Rs. 80,000/ha and generate income from *C. cajan* of Rs. 1 Lakh/ha @ Rs. 200/kg and from lac crop: Rs. 2-4 Lakhs with 13 t/ha @ Rs. 200/kg and net income: Rs. 2.60 lakhs.



### Teak (*T. grandis*)-Turmeric (*Curcuma domestica*) silvi-medicinal model

- Performs better in well drained sandy soils with irrigation during early 1-2 years
- Teak trees harvested at the age of 10-12 years for pole and 20 years for timber
- Total expenditure: Rs. 1.50 Lakhs. Total production of turmeric: 3 t/ha/year and income Rs. 1.80 lakhs (@ Rs. 60/kg), teak poles: Rs. 6.50 Lakhs (@Rs. 1250/pole for 200 poles and Rs. 2000 per pole for 200 poles). Net income: Rs. 6.80 Lakhs



### Bamboo (*Dendrocalamus* species) based silvi-agri model

- Improves degraded lands by planting Bamboo with suitable annual crops especially with *Vigna mungo* (soya) and *Triticum aestivum* (wheat) up to 5 years, till bamboo canopy closes
- The average yield of wheat 0.16 t/ha and urd 0.10 t/ha. Bamboo culms can be harvested from 4<sup>th</sup> year onwards
- Total expenditure: Rs. 96,000.00. The income/ha from urd: Rs. 40,000 and wheat: Rs. 70,000, bamboo poles: Rs. 2 lakhs/ha (@Rs. 100/culm for 2000 culms). Net income: Rs. 2.14 lakhs

### Babul (*Acacia nilotica*)-Paddy (*Oryza sativa*) silvi-agri model

- Paddy (variety JR 75) intercropped with babul prefers sodic and alkaline soils. The model with ten years period provides fodder, fuel wood (10 kg/m<sup>3</sup>), brushwood (110/ha/yr), small timber (0.2 m<sup>3</sup>) and non timber products (gum). The paddy yield recorded 2.5 t/ha against 1.5 t/ha from traditional varieties
- Total expenditure: Rs. 70,000/ha with net income: Rs. 3 Lakhs/ha

### Sandalwood-Teak-Eucalyptus-Redsanders based silvi-agri model

- Suitable for red loamy soil with optimum irrigation during first two years
- Beneficial for farmers planting *Santalum album*, *Persea caroliniana*, *Eucalyptus* species and *T. grandis* trees on farm fields along with short term agriculture crops (green gram, jawar, red gram and castor)
- Red sanders *Santalum* is most suitable for the cultivation of green gram, jawar and red gram and no other tree combination helpful for castor cultivation as weeds suppress the crop and do not allow it to grow with vigour

| Tree Combination      | Yield (Q/ha) per year for Green gram, Pigeon pea, Jawar and Castor |            |       |        |
|-----------------------|--|------------|-------|--------|
|                       | Green gram   | Pigeon pea | Jawar | Castor |
| Red sanders-Sandal    | 19   | 23.8       | 19.5  | 6.5    |
| Teak-Sandal           | 9.5  | 29         | 17    | 5.3    |
| Eucalyptus + Sandal   | 7.5  | 17.5       | 15.3  | 3.8    |
| Red sanders sole crop | 11.3   | -          | -     | -      |
| Teak sole crop        | 10   | -          | -     | -      |
| Eucalyptus sole crop  | 8.5  | -          | -     | -      |
| Agri-crop (soya)      | 11   | 24.3       | 19.5  | 29     |

### Economics of the model

Net income from green gram: Rs. 60,000/ha, pigeon pea: Rs. 1.0 Lakh/ha and jawar: Rs. 50,000/ha



### Sandalwood (*Santalum album*) based agroforestry model

- Model performs better in well drained red ferruginous loam soils
- Beneficial for farmers who can plant sandalwood along with horse gram and aonla and block plantation with Casuarina
- Sandalwood trees harvested at age 15 for heartwood with a yield of 15 kg of heartwood @Rs. 6000/kg
- The yield of horse gram: 500 kg/ha/year and aonla : 4 ton/ha from 5<sup>th</sup> year onwards
- Casuarina yielded 500 poles in 10 years
- Total expenditure : Rs. 1.5 cr. Income from aonla :Rs. 1.2 lakhs for 4 t/ha/year @ Rs30/kg, sandalwood kg at age 15 : Rs. 3.6 cr for 6000 kg of heartwood /ha at 15kg/tree @ Rs. 6000/kg, horse gram : Rs. 20,000 for 0.5 t/ha/year @Rs. 40/kg, Casuarina : Rs. 50,000 for 500 poles @ Rs. 100/pole. Net income : Rs. 2 cr



Sandalwood based Agroforestry Systems

### Agroforestry in Western Dry Region

The western dry region covers hot deserts, arid and semi-arid areas extending over Rajasthan, west of Aravallis, Gujrat and Dadar-Nagar Haveli. The models developed are:

- Hardwickia binata* based agroforestry model
- Embliba officinalis* based agroforestry model
- Colophospermum mopane* based agroforestry model
- Prosopis cineraria-Zizyphus mauritiana* agroforestry model

### *Hardwickia binata* based agroforestry model

- Model performs well in arid and semi-arid regions of Rajasthan with fixed (*Vigna radiata*) and rotational crop sequences (*Guar, Sesamum, Pennisetum*)
- Model common in Central India particularly as boundary plantation. The species introduced in western dry region to enhance fodder production

#### Fuelwood and fodder yield :

- The fodder yield : 3.99 kg in rotation crop and 3.33 kg in fixed crop/plant at 8 years. The average total dry biomass of *H. binata* trees ranged between 4.49 to 135.85 kg/tree at age 17. Biomass accumulation in stem was 45.7% of total biomass. Foliage contribution of total biomass was 23.5%



Hardwickia binata based Agroforestry Model

### *Embliba officinalis* based agroforestry model

- Model suitable for maximizing food and fruit yields under crop sequences of *Cyamopsis tetragonoloba, Sesamum indicum, Pennisetum glaucum* and *Vigna radiata*
- Tree height favorable under rotational cropping system than fixing a single crop continuously

### *Colophospermum mopane* based agroforestry model

- Model performs well in dry regions of Rajasthan as the tree grows well on loamy sand and clay loam soils
- C. mopane* introduced for maximizing food, fodder and fruit yield with fixed and rotation crop sequences

- The tree produces 3-4 kg dry fodder/fuelwood/tree/year (age 7), fruit yield of 0.5 kg/tree (age 5) and 1.25 kg/tree (age 9).

#### *Prosopis cineraria-Zizyphus mauritiana* agroforestry model

- Model works well in dry region of Rajasthan with well drained soil and irrigation facility (up to 3<sup>rd</sup> year after plantation)
- Integration of grafted ber and khejri with wheat crop : best agroforestry model
- The production of fodder : 0.20 t/ha (6<sup>th</sup> yr) for *P. cineraria* and utilizable biomass for *Z. mauritiana* and *P. cineraria* : 2.18 t/ha
- Model provided additional benefit of Rs. 7184/ha (6 yr) compared to agriculture crop



Colophospermum mopane based Agroforestry model

### Agroforestry in Coastal Plains and Ghats

Coastal plains and ghats cover Coromandel and northern Circar coasts of Andhra Pradesh, Odisha, Malabar coastal plains, Konkan coastal plains and the Sahyadris. States and Union territories covered under this agro-climatic condition are Tamil Nadu, Kerala, Andaman and Nicobar Islands, Lakshadweep Islands and Puducherry. The models developed by IFGTB, Coimbatore are:

- Casuarina (*Casuarina equisetifolia*)-Maize (*Zea mays*) agrisilviculture model
- Casuarina (*Casuarina equisetifolia*)-Moringa (*Moringa oleifera*)-Maize (*Zea mays*) agri-silvi-horticulture model
- Acacia auriculiformis*-Napier grass silvi-pasture model
- Tectona grandis*-Phaseolus mungo agri-silviculture model
- Acacia mangium*-Beans (*Vigna species*) agri-silviculture model
- Acacia mangium*-Pepper (*Piper nigrum*) silvi-horticulture model
- Casuarina* spp. based windbreak agroforestry model

### Casuarina (*Casuarina equisetifolia*)-Maize (*Zea mays*) agri-silviculture model

- IFGTB has developed superior clones and hybrids of Casuarina with high wood yield
- Raising of agricultural crop and planting of Casuarina seedlings is done simultaneously with 650 trees/ha
- Casuarina tree harvested at 4 years for pole and sold @ Rs.45/pole. The Maize yield recorded : 2 t/ha/year
- Total expenditure : Rs. 6,238 and income from maize Rs. 8,000/ha/yr (@Rs. 4000/t), Casuarina poles : Rs. 29,250 (@ Rs. 45/pole) and Rs. 1820 from fuel wood. Net income from the model : Rs. 32,832



Casuarina-Maize Agri-silviculture Model

### Casuarina (*Casuarina equisetifolia*)-Moringa (*Moringa oleifera*)-Maize (*Zea mays*) agri-silvi-horticulture model

- Maize yield 2 t/ha. Moringa yield 68250 number of drumsticks/ha in 3 years
- Total expenditure : Rs. 7,264. Income from Maize : Rs. 8,000/ha/yr (@ Rs. 4,000/t), Casuarina poles :Rs. 29,250 (@ Rs. 45/pole) and Rs. 1820 from fuelwood, Moringa Rs. : 40,950 (@ Rs.60/100 fruits). Net income : Rs. 57,971.

### *Acacia auriculiformis*-Napier grass silvi-pasture model

- Model for class IV-VIII lands (fallow lands) to meet fuel and fodder demand
- During 2<sup>nd</sup> and 3<sup>rd</sup> year, the lateral branches pruned to ward off shade to the grass and the pruned material yields biomass for fuelwood (2.8 t/ha). Total 18.44 t/ha biomass available at age 4
- Total expenditure : Rs. 21,088. The income from Napier grass : Rs. 80,000/ha, *Acacia* fuelwood : Rs. 14,752 @Rs.800/t. Net income : Rs. 73,664

### *Tectona grandis*-Phaseolus mungo agri-silviculture model

- Total expenditure : Rs. 12,275 and income from Black gram : Rs. 10,400/ha/year @Rs.16/kg. Income from teak poles : Rs. 65,000 @ Rs. 200/pole and Rs. 2250 from fuelwood. Net income : Rs. 65,375



Teak- blackgram Agri-Silviculture Model

### *Acacia mangium*-Beans (*Vigna species*) agri-silviculture model

- After 6 years, *Acacia mangium* pulp yield estimated was 18 MT/ha and fuel wood yield of 2 MT/ha. The green beans yield was estimated at 24 MT/ha
- Total expenditure : Rs. 89,000. Income from beans : Rs. 1,44,000/ha in 6 years @Rs.6/kg, mangium pulp wood : Rs. 36,000 @ Rs. 2000/MT of pulp wood and Rs. 2000 from fuelwood. Net income : Rs. 93,000



Acacia mangium - Beans Agri-Silviculture Model

### *Acacia mangium*-Pepper (*Piper nigrum*) silvi-horticulture model

- Acacia mangium* trees serve as support for pepper cultivation
- After 20 years *Acacia mangium* pulp yield estimated is 160 MT /ha and fuelwood yield 30 MT/ha from branches. Pepper yield estimated was 14.6 MT/ha for 17 years (yield starts from 4<sup>th</sup> year onwards)
- Total expenditure : Rs. 3,78,500. Income from pepper Rs. : 8,76,000/ha for 17 years @Rs.50/kg, mangium pulp wood : Rs. 3,20,000 @Rs.2000/MT of pulp wood and Rs. 30,000 from fuelwood. Net income : Rs. 8,48,000.



Acacia mangium - Pepper Silvi-Horticulture Model

### *Casuarina* spp. based windbreak agroforestry model

- IFGTB, Coimbatore has released five superior clones of *Casuarina junghuhiana* for providing protection against windstorms to horticultural and agricultural crops like banana, citrus crops and red gram etc.
- Windbreak tree varieties on the periphery of farm bunds help slow down the speed of wind and minimize the damage to cash crops, reduce evaporation from the soil and water loss through transpiration from the crop inside, thus increasing the productivity of agriculture crops from 10-30 %.
- Total expenditure : Rs. 31,500. Income from banana : Rs. 51,450/ha/year, Casuarina pulp wood : Rs. 1,00,000 @ Rs. 5000/MT at 4<sup>th</sup> year. Net income : Rs. 1,19,950.



IFGTB windbreak tree varieties with cow pea

## 9. Horti-techniques for making agroforestry more profitable in arid regions: Dr. P.R. Meghwal, Principal Scientist and Head, ICAR- CAZRI, Jodhpur

### Horti-Techniques for making Agroforestry more Profitable in Arid regions



P.R.Meghwal  
Principal Scientist(Horticulture)  
ICAR-Central Arid Zone Research Institute  
Jodhpur(Rajasthan)



### Major Agroforestry species in arid regions

#### Forestry tree species

- Khejri(Prosopis cineraria)
- Rohida (Tecomella undulata)
- Kumat(Acacia senegal)
- Jal(Salvadora Oleoides and S.persica)
- Bawal (Acacia nilotica)

#### Horticultural species

- Ber(Ziziphus mauritiana, Z.rotundifolia, Z.nummularia)
- Lasora(Cordia myxa and C.gharaf)

### Horticultural interventions in agroforestry species- Khejri and Lasora

- Genetic improvement- Mostly by selection
- Clonal propagation
- Value addition of the produce



### Socio-economic and Ecological Importance of khejri

- Perennial, multipurpose and life support plant species
- Leguminous tree-Nitrogen fixer
- Supply edible pods for humans, Fodder for livestock and fuelwood
- Drought and frost resistant
- Unique agroforestry tree which do not have adverse effect on companion crop growth
- Unripe pods are used for vegetable/pickles, flour of ripe pods are used for cookies and preparation of local dishes
- Litter fall and its decomposition rate is quite high, that build up soil organic matter under its canopy, increase soluble calcium and available P and decrease soil pH
- The round crown of khejri provides shade and shelter to animals and wild life during hot summer
- Different plant parts are used to treat human ailments-Leaves and seeds used to treat diarrhea, inflammation, measles, diabetes, prostate disorders

### Traditional agroforestry system

- Khejri based agroforestry system is most popular and widespread covering 60% area of arid zone.
- It has unique ability to improve crop yields grown beneath their canopy
- Small leaves of khejri fall in the canopy area of khejri, not driven away by wind get decomposed and adds to soil fertility
- Tree crop interaction studies revealed that pearl millet and cowpea perform better with *khejri* than green gram and dewgram
- Besides good yield of dry land crops, bonus yield of dry leaves and twigs (650-1050 kg/ha) and fuel wood (1.8-2.6 t/ha) could be obtained from the trees through annual lopping (Bhati *et al.*, 2008).
- A tree density of 100-200 plants per ha was found optimum for minimum interference with yield of dryland crops under *P. cineraria* canopy shade



### Budded Khejri based Agroforestry System in Arid Zone



### Nutritive value of khejri pods and leaves

| Nutrients     | Leaves  | Pods  |
|---------------|---------|-------|
| Crude protein | 14-18 % | 18 %  |
| Crude Fibre   | 13-22 % | 26%   |
| Carbohydrates | -       | 56 %  |
| Fat           | -       | 2 %   |
| P             | 0.4     | 0.4   |
| Calcium       | 2.1     | 0.4 % |
| Iron          | -       | 0.2 % |

Source: Pareek *et al.*,1998)

### Propagation

- Sexual propagation(seeds) for creation of variability and for use as rootstocks- **Natural and most common method**
- Vegetative propagation-Air layering and budding, budding more common
- Budding in nursery in polybag raised seedling-should be one year-old, with stem girth of 0.5-0.8mm(Meghwal and Harsh,2008)
- In-situ budding-may be done on naturally growing seedling plant up to 2 years of age or seedling may be planted at desired spacing and budded after 1-2 years
- Preparation of mother plant-The selected mother plants should be pruned during December-January for production of new shoots for taking buds
- The budding can be done from June to September

### Naturally growing trees- Selection of desirable Genotypes



### Desirable Pods

- Long green and thin pods
- It should be soft and non acrid types
- Higher yield of both leaves and pods



### In situ budding



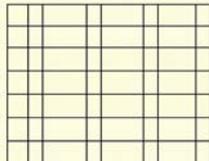
### Preparation of mother plants for taking budwoods



### Planting and management of budded khejri plants

#### Planting system and distance-

- ❑ Generally, 8x8m in square system-156 plant per ha
- ❑ Paired row planting 4x4m two rows, next pair of row is spaced at 24 m-about 200 plant per ha.



### Management of Budded Khjeri Plantation

- Supplemental irrigation may be required up to three years after planting if used budded plants from poly bags, no irrigation required in case of in situ budded plants
- Irrigation frequency- 7-15 days depending upon the season and soil types
- Plants are trained to a low headed structure with branching allowed at 2-3 feet from ground level



2-Years old in situ budded khejri

### Training, Pruning and manuring



- During initial three years, the budded plants are trained to build a short statured structure
- Annual Pruning is done after harvest of pods during the end of June
- The cut surface should be treated with copper oxychloride
- About 20 kg FYM per plant can be added in the beginning of monsoon as general recommendation
- Fruiting during April next year



### Profuse Fruiting in Budded Khejri at CAZRI, Jodhpur



## Pod harvesting and value addition

- Harvesting at correct stage of pod maturity is very essential for culinary purpose
- It should be neither too immature nor over mature
- Blanching of pods in water having 0.1% KMS or 0.2% common salts help in retaining the natural colour of pods after dehydration upon rehydration
- Dehydration can be done under Sun or in electric drier with final moisture content of 5-7% or till the pods become brittle



## Dehydration of pods



Pretreatment of pods with 0.1 % KMS while blanching results better quality dried pods

## Fully ripened(dried) pod processing



## Nutritional values of Prosopis flour compared with plain white wheat flour (Cattaneo et al. 2016).

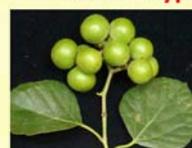
| Compounds                      | Prosopis flour | Plain white wheat flour |
|--------------------------------|----------------|-------------------------|
| Energy (kcal/100 g)            | 361            | 338                     |
| Carbohydrate (g/100 g)         | 69.2           | 72.2                    |
| Total sugars (g/100g)          | 13.0           | 1.5                     |
| Fiber (g/100g)                 | 47.8           | 3.2                     |
| Protein (g/100g)               | 16.2           | 9.4                     |
| Fat content (g/100g)           | 2.12           | 1.3                     |
| Saturated fatty acids (g/100g) | 0.6            | 0.2                     |

## Gunda or Lasora

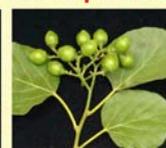
- *Gunda* or Lasora (*Cordia myxa* L.) belongs to family Boraginaceae
- It has tremendous potential in arid and semi arid regions of India as it is drought hardy plant
- It can be planted on farm boundary as wind break to improve microclimate
- Green unripe fruits are used for fresh vegetable and for preparation of pickles
- The fruits can also be preserved by dehydration for use during off season.
- Its cultivation is becoming popular due to high economic returns.



## Cordia: types and species of Importance



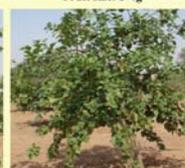
Commercial Lasora  
Fruit size: 6-10g



Small fruited Lasora for rootstock  
Fruit size: 3-4g



Goondi (*Cordia sinensis*)  
Germination-50-60%



Drought hardiness: Goondi > small fruited gonda > Commercial large fruited gonda

## Farmers' Practice

Mostly boundary Plantation  
Can't Sacrifice the main land

Dual Purpose-Wind breaks  
and fruits



## Species and varieties

- *Cordia myxa*-Large fruited
- *Cordia myxa* -small fruited ecotypes
- *Cordia sinensis*- rye goondi-related species

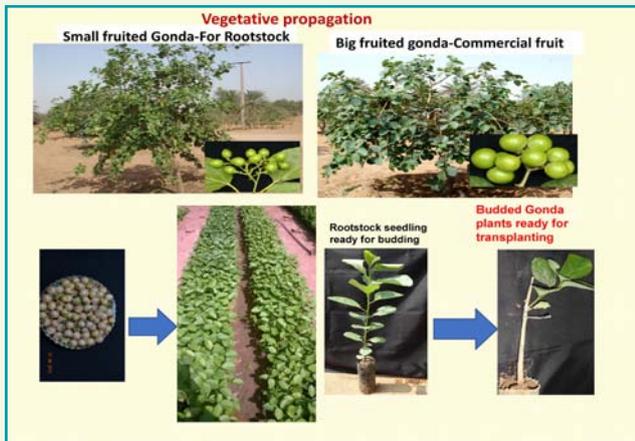
### Varieties improvement of large fruited types

- Maru Samridhi-CAZRI Jodhpur
- Karan Lasora-SKNAU, Jobner
- Thar Bold-CIAH Bikaner



Nutritional composition of different accessions of cordia myxa at different maturity stages

| Accessions | Maturity stage | Fiber extract % | Crude Protein % | Total Ash % | Silica % | C.F. % | N.D.F % | A.D.F % | Ca % | P %  |
|------------|----------------|-----------------|-----------------|-------------|----------|--------|---------|---------|------|------|
| CZCM-2011  | 20 DAFS        | 3.65            | 12.12           | 8.90        | 1.20     | 32.45  | 73.40   | 56.2    | 0.18 | 0.35 |
| CZCM-2011  | 30 DAFS        | 4.05            | 12.21           | 9.10        | 0.80     | 17.80  | 70.80   | 54.20   | 0.14 | 0.35 |
| CZCM-2012  | 20 DAFS        | 3.25            | 11.56           | 8.90        | 0.90     | 14.41  | 76.40   | 55.60   | 0.20 | 0.25 |
| CZCM-2012  | 30 DAFS        | 3.55            | 11.68           | 9.00        | 0.90     | 17.45  | 72.60   | 51.00   | 0.19 | 0.38 |
| CZCM-2021  | 20 DAFS        | 3.75            | 11.97           | 8.80        | 1.30     | 14.00  | 73.60   | 55.40   | 0.24 | 0.28 |
| CZCM-2025  | 20 DAFS        | 1.35            | 11.06           | 13.40       | 0.50     | 14.30  | 70.80   | 55.60   | 0.20 | 0.35 |
| CZCM-2025  | Ripened Fruit  | 2.20            | 6.62            | 12.90       | 0.80     | 12.72  | 28.80   | 26.60   | 0.19 | 0.35 |



## Planting and Management

- **Planting time-** July-August or Feb-March
- **Spacing:** 5-7 m depending upon location and purpose
- **Pit size:** 2'x2'x2'

### Manuring (based on experience)

| Age (years) | FYM (kg/plant) | Compost (kg/plant) |
|-------------|----------------|--------------------|
|             | Time : July    | Time: February     |
| 1           | 5              | -                  |
| 2           | 10             | -                  |
| 3           | 15             | 10                 |
| 4           | 20             | 15                 |
| 5 and above | 20             | 20                 |



## Canopy Management

- The budded plants tend to grow more laterally.
- The first heading back of the main shoot is done after about two months of the planting leaving about 20-25 cm from the bud union.
- 3-4 well spaced upright growing limbs are allowed to develop as main scaffold.
- The sprouts coming from rootstock portion should invariably be removed.
- All dried up and over crowded branches should be pruned during October and February.
- Many branches get dried due to gummosis during April, such branches should also be pruned after fruit harvest.



## Defoliation



- ❑ *Lasora* plants require defoliation for early and uniform fruiting.
- ❑ It should be done at the end of December to beginning of January. The leaves start yellowing and falling naturally after withholding irrigation during November-December.
- ❑ Leaves can be removed either manually or by chemical spray of ethrel(1000 ppm) in first week of January.
- ❑ The fallen leaves must be spread in tree basin and covered with soil to conserve moisture.
- ❑ The leaves get decomposed over the time adding to soil fertility.

## Water management

- *Lasora* plants require regular irrigation during first three years for proper establishment.
- Once the plants are established they require very little or no irrigation during rainy and winter season.
- The irrigation should rather be withheld from October to January to facilitate easy leaf defoliation during December-January.
- First irrigation should be started in the beginning of February. There after regular irrigation at 7-10 days interval (about 400 L/plant/irrigation) should be given up to last week of April depending upon the weather condition.
- Flowering starts in the middle of February and fruit set during end of February to March, fruit harvesting is completed by the end of April after which irrigation is stopped.



## Harvesting , yield and PH Management

- ❑ The fruits are ready for harvesting after 20-30 days after fruit set
- ❑ Fruit varies from 30-100 kg per plant depending upon varieties and management
- ❑ Fruits can be sold fresh, dehydrated and pickled



## Conclusions

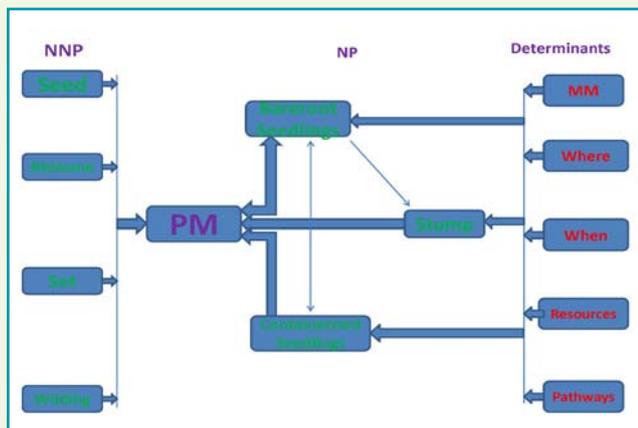
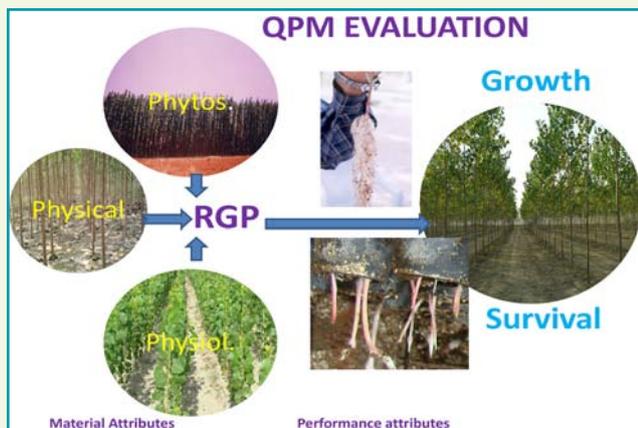
- Use of remunerative agroforestry species like Khejri and *lasora* can be better option for profitable agroforestry in arid area
- More profits can be earned by selection of desirable types, clonal propagation, systematic planting and better management under agroforestry systems
- Trees like khejri and *lasora* are important constituents of traditional panchkuta mixture of dried vegetables which fetches additional returns when selected in agroforestry systems
- Value added products can be prepared from khejri pods and *lasora* fruits
- The fruits/pods are organic by default-Scope to increase the profit simply by certification and proper packaging and labelling



10. Quality planting materials for productivity enhancement under agroforestry and farm forestry practices: Dr. R.C. Dhiman, MD Retd., WIMCO Seedling Limited

## Quality Planting Material for Productivity enhancement under Agroforestry and Farm Forestry Practices

R C Dhiman  
CIFOR-ICRAF, New Delhi  
9927042364



## QPM-Definition

- Nursery produced disease free, physically sound, and physiologically active planting stock; raised through seed or vegetative reproductive material from **known** mother material; with **potential** of high field performance

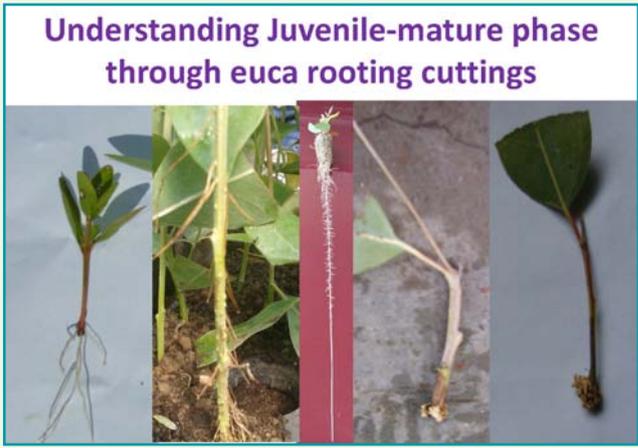
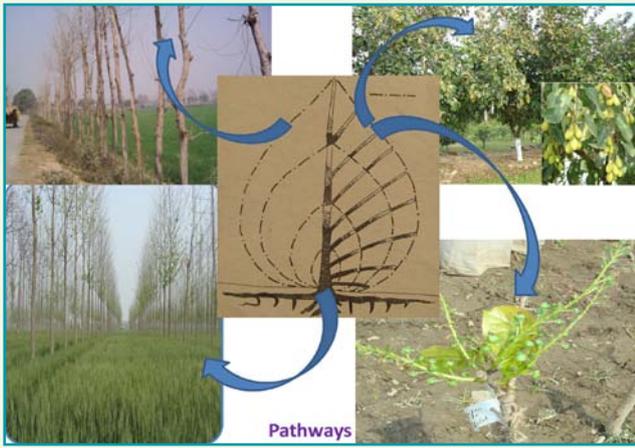
1960,s      1984

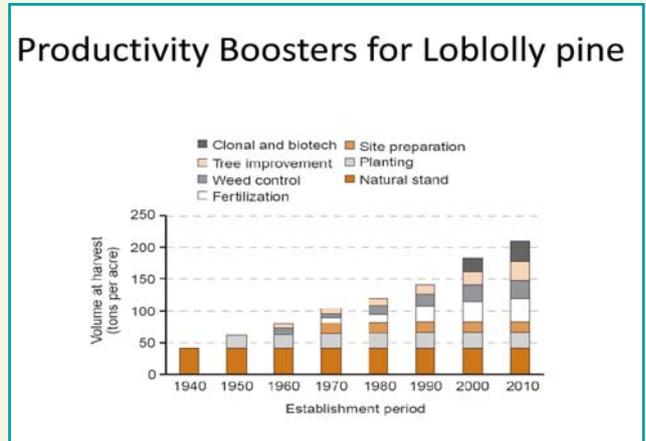
Stump      Containerized PM

P bag      Root Trainer

### Growth of different Stock types (*M.dubia*) after one growth season

| Repl | ETPs       |          |         | Stump (Root Shoot cuttings) |          |         | Containerized plants |          |         |
|------|------------|----------|---------|-----------------------------|----------|---------|----------------------|----------|---------|
|      | Height (m) | DBH (cm) | CBL (m) | Height (m)                  | DBH (cm) | CBL (m) | Height (m)           | DBH (cm) | CBL (m) |
| 1    | 6.6        | 7.8      | 0.6     | 7.8                         | 8.4      | 1.2     | 8                    | 8.6      | 1       |
| 2    | 5.7        | 7.1      | 1.4     | 8                           | 7.5      | 1       | 6.6                  | 5.3      | 0.7     |
| 3    | 5.6        | 7.3      | 1.3     | 7                           | 6.2      | 0.5     | 7                    | 6.5      | 1.1     |
| 4    | 5.4        | 7.6      | 1.2     | 8                           | 8.4      | 0.8     | 6.7                  | 5        | 2.3     |
| 5    | 4.6        | 7        | 1.9     | 8.2                         | 8.5      | 0.9     | 6.1                  | 6.2      | 1.4     |
| Mean | 5.6        | 7.4      | 1.3     | 7.8                         | 7.8      | 0.9     | 6.9                  | 6.3      | 1.3     |







## 11. Quality planting material and high yielding varieties for agroforestry developed by ICFRE: Dr. Ashok Kumar, Scientist G, ICFRE- FRI, Dehradun

### QUALITY PLANTING MATERIAL AND HIGH YIELDING VARIETIES FOR AGRO-FORESTRY DEVELOPED BY ICFRE

**Dr. Ashok Kumar**  
Scientist G  
(ashok@icfre.org, akcgtp@gmail.com)



**Forest Research Institute**  
(Indian Council of Forestry Research & Education)  
Dehradun, Uttarakhand

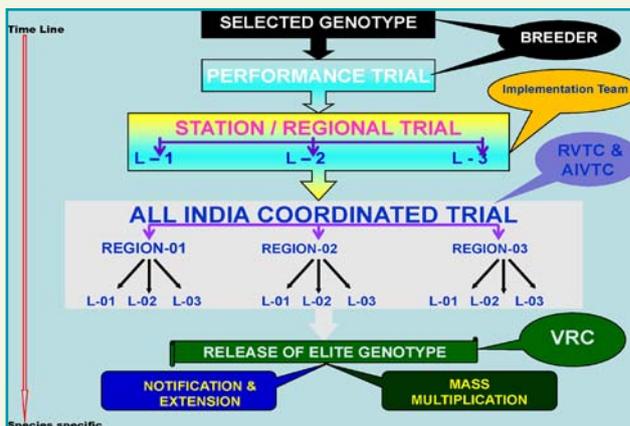
### NATIONAL AGROFORESTRY POLICY 2014

- Seeds Act 1966 / Seeds Act 2019 (Proposed) in conjunction with National Agroforestry Policy (2014) are powerful tools for forest varieties and clones
- National Agroforestry Policy (2014) specifically covers tree varieties and clones under following Sections and Sub-Sections,
  - 2.6 Dearth of quality planting material, as only 10 % planting material are of high quality
  - Focus on production, handling, distribution, planting and supervision of high quality planting materials
  - 5.1.4 Strengths of ICFRE should be capitalized
  - 5.7.1 Role of industries in promotion of agroforestry to be tapped,
    - Production and supply chain of high quality planting materials
    - Technology development and dissemination, especially for quality planting materials, processing, etc.
    - Extension services to the farmers
    - Providing market information and future trends
  - CERTIFICATION OF NURSERIES, SEEDS AND FINISHED PRODUCTS FOR SUSTAINABLE MANAGEMENT PRACTICES

### QPM : TREE VARIETIES AND CLONES

- No procedure for release of tree varieties existed till 2008
- FRI and ICFRE developed a scientific procedure for release of tree varieties which was duly ratified by Govt. of India (2008)
- Expected points of concern related to Gazette Notification, as per Seeds Act 1966, were also considered while instituting various committees,
  - Implementation Team
  - Regional Variety Testing Committee
  - Variety Testing Committee
- Though ICFRE has released as many as 69 varieties / clones so far, it is surprising that no private firm / industry has come forward to release any of the clones / varieties
- The Seed Bill (2019), pending for approval of parliament, makes it mandatory to multiply released / certified germplasm in certified nursery

**SINCE NO PROCEDURE FOR RELEASE OF CULTIVARS FOR FOREST TREES EXISTED, NO PROCEDURE WAS NEEDED FOR NOTIFICATION IN GAZETTE OF INDIA**



### IMPLEMENTATION TEAM

| COMPOSITION OF IMPLEMENTATION TEAM |   |
|------------------------------------|---|
| Coordinator                        | A tree breeder / geneticist / expert of ICFRE Institute   |
| Member                             | One outside (other than ICFRE and MoEF&CC) subject matter expert  |
| Members                            | Two tree breeders or geneticists of the regional institute(s) of ICFRE, of which one should be the species specialist                     |
| Member                             | One forest statistician   |
| Member                             | One member from either State Forest Department (SFDs) or Forest Development Corporation (FDCs) or State University or Wood Based Industry |

### REGIONAL VARIETY TESTING COMMITTEE

| COMPOSITION OF RVTC |   |
|---------------------|---|
| Chairperson         | Director of Regional Institute of ICFRE   |
| Member              | Coordinator, Implementation Team  |
| Members             | Two outside (Other than ICFRE and MoEF&CC) as Subject matter Experts  |
| Members             | Four members from the State Forest Department (SFDs) or Forest Development Corporation (SFDs) or State Universities or National Research Centre for Agroforestry, forest based Industries and progressive farmers |
| Member Secretary    | Head, Division of Genetics and Tree Improvement   |

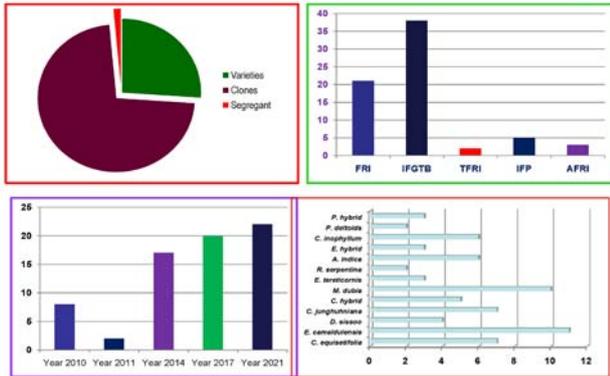
### ALL INDIA VARIETY TESTING COMMITTEE

| COMPOSITION OF AIVTC |  |
|----------------------|--|
| Chairperson          | Director General, ICFRE  |
| Members (8)          | Directors of ICFRE Institutes  |
| Members (7)          | <ul style="list-style-type: none"> <li>Two subject experts from outside ICFRE and MoEF&amp;CC</li> <li>Three Chairpersons of the Regional Variety Testing Committee (other than proposing Institute)</li> <li>Two ICFRE experts</li> </ul> |
| Member Secretary     | Deputy Director General (Research), ICFRE  |

### VARIETY RELEASING COMMITTEE

|                  |  |
|------------------|--|
| Chairperson      | Director General of Forests and Special Secretary                                |
| Co-Chairperson   | Director General, ICFRE-cum-Chairperson, AIVTC                                   |
| Members (8)      | Chairpersons of Regional Variety Testing Committees                              |
| Members (2)      | Principal Chief Conservators of Forests  |
| Members (2)      | Specialists with outstanding contributions in the field of genetics and breeding |
| Member Secretary | Deputy Director General (Research), ICFRE  |

## RELEASE OF TREE SPECIES



## NATIONAL REGISTER : CLONES AND VARIETIES

1. A register of all kinds and varieties of seed as 'National Register of Varieties and Clones' is maintained with Assistant Director General (RP), ICFRE with all specifications
2. Register is in full control and management of Deputy Director General (Research), ICFRE as Member Secretary, Variety Releasing Committee
3. Various Committee regularly furnish information for inclusion and maintaining in 'National Register of Varieties and Clones'
4. The Release Certificates are issued according to entries entered and verified in 'National Register of Varieties and Clones', after the approval of the variety Releasing Committee

## Melia dubia Cav.

- *Melia* is a native to India, Bangladesh and Myanmar, and terms as Dreak, Gora Neem, Meetha Neem and so on
- Though exact centre of diversity is not known, it ranges from Northeastern India to Myanmar
- Domesticated and grown in all most entire India from North to South and East to West, upto 1500 m asl.
- Systematic studies not carried out for growth and productivity parameters
- Neither gene pool explored nor genetic diversity analyzed
- No analysis carried out for wood parameters, insect-pest infestation, seed and nursery technology
- Germplasm not identified for specific end-uses as well as for particular growing regions

Hence,

Genetic resources were needed to be explored and utilized judiciously with application of intensive scientific tools

## UN-IMPROVED PLANTATIONS



## SELECTIONS



## SELECTIONS

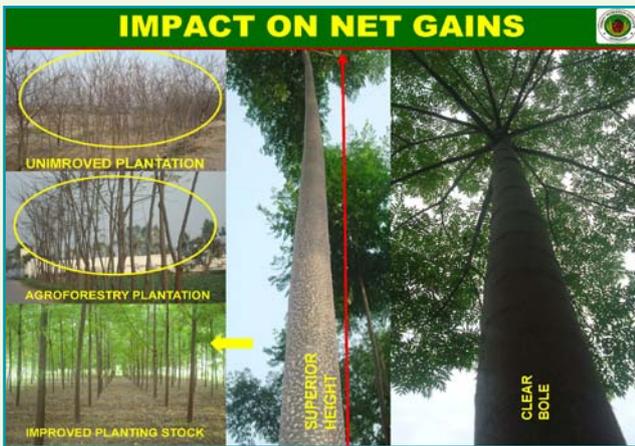


## VARIATIONS IN BARKS



## IMPACT OF PROGENY TESTING





### DETAILS OF GEOGRAPHICAL LOCATIONS

| Year of establishment | No. of genotypes | Geographic location | District    | State         | Latitude     | Longitude    |
|-----------------------|------------------|---------------------|-------------|---------------|--------------|--------------|
| 2009                  | 21               | Mehuwala            | Dehradun    | Uttarakhand   | N30°18'45.4" | E77°59'20.8" |
|                       |                  | Bithmara            | Hissar      | Haryana       | N29°31'57.8" | E75°55'10.6" |
|                       |                  | Pindori Mindo Mind  | Hoshiarpur  | Punjab        | N31°33'34.1" | E75°49'1.60" |
| 2010                  | 21               | Kharkan             | Hoshiarpur  | Punjab        | N31°29'88.2" | E76°02'1.60" |
|                       |                  | Tanda               | U. S. Nagar | Uttarakhand   | N29°14'39.2" | E79°32'55.2" |
| 2011                  | 21               | Chutamalpur         | Saharanpur  | Uttar Pradesh | N30°33'37.0" | E77°03'19.5" |
|                       |                  | Lai Kuoan           | Nainital    | Uttarakhand   | N29°3'48.9"  | E79°30'56.8" |
| 2013                  | 42               | Pipal Parao         | U. S. Nagar | Uttarakhand   | N29°14'39.2" | E79°32'55.2" |
|                       |                  | Gilla Khera         | Fatehabad   | Haryana       | N29°30'12.7" | E75°18'0.83" |
|                       |                  | Chak Sarkar         | Firozpur    | Punjab        | N30°77'21"   | E74°29'12"   |



## PRODUCTIVITY OF RELEASED VARIETIES



| Cultivar No. | Proposed Commercial Name | TRAITS      |         |          |          |      |      |      |                   | Productivity (m <sup>3</sup> ha <sup>-1</sup> yr <sup>-1</sup> ) |
|--------------|--------------------------|-------------|---------|----------|----------|------|------|------|-------------------|--|
|              |                          | Height (cm) | CD (cm) | DBH (cm) | CBH (cm) | Str. | NB   | BB   | Volume (per tree) |  |
| FR/MD/235    | SHARAD                   | 1433.33     | 31.00   | 25.73    | 790.00   | 3.67 | 4.33 | 3.33 | 0.2513            | 55.83  |
| FR/MD/349    | SHASHI                   | 1618.17     | 29.26   | 24.38    | 779.10   | 3.69 | 2.94 | 3.51 | 0.2546            | 40.41  |
| FR/MD/032    | BAHUMUKHI                | 1233.33     | 28.67   | 23.33    | 666.67   | 3.33 | 2.33 | 3.00 | 0.1791            | 39.79  |
| FR/MD/232    | VARSHA                   | 1216.67     | 28.33   | 22.67    | 616.67   | 3.67 | 4.67 | 3.00 | 0.1670            | 37.11  |
| FR/MD/241    | KARTIK                   | 1521.40     | 28.88   | 22.93    | 892.54   | 6.41 | 5.09 | 6.11 | 0.2124            | 33.71  |
| FR/MD/075    | KSHITIZ                  | 1233.33     | 28.00   | 21.33    | 740.00   | 4.00 | 3.33 | 3.00 | 0.1504            | 33.43  |
| FR/MD/262    | AMAR                     | 1619.03     | 28.91   | 21.33    | 880.55   | 3.69 | 2.94 | 3.51 | 0.1960            | 31.10  |
| FR/MD/231    | MEGHA                    | 1216.67     | 25.33   | 19.13    | 650.00   | 3.67 | 2.67 | 3.00 | 0.1203            | 26.73  |
| FR/MD/256    | DEV                      | 1366.67     | 22.33   | 17.20    | 890.00   | 4.00 | 3.67 | 4.00 | 0.1096            | 24.36  |
| FR/MD/261    | RITU                     | 966.67      | 24.80   | 19.93    | 513.33   | 3.00 | 2.67 | 3.00 | 0.1044            | 23.19  |

## REGIONWISE CULTIVARS

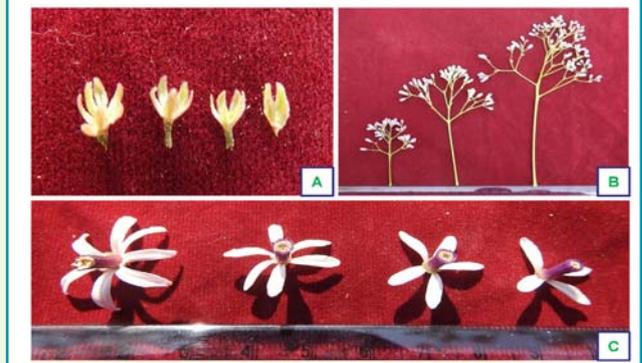
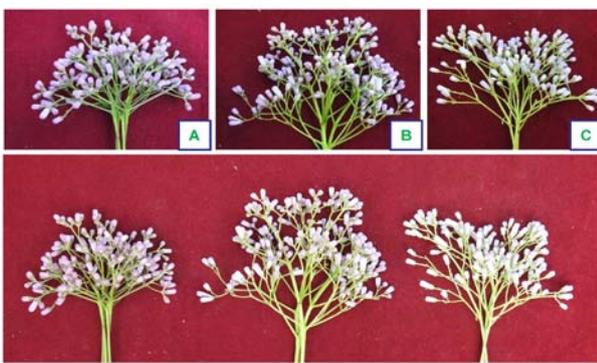


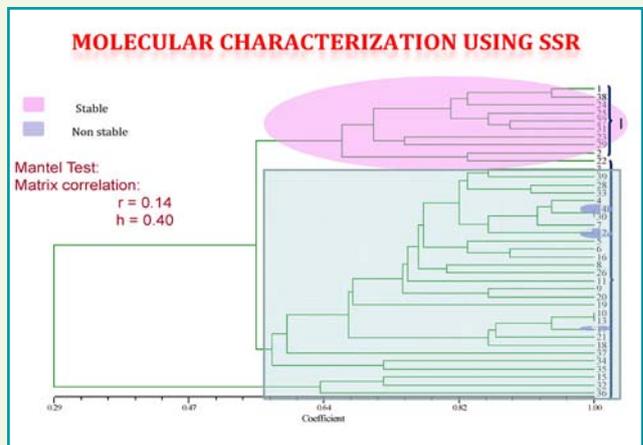
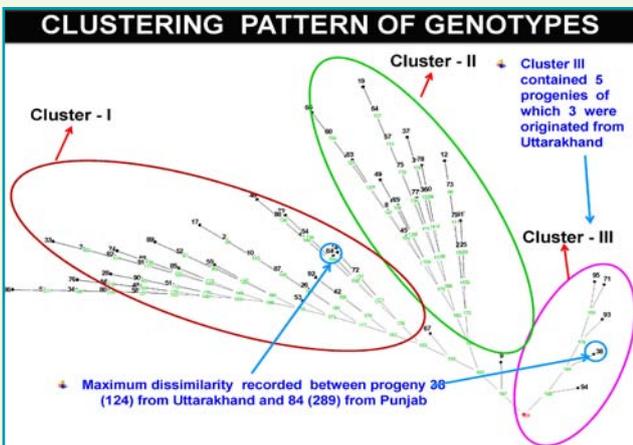
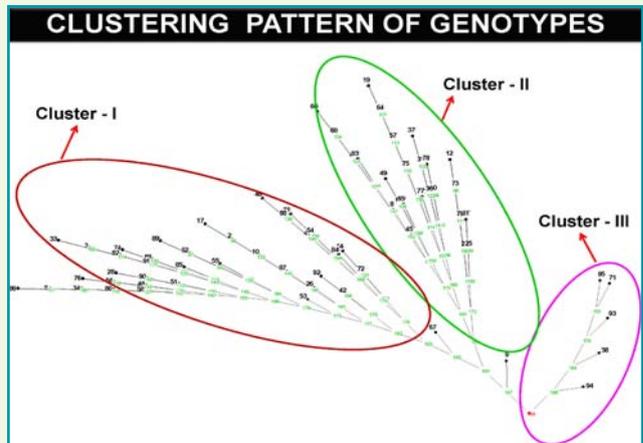
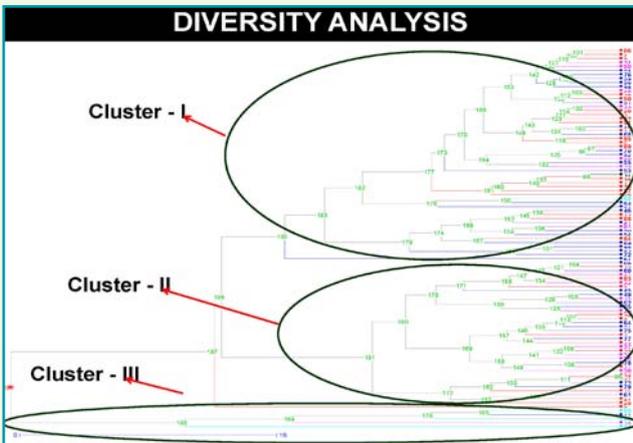
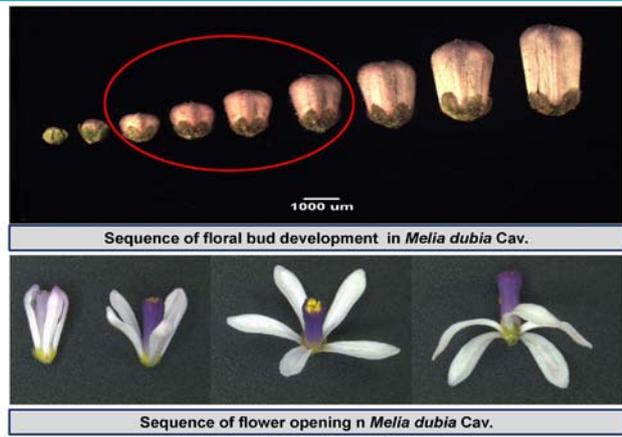
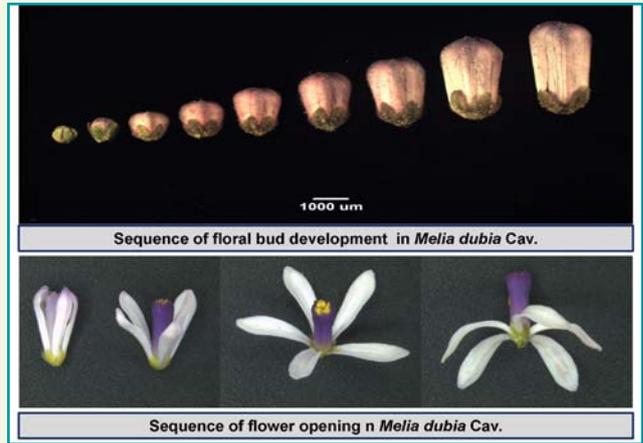
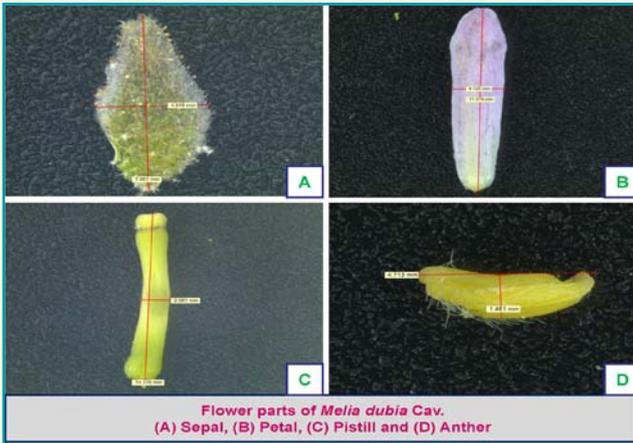
| S. No. | Cultivars | Commercial Name | Region                   | District           | Evaluation Location                       |
|--------|-----------|-----------------|--------------------------|--------------------|---|
| 1      | FR/MD/032 | BAHUMUKHI       | • Western Haryana        | • Hissar           | • Bithmera, Hissar, Haryana               |
| 2      | FR/MD/075 | KSHITIZ         | • Northeastern Punjab    | • Hoshiarpur       | • Pandori Mindo Mind, Hoshiarpur, Punjab  |
| 3      | FR/MD/231 | MEGHA           | • Western Uttarakhnad    | • Dehradun         | • Mehuwala, Dehradun, Uttarakhnad         |
| 4      | FR/MD/232 | VARSHA          | • Northeastern Punjab    | • Hoshiarpur       | • Khadkan, Hoshiarpur, Punjab             |
| 5      | FR/MD/235 | SHARAD          | • Southern Uttarakhnad   | • Udhm Singh Nagar | • Tanda, Udhm Singh Nagar, Uttarakhnad    |
| 6      | FR/MD/241 | KARTIK          | • Central Haryana        | • Rohtak           | • Rohtak, Haryana                         |
| 7      | FR/MD/256 | DEV             | • Northern Uttar Pradesh | • Saharanpur       | • Chutamalpur, Saharanpur, Uttar Pradesh  |
| 8      | FR/MD/261 | RITU            | • Southern Uttarakhnad   | • Udhm Singh Nagar | • Tanda, Udhm Singh Nagar, Uttarakhnad    |
| 9      | FR/MD/262 | AMAR            | • Western Haryana        | • Fatehabad        | • Gilla Khera, Fatehabad, Haryana         |
| 10     | FR/MD/349 | SHASHI          | • Western Punjab         | • Firozpur         | • Chak Sarkar, Firozpur, Punjab           |
|        |           |                 | • Southern Uttarakhnad   | • U. S. Nagar      | • Lal Kuan, Udhm Singh Nagar, Uttarakhnad |

| NUMBER & NAME OF ENTRY |  | FRI-MD-032 (BAHUMUKHI)   |
|------------------------|--|--|
| Survival               | 84.00 %  |  |
| Height                 | 12.33 m  |  |
| DBH                    | 23.33 cm   |  |
| CBH                    | 6.66 m   |  |
| CD                     | 28.67 cm   |  |
| Straightness           | 3.30   |  |
| Branching behaviour    | 3.00   |  |
| No. of branches        | 2.33   |  |
| Disease incidences     | Nil  |  |
| Insect incidences      | Nil  |  |
| Stability              | Stable   |  |
| Volume                 | 0.1791 m <sup>3</sup>  |  |
| Productivity           | 39.79 m <sup>3</sup> ha <sup>-1</sup> yr <sup>-1</sup>               |  |
| Regions of growing     | • Western Haryana<br>• North-Eastern Punjab<br>• Western Uttarakhnad |  |

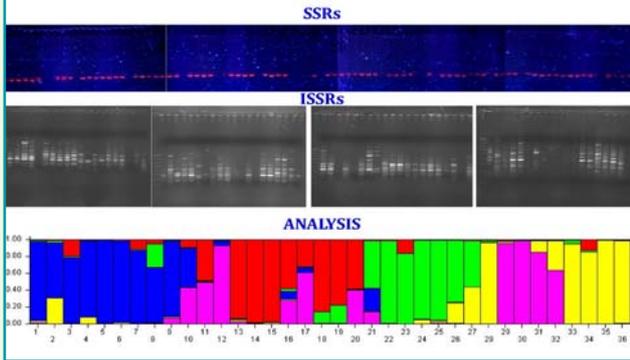


| NAME OF ENTRY DURING TESTING |  | FRI-MD-256 (DEV)  |
|------------------------------|--|---|
| Survival                     | 80.00 %  |  |
| Height                       | 13.66 m  |   |
| DBH                          | 17.20 cm   |   |
| CBH                          | 8.90 m   |   |
| CD                           | 22.33 cm   |   |
| Straightness                 | 4.00   |   |
| Branching behaviour          | 4.00   |   |
| No. of branches              | 3.67   |   |
| Disease incidences           | Nil  |   |
| Insect incidences            | Nil  |   |
| Stability                    | Stable   |   |
| Volume                       | 0.1096 m <sup>3</sup>                                  |   |
| Productivity                 | 24.36 m <sup>3</sup> ha <sup>-1</sup> yr <sup>-1</sup> |   |
| Regions of growing           | • Northern Uttar Pradesh<br>• Southern Uttarakhnad     |   |

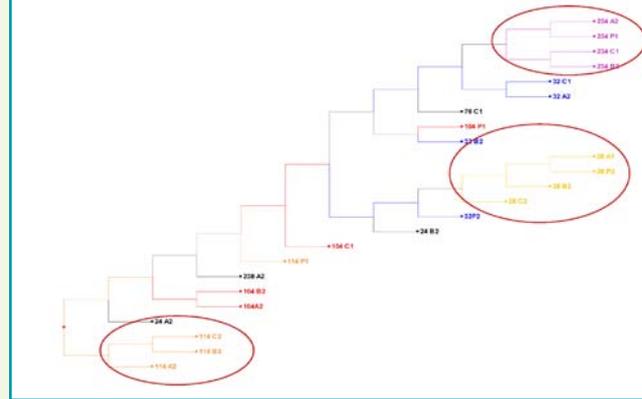




## Parent - Progeny - Relationship



## TOPOLOGY ON PARENT-PROGENY RELATIONSHIP



## HYBRIDIZATION PROGRAMME



## AZADIRACHTA INDICA (NEEM)



### TRADITIONAL USES

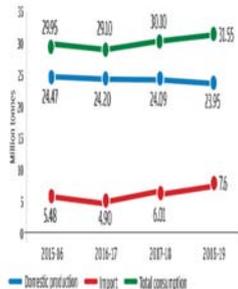
- Most notable factor in neem is azadirachtin, a tetranortriterpenoid (limonoids), which is chiefly present in seed kernels
- Most notable traditional uses are,
  - Eco-friendly and biodegradable pesticide
  - Organic fertilizers
  - Toiletries
  - Beauty products
  - Traditional medicines
  - Pharmaceuticals for human health
  - Furniture industry

### NEEM COATED UREA

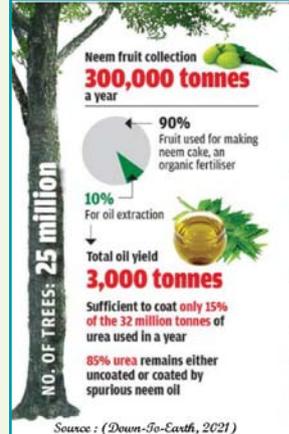
- Neem coated urea, maximizes efficiency due to slow release which enables availability of nitrogen to plants for a longer duration
- Coating of urea with neem is environmentally advantageous
  - Required less quantity of urea and ensures higher productivity / yields
  - Reduces solubility of urea substantially and reduces contamination of ground water under control
  - Coating reduces ammonia volatilization and controls atmospheric pollution
  - Most importantly, not fit for industrial use and adulteration
- Environmental friendly endeavor can be converted into economic boon for farmers as well

## UREA

- In India, fertilizer industry is growing with tremendous rate and contribution of urea is proportionally very high
- India is the second largest consumer of fertilizers after China, and also ranks second in production of nitrogenous fertilizers
- Cabinet Committee on Economic Affairs (CCEA) approved 'New Urea Policy-2015' (NUP-2015), and decided that
  - 100 % Indigenous Urea to be neem coated by September 01, 2015
  - 100 % Imported Urea to be neem coated by December 01, 2015
- Curbing illegal diversion of agricultural subsidy to non-agricultural purposes



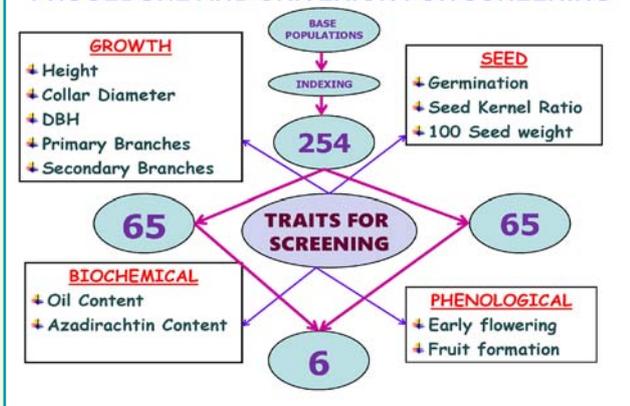
| Year      | Urea  | DAP   | Complex | Total  |
|-----------|-------|-------|---------|--------|
| 2014-2015 | 22.29 | 34.44 | 78.32   | 338.61 |
| 2015-2016 | 24.47 | 37.87 | 83.01   | 365.63 |
| 2016-2017 | 24.20 | 43.65 | 79.55   | 365.32 |



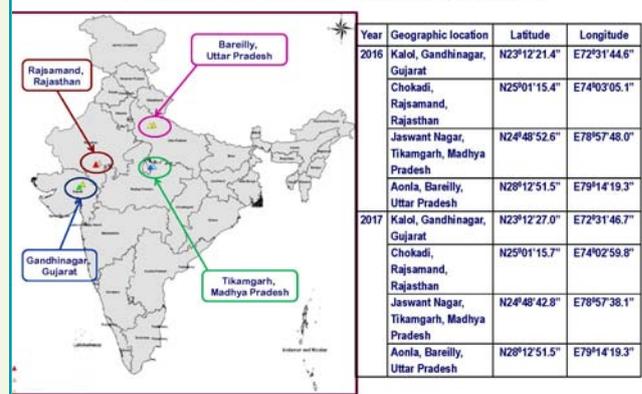
## NEEM FOR COATED UREA

- About 85 % of shortage exists for neem oil, and therefore Govt of India is contemplating to import neem oil from China, Malaysia and Myanmar
  - Neem is native to India, and has approximately about 25 Million Neem trees presently
  - About 600 gm Neem Oil is needed to coat 1 metric ton of urea
  - However, full potential of neem coated urea would be possible when quantity of oil enhanced to ~ 2 kg / metric ton
  - Nonetheless with even present status India needs ~22000 Metric Tones of neem oil to coat 32 Million Tonnes Urea
- Therefore, Gap between demand and supply though is substantially higher, can be filled with ease by cultivating genetically improved and productive trees

## PROCEDURE AND CRITERION FOR SCREENING



## DETAILS OF MULTI-LOCATION TRIALS





| TECHNICAL DETAILS<br>(FRI-IFFCO-112) |               |
|--------------------------------------|---------------|
| Name of entry proposed for release   | FRI-IFFCO-1   |
| Name of the entry during testing     | FRI-IFFCO-112 |
| Survival (%)                         | 83.00         |
| Height (cm)                          | 383           |
| Collar diameter (cm)                 | 10.85         |
| DBH (cm)                             | 7.67          |
| Seed-Kernel Ratio                    | 1.81          |
| Primary Branches                     | 2.90          |
| Secondary Branches                   | 12.92         |
| Germination (%)                      | 86.33         |
| 100 Seed Weight (gm)                 | 34.67         |
| Oil content (%)                      | 43.51         |
| Azadirachtin (ppm)                   | 9559.00       |
| Age of Flowering                     | 2 Years       |
| Disease incidences                   | Nil           |
| Insect incidences                    | Nil           |
| Stability                            | Stable        |
| Total Index Value                    | 68.75         |



### MASS MULTIPLICATION THROUGH TISSUE CULTURE

- Good multiplication was recorded with 0.10, 0.20 and 0.40 mg/l BAP for different genotypes of Neem
- Across genotype, neem multiplication rate per cycle has been to 2-3 times in 5-6 weeks
- Therefore, production of large plantlets have been standardized through application of tissue culture
- The survival of plants has been recorded to more than 70 %
- The tissue cultured plants have even been evaluated in the field and performing

### MASS MULTIPLICATION THROUGH TISSUE CULTURE

### RECENT ADVANCES IN MELIA DUBIA CAV.

Recent Advances in *Melia dubia* Cav.

Editors  
Ashok Kumar  
Geeta Joshi

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Research & Education  
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**Acknowledgement**

- ICFRE, Dehradun
- IFFCO, New Delhi
- DPIIT, MoI&C, New Delhi

**THANKS**



## 12. Increasing Productivity of Agroforestry and Farm Forestry Plantations High Yielding Varieties Developed by ICFRE for Southern India: Dr. A. Nicodemus, Scientist G, ICFRE- IFGTB, Coimbatore

### Increasing Productivity of Agroforestry and Farm Forestry Plantations High Yielding Varieties Developed by ICFRE for Southern India



A. Nicodemus



Institute of Forest Genetics and Tree Breeding  
(Indian Council of Forestry Research and Education)  
Coimbatore 641 002, India

National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management  
Delhi, 09-06 January 2023

### Overview



- Wood demand and supply in South India
- Major Farm Forestry Species
- Varieties released
- Commercialization
- Realized Gains
- Opportunities and Challenges

### South India: Demand for Wood

Annual consumption of industrial wood (million tonnes)



| Species         | Pulpwood   | Plywood   | Poles      | Total       |
|-----------------|------------|-----------|------------|-------------|
| Eucalypts       | 2.9        | 25        | 5.8        | 33.7        |
| Casuarina       | 1.5        | 0         | 3.0        | 4.5         |
| Leucaena        | 1.2        | 0         | 0          | 1.2         |
| Acacia, Melia + | 0.3        | 5         | 0          | 5.3         |
| <b>Total</b>    | <b>5.9</b> | <b>30</b> | <b>8.8</b> | <b>44.7</b> |

Major paper industries in South India: APL, ITC, SPBL, TNPL, WCPM, Sirpur

### Agro and Farm Forestry – Ecosystem, Socio-economic

- Two thirds of ~45 million tonnes come from agro and farm forestry plantations
- Annual turnover: Rs. 14,500+ crores (USD 1.75 billion)
- Area harvested yearly: 0.48 million ha
- Total area under farm forestry: 1.94 million ha
- Increase green cover; Sustains soil fertility; reduces pressure for fuelwood
- Dependable source of farm income; prevents non-agri land use; retains farm labour in the rural areas

### Major Farm Forestry Trees: Eucalyptus



- Mainly grown in semi-arid landscape and low nutrient soil (600-700 mm rainfall)
- Species: *E. camaldulensis* & *E. tereticornis*
- Meets ~50% of pulpwood and >75% of plywood raw material requirement
- Moderate tree improvement efforts
- Preferred for absentee farming and low cultivation cost

### Major Farm Forestry Trees: Casuarina

- Mostly grown in coastal landscape with irrigation; rapid expansion into inland areas
- Compatibility with other crops; enriching soil with biological Nitrogen fixation
- Amenability to high-density plantations. Short rotations: 3 to 5 years
- Meets ~25% of pulpwood raw material need; widely used as poles and for charcoal making
- Generally low productive plantations; source-known variety / seed source are limited

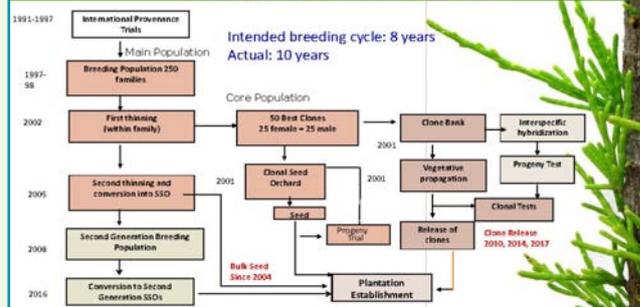


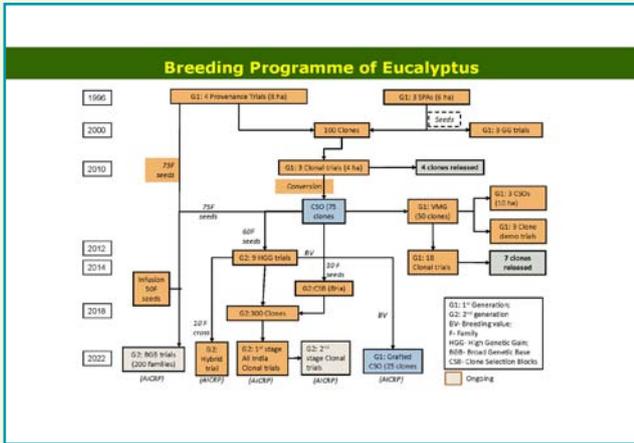
### Major Farm Forestry Trees Leucaena

- Plantations concentrated in coastal AP and Karnataka
- Meets 20% of pulpwood raw material requirement
- Amenability to high-density plantations, short rotation (3-4 y) coppice growth, biological Nitrogen fixation
- Least recognized farm forestry species; Limited tree improvement



### Breeding Programme of Casuarina





## Gain from Improved Seed

Genetically improved increased yield by 20% on average benefiting farmers with higher income – seed supply from orchards since 2004

IFGTB Seed

Local Seed

10

## Varietal Development and Release

Outstanding clones released as new varieties as per the guidelines of ICFRE

Multilocation Testing

Certificate of Release

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## Regional Release of Varieties (2010-22)

The Variety Release Committee has met four times during 2010-22

Total number of varieties released : 38

| Species                | Count |
|------------------------|-------|
| <i>Casuarina</i> spp.  | 19    |
| <i>Eucalyptus</i> spp. | 13    |
| <i>Calophyllum</i>     | 06    |

Superior characters of new varieties

- = Fast growth
- = Stem straightness
- = Adaptability to sodic sites
- = Tolerance to drought and pests
- = Windbreak efficiency

| Under Testing                              |         |
|--|---------|
| Species                                    | Release |
| <i>Alliathus excelsa</i> clones            | 2026    |
| <i>Acacia auriculiformis</i> clones        | 2026    |
| <i>Casuarina</i> hybrid clones / families  | 2025    |
| <i>Eucalyptus</i> hybrid clones / families | 2025    |
| <i>Gmelina</i> clones / families           | 2027    |
| <i>Gmelina</i> clones                      | 2025    |
| <i>Leucaena</i> clones                     | 2025    |
| <i>Tamarindus indica</i> clones            | 2025    |
| Teak clones                                | 2031    |
| <i>Thespesia populnea</i> clones           | 2030    |

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## High-yielding Eucalyptus Clones

IFGTB-EC-4 in TN Forest Plantation Corporation

IFGTB-EC-6 in farm forestry

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## High-yielding Casuarina Clone

IFGTB-CJ-9

Tindivanam, TN; 28 months

14

## Interspecific Hybrid Clones CE x CJ

Fast growth, straight stems, smooth and thin bark, higher pulp yield

150-175 tonnes pulpwood per ha (3-4 years; with irrigation)

Benchmark clone (Pure species)  
C19 - 2010 release

New clone CHS (Hybrid)  
2017 release

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## IPR Protection – PPVFR Act, 2001

Six clones of *Casuarina* and one clone of *Eucalyptus* registered under the Protection of Plant Varieties and Farmers Rights Act, 2001.

First instance of IPR protection for varieties of forestry species

| Sl. No. | Species           | Year        | No. of varieties registered | Provisional Registration Number |
|---------|-------------------|-------------|-----------------------------|---------------------------------|
| 1       | <i>Casuarina</i>  | 2015 & 2017 | 6                           | REG/2015/1658 – IFGTB-CJ-09     |
|         |                   |             |                             | REG/2017/1564 – IFGTB-CH-01     |
|         |                   |             |                             | REG/2017/1565 – IFGTB-CH-02     |
|         |                   |             |                             | REG/2017/1566 – IFGTB-CH-03     |
|         |                   |             |                             | REG/2017/1567 – IFGTB-CH-04     |
| 2       | <i>Eucalyptus</i> | 2015        | 1                           | REG/2015/1659 – IFGTB-EC-11     |

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### Clones of Eucalyptus and Casuarina given to planting agencies under MTA

#### Agencies planting IFGTB clones

- TN Forest Plantation Corporation
- AP Forest Department
- A.P. Forest Development Corporation
- Karnataka Forest Development Corporation
- TN Newsprint and Papers Limited
- Andhra Papers Limited
- Ballarpur Industries Limited
- JK Papers
- Harihar Polyfibers
- Seshasayee Paper and Boards Limited, TN,
- The West Coast Paper Mills Limited
- Pragati Biotechnologies, Punjab
- and Farmers



### Institute-Farmer-Industry Partnership

Andhra Paper Ltd.

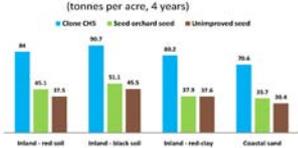


- New varieties licensed to paper industries – channels of reaching farmers
- Collaborative on-farm demo / gain testing in the catchment area
- Increase accessibility of new varieties at an affordable price
- Technical support through the farm forestry network of industries

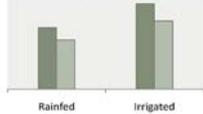


### Realized Genetic Gain

Casuarina Pulpwood yield (tonnes per acre, 4 years)



Eucalyptus Pulpwood Yield – 5 years



### Commercialization and Expanding Cultivation Area



Commercialized through non-exclusive licenses granted to paper industries and private nurseries.

Six licensees produce around 100 million plants annually and supply to farmers

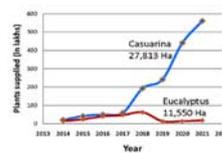
Large scale multiplication ensures the new clones are accessible and affordable to farmers

### Developing Clone-specific Silviculture

e.g. Spacing, fertilizer, disease control



### Economic Gain from New Varieties



IFGTB's new varieties increased plantation productivity 20-100%

Cumulative area planted during 2014-2021: 39,363 Ha

Minimum cumulative additional income to farmers: ~Rs.400 crores

### All-India Coordinated Research Projects (AICRP)

Testing selected varieties in new soil and environmental conditions

Recommending region-specific varieties for cultivation; releasing All-India varieties

Gujarat

Punjab

Telangana

MP



### AICRP – Multispecies Plantations

Teak + Casuarina

Gmelina + Casuarina

Sandalwood + Casuarina



## Opportunities and Challenges

Cooperative tree improvement for optimal use of resources.  
Replacing varieties at regular intervals. New varieties for both industrial wood and ecosystem services

Sustaining high-yield and soil fertility under long-term cultivation

Managing biotic (disease, insect) and abiotic (climate change) threats  
Securing a broad gene base to address future needs

Reducing dependence on exotics, more focus on indigenous species

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Thank You

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## Environmental Services

Windbreaks

Shelterbelts

Mined area reclamation

Inter-cropping during first six months



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## Challenges for Increasing Productivity

- Weak linkages between breeding and planting programmes
- Fluctuation in wood prices: USD 30- 100 per tonne of pulpwood in last five years
- Adapting new cultivation techniques to realize maximum gain from new planting material

| Species   | Annual planting area (000 Ha) | Realized genetic gain (%) | Proportion of orchard derived plantations (%) | Proportion of clonal plantations (%) |
|-----------|-------------------------------|---------------------------|---|--------------------------------------|
| Teak      | 40                            | 10                        | >10   | >10                                  |
| Eucalypts | 300                           | 17                        | 5-10  | 30-40                                |
| Casuarina | 100                           | 21                        | 5-10  | 20-30                                |
| Acacias   | 10                            | 15                        | >5  | >5                                   |

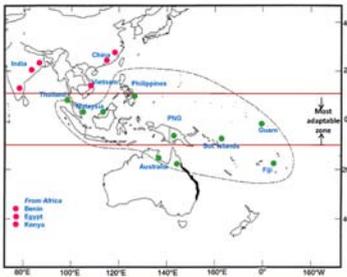
## Internationally Coordinated Provenance Trials

1995-2000

*Casuarina equisetifolia* - CE

35 provenances and landraces from 15 countries of Asia, Africa and Australia-Pacific

Introduction of broad-based genetic resource after a century of cultivation



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## Clonal Selection and Testing - CJ

2010, 2014



- Taking advantage of fast growth and coppice vigour
- 30-35 tonnes pulpwood ha<sup>-1</sup> year<sup>-1</sup> (partially irrigated)
- 25% more wood production than best seed source

| Accession (Age: 5 Y) | HT (m) | DBH (cm) | Volume (m <sup>3</sup> ) |
|----------------------|--------|----------|--------------------------|
| Clone CJ9            | 14.2   | 13.0     | 0.066                    |
| Check clone          | 10.7   | 7.81     | 0.021                    |
| Orchard Seed         | 11.6   | 11.64    | 0.050                    |
| LSD (p<0.001)        | 1.34   | 1.81     | 0.013                    |

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## 2. சரியான நடவு இடைவெளி

5 x 4 அடி 2200 மரங்கள்  
6 x 3 அடி 2400 மரங்கள்

4 x 4 அடி 2700 மரங்கள்  
(முன்று ஆண்டுகள் வரை அறுவடை)



வண்ணம்  
அமைக்க வேண்டும்

இடை-வெளி மரங்கள்

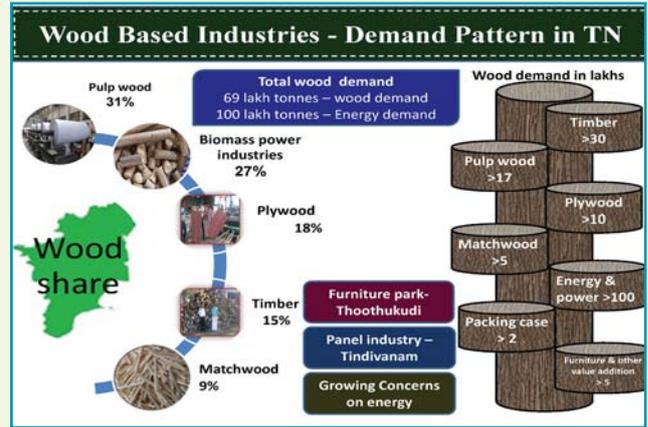
|             |      |
|-------------|------|
| 6 x 4       | 1815 |
| 6 x 3.5     | 2074 |
| 5 x 4       | 2178 |
| 6 x 3       | 2420 |
| 4 x 4       | 2722 |
| 3.5 x 3.5   | 3556 |
| 4 x 3       | 3630 |
| 3.5 x 3.25  | 3829 |
| 3.25 x 3.25 | 4124 |
| 5 x 2       | 4356 |
| 3 x 3       | 4840 |
| 3.25 x 2.5  | 5361 |

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13. A value chain on industrial agroforestry-consortium approach: Dr. K.T. Parthiban, Dean, Tamil Nadu Agricultural University

**A Value Chain on Industrial Agroforestry Consortium Approach**

Prof. Dr. K.T. PARTHIBAN  
DEAN, FC&R, TNAU  
M.No:870868299  
Mail Id: ktparthi2001@gmail.com  
You tube channel: Agroforestry, Environment & Forests



**APPROACHES & STRATEGIES**

- Plantation Forest
- Sustainable Supply of Raw materials
- Economic benefit to farmers
- Agroforestry
- Industrial Agroforestry
- Climate mitigation & adaptation

**CONSTRAINTS AND CHALLENGES**

**3. CONSUMPTION**

1. Unorganised Supply chain
2. Weak buy back system
3. Insufficient market intelligence
4. Lack of price supportive system
5. Lack of credit and insurance facilities
6. Policy issues on Taxes

**2. PROCESSING**

1. Lack of alternate processing technology
2. Non adoption of mechanization
3. Poor post harvest management
4. Un and under utilization of residues
5. Access to quality & cost effective inputs

**1. PRODUCTION**

1. Inferior genetic resources
2. Absence of site specific design & models
3. Non availability of quality seedlings
4. Low productivity from existing species
5. Long rotation
6. Absence of Alternative FGR
7. Poor adoption of silv. technologies
8. Lack of profitable tree crop Model

**RESEARCH INTERVENTIONS**

NAIP (2008-2014) → CIAF (2015) → MAFBIF (2019)

1. TECHNOLOGICAL INTERVENTIONS (PRODUCTION)

2. ORGANIZATIONAL INTERVENTIONS (PROCESS)

3. MARKETING INTERVENTIONS (CONSUMPTION)

**A. TECHNOLOGICAL INTERVENTIONS**

**DESIGNING A TREE - YIELD & QUALITY**

Provenance → Selection of Superior Tree → Identification of Potential Clones → Clonal Multiplication → Clonal Test → Amplified → Final Screening

Associated tests: Wood Quality Test, Coppice Shoots, Agroforestry, Wood Quality.

**1. HYSR - INDUSTRIAL UTILITY**

1. TIMBER CLONES: Teak MTPK 07, Khaya FCRI KS 55 01, Gmelina FCRI GA 08, Rindanders TNRS 01
2. PULPWOOD CLONES: 1. CASUARINA MTP 1 (1125 - 150 tons/ha), 2. CASUARINA MTP 2 (150 - 200 tonnes /ha), 3. LUCALYPTUS MTP 1 (150 tons/ha)
3. PLYWOOD CLONES: MELIA MTP 1 (4000 CFT/ha), MELIA MTP 2 (150 tons/ha), MELIA MTP 3 (70-80 tons/ha)
4. BIOFUEL CLONES: CH 13 & CH 5, FCRI LL 15, KADAM MTP 1, DS 1B
5. MATCHWOOD CLONES: ALANTHUS ENCELA (FCRI 516, Yield: 250 tonnes/ha), STERCULIA FOETIDA (Vendor recovery: 50%), STERCULIA ALATA (Vendor recovery: 64%)
6. NTFP CLONES: Ficus - Kapak, TBO - Neeru, Terminalia bellirica

**2.1. MINICLONAL TECHNOLOGY**

1. Mother Garden
2. Mist Chamber
3. Hardening Chamber
4. Open Mother Garden
5. Open Nursery

### 2.2. MINICLONAL TECHNOLOGY

|              |                    |              |                 |                    |                  |
|--------------|--------------------|--------------|-----------------|--------------------|------------------|
| <b>Teak</b>  | <b>Red sanders</b> | <b>Khaya</b> | <b>Mulberry</b> | <b>Eucalyptus</b>  | <b>Casuarina</b> |
| <b>Melia</b> | <b>Kadam</b>       | <b>Toon</b>  | <b>Jatropha</b> | <b>Calophyllum</b> | <b>Neem</b>      |

### 3. MULTIFUNCTIONAL AGROFORESTRY

Daily Income : Rs. 500 - 1000/day

|                           |             |  |
|---------------------------|-------------|--|
| <b>Ecosystem services</b> | Provisional | Food, Flower, Fodder, medicinal, wood etc. |
|                           | Regulating  | Soil and Climatic regulations              |
|                           | Cultural    | Education, Tourism and Biodiversity        |
|                           | Supporting  | Carbon sequestration                       |

### 4. FELLING TECHNOLOGY

|  |   |
|--|---|
| <b>Timber</b><br>Size requirement: > 24 inches<br>Log size- 2m, 3m, 5m         | <b>Plywood</b><br>Size requirement: 16-30 inches<br>Log size- 52 inches |
| <b>Pulpwood</b><br>Size requirement: 5-8 inches<br>Raw material- Chips or logs | <b>Energy</b><br>Size requirement: > 2 inches<br>Raw material - Chips   |

### 5. MECHANIZATION IN FORESTRY

**Mechanization**

1. Land development
2. Ripping
3. Pitting
4. Harvesting
5. Debarking
6. Chipping (In-situ & Ex-situ)

### 6. VALUE ADDITION TECHNOLOGY

|  |                                |                    |
|--|--------------------------------|--------------------|
| <b>WOOD SEASONING</b>  | <b>CNC &amp; WOOD ANTIQUES</b> | <b>Briquettes</b>  |
| Species: <i>Melia dubia</i><br>Seasoning Schedule: 48 - 60 hrs<br>Moisture Reduction: 50% - 12%<br>Preservatives: CCB, Borax | <b>Pellets</b>                 | <b>Animal Feed</b> |
| <b>Particle Board</b>  | <b>Cut wood &amp; Carbon</b>   |                    |

### B. ORGANIZATIONAL INTERVENTIONS

**CONTRACT TREE FARMING**      **AUGMENTED SUPPLY/VALUE CHAIN**

**QUAD PARTITE**      **TRI PARTITE**      **BI PARTITE**

|                           |                          |                         |                             |                          |                                 |                         |                       |
|---------------------------|--------------------------|-------------------------|-----------------------------|--------------------------|---------------------------------|-------------------------|-----------------------|
| 2005                      | 2007                     | 2011                    | 2012                        | 2013                     | 2016                            | 2020                    | 2021                  |
| Pulpwood contract farming | Biofuel contract farming | Energy contract farming | Match wood contract farming | Plywood contract farming | Composite wood contract farming | Timber contract farming | Neem contract farming |

### PROMOTIONAL MODELS

Horizontal Expansion  
75000 Ha.  
50000 Beneficiaries

|                           |                            |
|---------------------------|----------------------------|
| <b>Farm Forestry</b>      | <b>Captive Plantation</b>  |
| <b>Agroforestry</b>       | <b>Benefit Share Model</b> |
| <b>Hybrid Clone Model</b> | <b>Land Lease Model</b>    |

### C. MARKET INTERVENTIONS

| Technologies   | Status  | MARKET SUPPORT SYSTEM- FARMER'S ACCESS  |
|--|---|---|
| Innovation: SRC Technology, Quad-partite- CI, Value Addition                                 | Decentralized Clonal Production Center, 20000 Ha with 50000 beneficiaries, Empowering Trich 500 beneficiaries, 2 units Biogas PLU | <b>TIMBER</b><br>Teak: Rs. 20000, Industry: Suresh Timbers<br>Gmelina: Rs. 8000-10000, Industry: B&K Timbers<br>Eucalyptus leucocarpa: Rs. 5000   |
| Market: Pulp wood, Ply wood, Bioenergy, Match wood, Residues & Briquettes, Timber, Oil seeds | Rs.5000 / tonne, Rs.9500 / tonne, Rs.5500 / tonne, Rs. 6500 / tonne, Rs. 5000 / tonne, Rs. 20000 / tonne, Rs. 60/kg               | <b>PAPER</b><br>Gmelina Species: Rs. 8500, Industry: TNP & DPS<br>Eucalyptus: Rs. 5500<br>Leucosia leucocarpa: Rs. 3900<br>Melia dubia: Rs. 4400  |
| <b>AGROFORESTRY INSURANCE</b>  | 1. Covered and implemented through - United India Insurance, 2. Innovative Abolish, 3. Satisfied the policy requirement           | <b>PLYWOOD</b><br>Eucalyptus: Rs.5500, Industry: Century Ply / Sharan Ply<br>Melia dubia: Rs. 9500, Industry: Sri Rang Ply Asian<br>Toona ciliata: Rs. 8000, Industry: Century Ply Asian<br>Leucosia leucocarpa: Rs. 3900, Industry: Century Ply Asian<br>Woodsenarctia codamba: Rs. 6500, Industry: Century Ply Asian<br>Albizia leucacarpa: Rs. 6000, Industry: Century Ply Asian |
| Risk Coverage: Forest fire, Lightning, Pest, Animal Damages, Flood, Diseases, Storm, Drought | Premium: -1.25% and 1.60%, Rs. 300- 800   | <b>MATCH SPLINTS</b><br>Albizia leucacarpa: Rs. 6500, Industry: Visham Match & Wood Systems   |
| Prioritized Species: Casuarina, Bath, Eucalyptus, Albizia, Sahabul, Gmelina, Dalbergia       |   | <b>ENERGY</b><br>Leucosia leucocarpa: Rs. 3000, Industry: Leucosia leucocarpa<br>TBO's: Rs. 60/kg, Industry: TBO's<br>Tamin Myrsin: Rs. 40/kg, Industry: Indian Wastes<br>Flora: Celtis perraudia: Rs. 130000, Industry: Ply Industries   |

### INSTITUTIONAL CREDIT FOR AGROFORESTRY TREES

**Timber species**

- Tectona grandis
- Khaya senegalensis
- Dalbergia sissoo
- Sweetenia macrophylla
- Gmelina arborea

**High value species**

- Santalum album
- Pterocarpus santalinus

**Plywood species**

- Eucalyptus spp.
- Melia dubia
- Neolamarkia cadamba
- Toona ciliata
- Acrocarpus fraxinifolius

**TBOs species**

- Azadirachta indica
- Pongamia pinnata
- Calophyllum inophyllum

**Other species**

- Bamboo spp.
- Match wood species
- Ailanthus Excelsa
- Floss-Cieba

### 7. CONSORTIUM OF INDUSTRIAL AGROFORESTRY

Total corpus fund -70 lakhs

**Linking stakeholders**

**Technology Development**

**Plantation Establishment**

**Facilitating Felling**

**Price Supportive System**

**Marketing platform**

**Suggesting Policy Issues**

Production → Consumption

### MoA – WOOD BASED INDUSTRIES

- PLYWOOD
- MFC – COTTON CONTACT
- COMPOSITE WOOD
- OLEORESIN
- PULPWOOD
- TIMBER INDUSTRY
- NGO - ASSEFA
- NATURAL DYES
- OIL SEEDS
- NGO - VIF
- DENDROPOWER
- MATCH WOOD
- WRI
- TOFI
- NABARD

### 8. AGROFORESTRY INCUBATOR – SERVICES & SUPPLY

REGISTERED MEMBERS: 136

- Awareness
- Intensive training
- Facilitate company formation
- Technology transfer
- Product licensing
- Facilitate seed money
- Market linkages

**STARTUPS**

- Technology transfer
- Technology commercialization
- Developing business plans
- Quality testing services
- Field testing experiments
- Impact evaluation
- Facilitate certification process

**BENEFICIARIES**

|                            |       |
|----------------------------|-------|
| Students                   | 5160  |
| Farmers                    | 873   |
| Entrepreneurs              | 1870  |
| Individuals                | 1320  |
| Lin. Department            | 686   |
| Government Officials       | 346   |
| Total No. of beneficiaries | 10342 |

**MILE STONES**

|                            |          |
|----------------------------|----------|
| No of Start-ups            | 26       |
| Products Commercialized    | 12       |
| Consultancy Projects       | 02       |
| IVP - Voucher              | 14       |
| Seed Grant Disbursed       | 32 Lakhs |
| Technology Commercialized  | 13       |
| Capacity building Programs | 191      |

### IMPACT OF AGROFORESTRY VALUE CHAIN MODEL

Demonstration - 200 ha  
Expansion - 75000 ha

Baseline 10 m<sup>3</sup> / ha / yr  
Impact - 25 m<sup>3</sup> / ha / yr

Baseline BCR: 1.66 to 1 : 1.91  
Impact BCR: 3.8 to 1 : 5.05

300 man days / ha  
22 Million man days

7.5 million C sequestration per year

**AREA EXPANSION**

**PRODUCTIVITY IMPACT**

**ECONOMIC IMPACT**

**SOCIOLOGICAL IMPACT**

**CARBON SEQUESTRATION**

### WAY FORWARD

Timber FPOs, Plywood FPOs, Pulpwood FPOs, Energy FPOs, High value FPOs, Cotton FPOs, NTFPs FPOs

**Creation of FPOs**

**Expansion of TOF**

**Networking and linkage**

**Creation of TBE**

**Skill and Entrepreneurship development**

**Capacity Building**

**Facilitating financial resources**

**Leverage of technologies**

**Technology commercialization and business development**

**Research & Development**

**Trees Outside Forests in India (TOFI)**

### PUBLICATIONS

- Industrial Agroforestry
- Forestry Technologies
- Plantation and Agroforestry
- Multifunctional Agroforestry
- Introduction to Forestry & Agroforestry
- TREE BREEDING AND IMPROVEMENT
- TECHNOLOGICAL APPROACHES TO AGROFORESTRY
- Malabar Neem Melia dubia
- FOREST DIVERSITY & SUSTAINABLE DEVELOPMENT
- FRUIT

### SOCIAL MEDIA-YOUTUBE

**YouTube Channel**

**Agroforestry Environment and Forest**

5.0K subscribers

HOME VIDEOS LIVE PLAYLISTS COMMUNITY MEMBERSHIP CHANNELS ABOUT

Recently updated Popular

Transylvanica grandis New Hybrid Clone

Multifunctional agroforestry - A multifunctional tree system (FPO, TOF, TBE, FPO, FPO)

Nursery Technology for Terminalia Chebula (MORINGA)

Toona ciliata - Multifunctional Agroforestry Tree Species

Agroforestry Production - A Success Story of Women Entrepreneur

Multifunctional Agroforestry - Ideal Economic Model for small Landholders

Chakra's Initiative - URBAN AGROFORESTRY

Temperate Agroforestry - An Experience from Jammu & Kashmir

## 14. Bamboo cultivation and its application in Maharashtra: Sh. M. Srinivasa Rao, MD, Maharashtra Bamboo Development Board



**Bamboo cultivation and its application in Maharashtra**  
M SRINIVASA RAO IFS  
MANAGING DIRECTOR and Additional PCCF  
MAHARASHTRA BAMBOODEVELOPMENT BOARD, NAGPUR

### Activities undertaken at BRTC

- Providing handicraft production training to unemployed men, women and members of self-help groups.
- To run "Two - Year Diploma in Bamboo Technology course for eligible boys and girls."
- Providing handicraft production training to Burud communities.
- To make available the facilities in Common Facility Centre at nominal cost to generate employment and livelihood.
- To promote research through establishment of Bamboosetum.

The Bamboo Research and Training Centre (BRTC) at Chinchpalli, Chandrapur was established vide Govt of Maharashtra, Revenue and Forest Department GR No Est-213/CR-64/Part.2/F-9, Mantralaya Mumbai, **Dated : 04/12/2014**. It is registered under Society's Act 1860 No Maha/210/2015. It is also registered under Mumbai Public Trust Act 1950, No F/13/840 under Charity Commissioner Chandrapur.

- To promote bamboo research in Universities.
- To study Bamboo flowering in Tadoba-Andhari Tiger Reserve
- To function as Technical Agency under MSME sponsored SFURTHI scheme for Wardha and Sakoli Clusters
- MOU signed between BRTC and MAVIM on Agarbatti production at Pombhurna agarbatti centre.
- Training on Agarbatti production through MAVIM.

### BAMBOO PLANTATION PROGRAM

#### 1. GOVERNMENT OF INDIA: NATIONAL BAMBOO MISSION

Rs 240/- cost of raising one bamboo plant in three years time,

50% subsidy that is Rs120/- provided to farmer in three years (50% 1st year, 30% 2<sup>nd</sup> year and 20% third year)

#### GOVERNMENT OF MAHARASHTRA SCHEME

##### 2. ATAL BAMBOO SAMRUDDHI YOJANA

FARMERS WITH LESS THAN 10 ACRE HOLDINGS BAMBOO TISSUE CULTURE SEEDLINGS WILL BE PROVIDED AT 80% SUBSIDY

FARMERS WITH MORE THAN 10 ACRE HOLDINGS BAMBOO TISSUE CULTURE SEEDLINGS WILL BE PROVIDED AT 50% SUBSIDY

### Bamboo Plantations in 2020

• Number of beneficiaries :- 3228

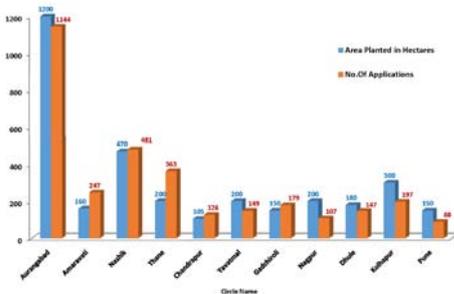
(Subsidy: Rs 240/- cost of raising one bamboo plant in three years time, 50% subsidy that is Rs120/- provided to farmer in three years (50% 1st year, 30% 2<sup>nd</sup> year and 20% third year)

• Area planted : 3315 Hectares

#### Circle wise application List under NBM in 2020

| S.No | Circle Name  | Area Planted in Hectares | No. Of Applications |
|------|--------------|--------------------------|---------------------|
| 1    | Aurangabad   | 1200                     | 1144                |
| 2    | Amaravati    | 160                      | 247                 |
| 3    | Nashik       | 470                      | 481                 |
| 4    | Thane        | 200                      | 363                 |
| 5    | Chandrapur   | 105                      | 126                 |
| 6    | Yavatmal     | 200                      | 149                 |
| 7    | Gadchiroli   | 150                      | 179                 |
| 8    | Nagpur       | 200                      | 107                 |
| 9    | Dhule        | 180                      | 147                 |
| 10   | Kolhapur     | 300                      | 197                 |
| 11   | Pune         | 150                      | 88                  |
|      | <b>TOTAL</b> | <b>3315</b>              | <b>3228</b>         |

Circle wise Plantation area under NBM in 2020



### Bamboo Plantations in 2021

• Number of beneficiaries :- 1889

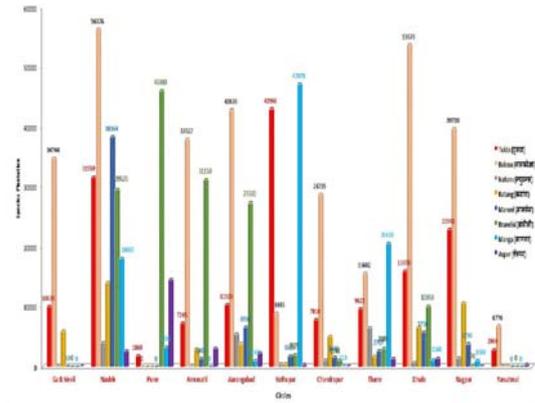
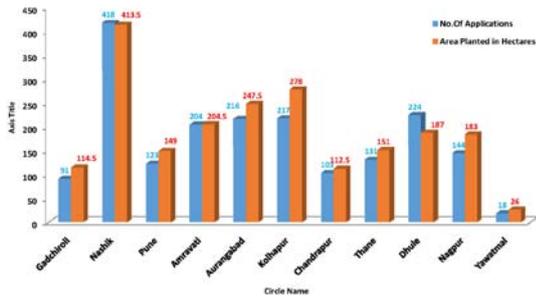
(Subsidy: Rs 240/- cost of raising one bamboo plant in three years time, 50% subsidy that is Rs120/- provided to farmer in three years (50% 1st year, 30% 2<sup>nd</sup> year and 20% third year)

• Area planted : 2066.5 Hectares

#### Circle wise application List under NBM in 2020-21

| S.No | Circle Name  | Area Planted in Hectares | No. Of Applications |
|------|--------------|--------------------------|---------------------|
| 1    | Gadchiroli   | 114.5                    | 91                  |
| 2    | Nashik       | 413.5                    | 418                 |
| 3    | Pune         | 149                      | 123                 |
| 4    | Amaravati    | 204.5                    | 204                 |
| 5    | Aurangabad   | 247.5                    | 216                 |
| 6    | Kolhapur     | 278                      | 217                 |
| 7    | Chandrapur   | 112.5                    | 103                 |
| 8    | Thane        | 151                      | 131                 |
| 9    | Dhule        | 187                      | 224                 |
| 10   | Nagpur       | 183                      | 144                 |
| 11   | Yavatmal     | 26                       | 18                  |
|      | <b>TOTAL</b> | <b>2066.5</b>            | <b>1889</b>         |

Graph Showing Circle wise Plantation area under NBM in 2021



Bamboo Treatment Plant



Treated Bamboos



**GIS BASED MOBILE APP TO VERIFY PLANTATION ON FARMERS FIELDS**

Maharashtra Bamboo Development Board is increasing Bamboo Plantation in Private lands through National Bamboo Mission and other states plan.

For monitoring, MBDB has developed GIS Based Mobile app for evaluating and verifying bamboo plantation in their fields.

Using this app farmer's upload their geo tag photos of plantation for evaluation and GIS Cell of this office verifies the data using cadastral survey map and on the basis of evaluation subsidy is released.

**MSME - SFURTHI projects**

Common Facility Centre proposals were processed and submitted to MSME and two clusters received the sanction one at Sakoli of Bhandara District and another at Wardha MIDC of Wardha district. The Sakoli is a tribal Forest Labourers Cooperative Society (FLCS) initiative and for which MBDB is the Implementing agency and BRTC is the technical agency. In these clusters under SFURTHI scheme artisans are given training in rearing various bamboo based handicrafts , furniture and treatment of bamboo for livelihood.

### RESEARCH WORK IN BAMBOO

Maharashtra Bamboo Development Board in association with Academic institutions like Laxminarayana Institute of Technology (LIT) Nagpur, National Institute of Technology (NIT) Warangal, Vishveshwarayya National Institute of Technology Nagpur, National Environmental Engineering Research Institute (NEERI) Nagpur is working on bamboo related research projects. The projects are given below.

- FAST PYROLYSIS PLANT with NEERI Nagpur
- CHARCOAL KILN with LIT Nagpur
- Water filter/Air purifier/Deodorant with bamboo Charcoal with LIT Nagpur.
- Activation (Iodine number) of Bamboo with LIT Nagpur.
- Fibre extraction from bamboo using Enzymes with LIT Nagpur.

- FAST PYROLYSIS PLANT with NEERI Nagpur
- CHARCOAL KILN with LIT Nagpur
- Water filter/Air purifier/Deodorant with bamboo Charcoal with LIT Nagpur.
- Activation (Iodine number) of Bamboo with LIT Nagpur.
- Fibre extraction from bamboo using Enzymes with LIT Nagpur.

Government accepted this recommendation and created Maharashtra Bamboo Promotion Foundation (MBPF) in August 2018 in collaboration with Tata Trusts. It was registered as a not for profit company in April 2019. There is provision in its rules for other organisations like corporates, Trusts, banks, research organisations to join MBPF by contributing to its corpus fund or by giving some grants.

### BROAD SUMMARY OF USE OF BAMBOO IN INDIA

| S. No. | Activity                                    | Details  |
|--------|---|--|
| 1      | Plantations                                 | Block Plantation, Bund Plantation  |
| 2      | Bamboo Preservative Treatment and Seasoning | Bamboo Preservative Treatment and Seasoning Units  |
| 3      | Bamboo products                             | Furnitures, Kitchen Articles, Doors Windows, Interior Designing, Wall Cladding, Flooring Tiles |
| 4      | Bamboo products                             | Jewelry, Incense / Agarbatti Sticks, Bamboo Corrugated sheets                                  |
| 5      | Bamboo Construction                         | Bamboo Resorts, Gazebos, Meditation centers  |
| 6      | Bamboo Waste Management                     | Pellets, Brickets, Activated Charcoal, Mushroom  |
| 7      | Bamboo Fibres                               | Bamboo Textiles, Ethanol   |

Supply of Tissue Culture seedling under Atal Bamboo Samruddhi Yojna



### KOLHAPUR CIRCLE



### THANE CIRCLE



GIS BASED MOBILE APP TO VERIFY PLANTATION ON FARMERS FIELDS



AGARBATTI STICKS FROM DIFFERENT BAMBOO SPECIES



BAMBOO ROUND STICK YIELD OF DIFFERENT SPECIES

| S. No. | Species                 | Weight of Bamboo | Weight of sticks (1.3 mm diameter) | % conversion |
|--------|-------------------------|------------------|------------------------------------|--------------|
| 1      | B. tulda (assam bamboo) | 8.15 kg          | 1.4 kg                             | 17.17        |
| 2      | D. brandisii            | 1.8 kg           | 250 gm                             | 13.80        |
| 3      | B. longispathus         | 3.95 kg          | 450 gm                             | 11.39        |
| 4      | B. bamboos              | 5 kg             | 550 gm                             | 11.00        |
| 5      | D. strictus             | 2.5 kg           | 250 gm                             | 10.00        |
| 6      | B. affinis              | 1 kg             | 100 gm                             | 10.00        |
| 7      | D. asper                | 1.55 kg          | 150 gm                             | 9.68         |
| 8      | T. oliveri              | 1.6 kg           | 150 gm                             | 9.38         |
| 9      | D. hamiltonii           | 1.1 kg           | 100 gm                             | 9.09         |
| 10     | B. longispiculata       | 1.7 kg           | 150 gm                             | 8.82         |



BAMBOO CHARCOAL KILN with CONDENSER



TRAINING PROGRAMS TO ENGINEERING AND ARCHITECTURE STUDENTS





BAMBOO STUDIO AT NAGPUR



STRUCTURAL MODELS IN BAMBOO



BAMBOO AS REPLACEMENT TO STEEL REINFORCEMENT



THANK YOU



15. Industrializing Bamboo: Sh. Sanjay Singh, Director, Green Solution India



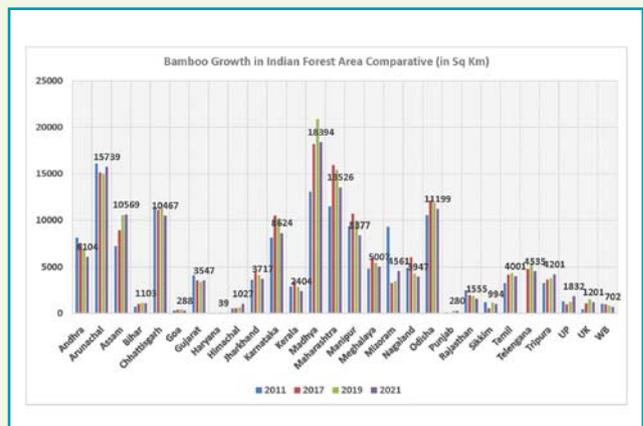
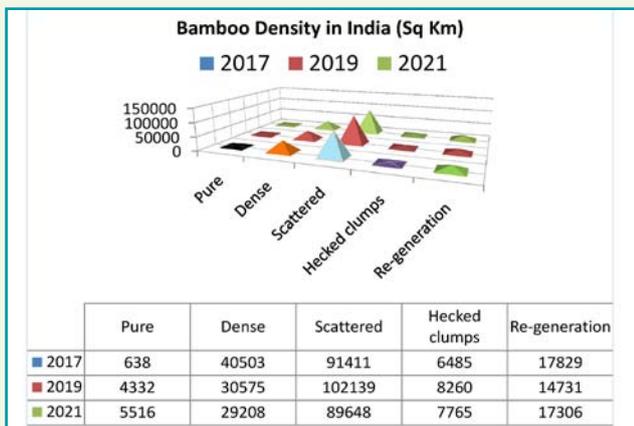
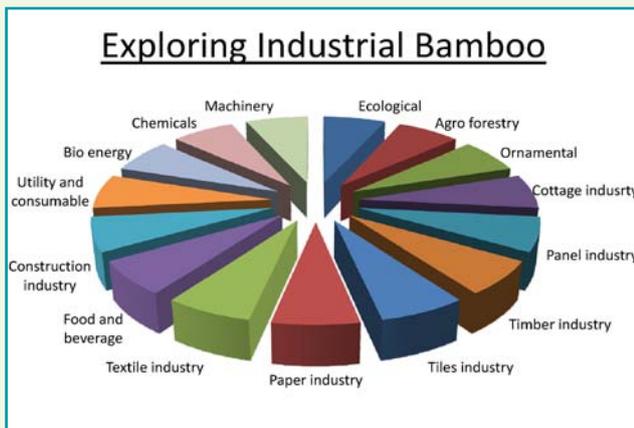
## INDUSTRIALISING BAMBOO

**SANJAY SINGH**  
M.S. WOOD SCIENCE & TECHNOLOGY

## Bamboo! The Global Scenario

- ▶ India contributes to only 5% share of the global market
  - ▶ About \$45 bn market worldwide
- ▶ Major Exporters-
  - ▶ China, Thailand, Vietnam
- ▶ Major Importers-
  - ▶ India, US, The Netherlands, Spain



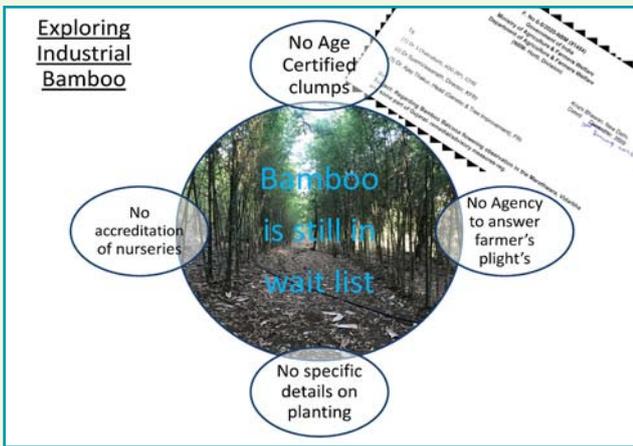




## Exploring Industrial Bamboo



## Exploring Industrial Bamboo



**DELHI SCHEDULE OF RATES (2016-17)**

WOODEN LAMINATED FLOORING

| Sl. No. | Description                             | Unit | Rate     |
|---------|---|------|----------|
| 1.01    | Preparation of site for laying of floor | Sq.m | 1,000.00 |
| 1.02    | Preparation of concrete base            | Sq.m | 2,000.00 |
| 1.03    | Preparation of wooden sub-floor         | Sq.m | 3,000.00 |
| 1.04    | Preparation of bamboo floor             | Sq.m | 4,000.00 |

**What is the need of our times**

- Knowledge**
  - Product
    - Process
    - People
- Market**
  - Demand
    - Manufacture
    - Supply
- Industrial Manufacturing**
  - Farm Gate Processing
    - Bamboo Poles
    - Primary Processing
    - Treatment
    - Seasoning
  - Supply Chain Management
    - Secondary Processing
    - Value addition
    - Semi Finished Level
  - Industrial Manufacturing
    - Specialized Industry
    - Finished Product Manufacturing

**Requisites of Bamboo for Industrial activities**

**Selection of Species**

- Traditional history
  - Local knowledge
  - Local practices
- Properties
  - Biological
    - Ecological
  - Physical
  - Mechanical
  - Chemical
- Availability
  - Forest
  - Plantation
  - Free hold
- Specialized uses

**Criteria**

- State of pole
  - Green / Dry
  - Hollow / Solid
    - Wall thickness
- Maturity
- Straightness
- Internodes
- Density
- Conicity
- Diameter
- Recomposing
  - Usefulness

**Can Bamboo!!! be a green source**

- 422 trees per person World average
- 28 trees per person India average
- 5bn trees Planting Per Year
- 10bn trees Harvesting Per Year

**What we should be doing... to secure our future !!!**

| TECHNICAL DETAILS                       | ENGINEERED FLOORS   | TEAK WOOD FLOORS  | BAMBOO WOOD FLOORS  |
|---|---|---|---|
| DENSITY                                 | 250 to 850 kg/m <sup>3</sup>  | 650 to 980 kg/m <sup>3</sup>  | 1156 kg/m <sup>3</sup>  |
| HARDNESS                                | 100 Kgf   | 524 Kgf   | 1360 Kgf  |
| Modulus of Rupture (MOR)                | 20 N/mm <sup>2</sup>  | 94.04 N/mm <sup>2</sup>   | 215.2 N/mm <sup>2</sup>   |
| Modulus of Elasticity (MOE)             | 6500 N/mm <sup>2</sup>  | 11,675.8 N/mm <sup>2</sup>  | 23216 N/mm <sup>2</sup>   |
| Screw holding strength                  | 200 Kg  | 399 Kg  | 405 Kg  |
| Nail holding strength                   | 50  | 93  | 200 Kg  |
| Dimensional Stable                      | The cross-grain structure of engineered floors hold moisture better than solid wood floors. Engineered structure makes it dimensionally stable than conventional solid wood floors. This minimizes weathering effect causes tension in floor. | Solid wood floors are very prone to weathering effect and causes shrinkage and swelling in solid wood floors.   | Bamboo wood floors are newest technology in the field of floors. This makes it unique and innovative floor. Strand Woven makes it dimensionally stable and minimizes weathering effect.                             |
| Resistance to Moisture, Insect and Heat | These floors are resistant to moisture, insect and heat.  | Solid wood floors have limited resistant and some hardwood have very good resistant. Solid Wood Floor is unsuitable for below grade installation.                             | Bamboo wood floors are very resistant to moisture, insect attack and Heat.  |
| Appearance                              | Engineered Floors reflect looks of top layer Wood.  | Solid Wood gave its own natural looks.  | Bamboo wood gives wood appearance as name reflects. It gives straight grain type wood looks.  |
| Customize Looks                         | Engineered Floors have limitation in customizing Looks.   | Solid Wood Floors can be customized in looks.   | Bamboo wood floors can give customize looks.  |
| Floor Made up of                        | Engineered Floors Top Layer is made up of Solid Wood. Middle layer and bottom layer can be of Fibre engineered/ Plywood/ Plantation Wood/ Harwood etc.  | Solid Wood Floors are Natural Hard Wood Floor.  | Bamboo wood floors are made up of Bamboo Grass. It is Strand Woven Bamboo wood floor.   |
| Environment Friendly                    | Engineered Floors are combination of Natural Solid Wood and Plantation Wood. It also causes damage to environment to limited extent it also uses hardwoods.   | Solid Wood Floors are made by Harvesting Natural Woods. Solid Wood floors cause Maximum Damage to our Environment by destroying Natural Forest which takes decades to mature. | Bamboo wood floors are Most Environment Friendly. Bamboo is a Grass and grows fast and Attain Maturity within 3 to 4 years. Bamboo Wood Helps SAVE PRECIOUS NATURAL FOREST and Helps Restore Environment imbalance. |





- ❖ Anchor Industry
  - Bamboo Timber
  - Bamboo Mat Ply
  - Bamboo Mat Veneer Ply
  - Bamboo Board
    - Special Purpose
      - Bamboo Laminated
      - Bamboo Tiles
      - Bamboo Mat Corrugated Sheet
- ❖ Secondary Industry
  - Bamboo Machine Craft
  - Bamboo Furniture
  - Bamboo Incense Sticks
- ❖ Final Stage Industry
  - Briquettes, Pallets, Fire Igniter ...
- ❖ Allied Industry
  - Adhesive (UF/ PF/ MUF)/ Packaging / Maintenance Work Shops



- ### Uses
- Ready Raw Material
    - Timber
    - Planks
    - Squares
  - Indoor Value-Added Products
    - Flooring's
    - Wall-cladding's
    - Ceiling's
    - Furniture's
  - Structural Value-Added Products
    - Chowkhat / Door Frame
    - Door's
    - Column / Post / Beam
    - Roof Truss
  - Outdoor Value-Added Products
    - Decking
    - Pergola / Facade / Portico & so on
- not limited too**

### Applications

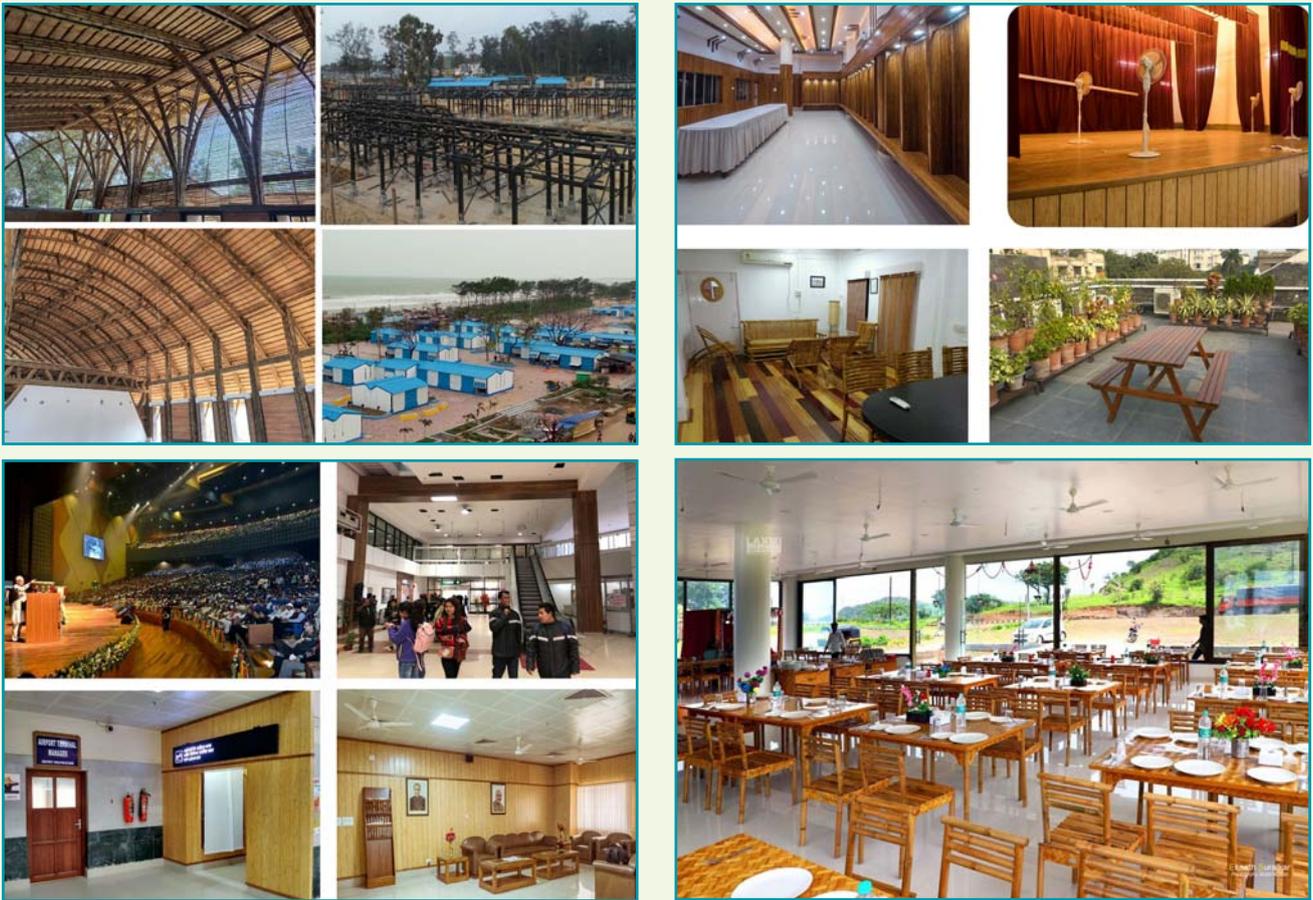
| Indoor   | Structural   | Outdoor   |
|--|--|---|
| <ul style="list-style-type: none"> <li>➢ Home</li> <li>➢ Office</li> <li>➢ Hospitality</li> <li>➢ Auditorium's</li> <li>➢ Stadium's</li> <li>➢ Public Places &amp; so on</li> <li>➢ Keep counting</li> </ul> | <ul style="list-style-type: none"> <li>➢ Quickly Develop Utility Spaces</li> <li>➢ Accommodation's</li> <li>➢ Disaster Management</li> <li>➢ Make Shift Shelter Homes</li> <li>➢ Camping Sites</li> <li>➢ Home's</li> <li>➢ Public Places on...</li> </ul> | <ul style="list-style-type: none"> <li>➢ Forest House's</li> <li>➢ Home's</li> <li>➢ Public Places</li> <li>➢ Hospitality</li> <li>➢ Deck's</li> <li>➢ Stairs, Landing, Facia, Rails</li> <li>➢ Stadium's Seat's / Bench's</li> <li>➢ Park's Furniture's &amp; on...</li> </ul> |

**- not limited too**

- ### Common Needs
- Age Certified Bamboo Plants
    - Accreditation of nurseries
    - Research Institute to certify
    - Regional Centre to come forward
  - Common Facility Centre
    - Treatment, Seasoning, Handicraft
  - Machinery R&D to benefit Indian Industry
    - Focus area for specialized machinery promotion
  - Subject Experts Pool Development
    - Intricate architecture VNIT – B. Arch Bamboo curriculum
    - Engineering Resource
    - Common man's engineering

- Selection of Technology
  - Right Technology for Right Product
- Technical Knowhow
  - Buying Machinery Suffice
- Raw Material
  - Resources & Supply Chain Management
- Home Work
  - New things means Great deal of home work
- Learn from industry
  - Human Asset
- Quality Produce
  - Quality in Time
- Assets
  - Act wisely
- Coach philosophy
  - O<sub>2</sub> Output Optimization





Eco Friendly

Innovative & Economical Solutions

**ABOUT GREEN SOLUTIONS INDIA**  
 Green Solutions India committed to put environment first by chasing eco-friendly approach with technical acumen. Green Solutions India is a well-known name in the Wood, Composites and Bamboo industry for providing one of the most comprehensive suites of technical consulting services. We at GSI dedicated and passionate about industry veterans and young budding entrepreneurs. With us you can proceed with your business/start-up; right from getting basic information to detailed technology advancements. We can be Turnkey Solution Partner for your project. Green Solutions India TEAM are the leading turnkey wood, composites and bamboo consulting company and serve as friend indeed for the esteemed customers as "The Brand Value Creator".

NEW PROJECTS

PROJECT UP-GRADATION

OUR INTERCONTINENTAL EXPERTISE

ESTABLISHMENT OF QUALITY SYSTEM

**GREEN SOLUTIONS INDIA**  
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## 16. Imperative of an industry led agroforestry planning in India: Ms. Alka Bhargava, IFS Retd., Former PCCF&HOFF Assam and Former Additional Secretary, MoAFW

### Imperative of 'Industry Led' Agroforestry Planning in India

DR ALKA BHARGAVA, IFS (RETD)

FORMER PCCF & HOFF, ASSAM AND ADDITIONAL SECY,  
MINISTRY OF AGRICULTURE AND FARMERS WELFARE

### The Need?

- Sharp decline from ~10 million cum in 1970 to 3 million cum from forests after 1996, subsequent to the Godavarman judgement which mandated working plans based forest felling
- Organic link with tree based industry would reduce dependency on imports for *inter alia* paper pulp, newsprint and timber – save forex – promote *Atma Nirbharta*
- Bouquet of multi purpose species
- Untapped component of climate resilient agriculture – fall back and additional income
- Carbon sequestration by trees and locked in wood products
- Mismatch in growing areas and location of industries – captive plantations (contract farming) required
- Between 1997 and 2011 an estimated \$4-20 trillion/yr was lost in ecosystem services, owing to land cover change alone and \$6-11 trillion/yr from land degradation (Source: OECD)

Innovative business models and value chains – role of industry imperative

### Advocating a Landscape Approach – IFS models

- "Restoration Opportunities Atlas of India" (WRI India) identifies an area of over 50 Mha of opportunity for ToF, referred to as mosaic restoration, with largest potential in rainfed farmlands
- Sunrise sectors
  - New age bamboo paper
  - Medicinal and beauty wellness industry
  - Food and nutrition security [fruits, Moringa, jackfruit, etc], green fodder
  - Tree borne oil seeds
  - Lac, silk, honey
- Role of industry led Sector Skill Councils to address the complete value chain
- Social and gender inclusion

### Union Budget 2022

- Agroforestry and private forestry included in "Transition to Carbon Neutral Economy"
- 2 major issues highlighted are imperative for its growth
  - Policy and legislative changes
  - Making available institutional finance to farmers

### Furniture

- One of 23 priority sectors identified for increasing exports but largely dependent on imported wood
- Import of wood in rough (HS 4403) has the largest share (about 50-75%) in India's total import of wood and wood products, being imported mostly from South Asia, Europe, Caribbean and New Zealand and with a nil duty under India-ASEAN FTA
  - India reduced tariffs on wood and wood products to facilitate imports with an intent to shift value addition to India and reduce domestic harvesting. India's bound tariff rate for most wood products is 40%, while applied rates range from 5 - 10%
  - Increasing import duty should be considered particularly for wood in rough along with a Mission mode increase in domestic production of these/ substitute species
- Import duty on furniture (HS 9403) is 25% with no bound duty
  - Needs to be increased to at least 50% to minimize import, thereby supporting **Make in India** for domestic and global markets
  - Example the dramatic positivity on small agar/batti sticks units when import of raw batti was shifted from free to restricted category in August 2019 and import duty on round sticks uniformly increased to 25% in June 2020

### Paper

- Per capita consumption in India will increase from current 13 kg to 17 kg by 2024-25; 1 million TPA of integrated pulp, paper and paperboard capacity will be needed [Source- IPMA]
- Current demand for pulpable wood is about 11 million TPA with domestic availability being only 9 million TPA
- Major bottleneck is high mill delivered prices due to transport distances being 150 – 2000 km as compared to 50-200 km globally
- Suggestions
  - Primary processing close to the plantations, establish CFCs with industry
  - Subsidised transport as for agri produce - network of Kisan Rail, use of inland waterways
  - Contract farming by farmer groups in industrial hinterlands as done by ITC
  - Indigenous production of bamboo pulp which is being imported as of now

### Bamboo

- Low convergence of sectors and stakeholders
- Need of facilitating new technology for high end uses, a complete change of discourse is imperative
- At 2% of the furniture industry, the scale of bamboo furniture industry is small
  - Furniture being made from bamboo wood, some of which is DIY and suitable for online suppliers, needs to be mainstreamed
- Bamboo and wood industry 'left overs' can be pelleted or briquetted for firing thermal and other industries using fossil fuels
- Incentivise a circular economy for improving price competitiveness of Indian products
- Forest bamboo supplied to paper mills in the past can be directed to this by harvesting as per approved working plans – benefit to JFMCs which largely depending on bamboo in areas allocated for livelihood and sustenance
- Charcoal has huge potential in FMCG and Beauty wellness sector [DGFT allows export]
- Biochar underutilised in agriculture and forestry works
- Captive plantations of *Litsea* spp [jiggat for agarbatti industry]

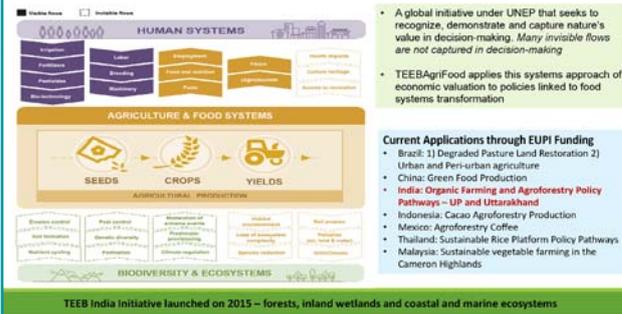
### Recent Decisions of Govt of Assam

- Assam Agroforestry Development Board registered as a Sec 8 company
  - Incentivising farmers / growers to take up planting of trees on their land – platform to establish partnership among farmers, industry and other stakeholders
- For every tree felled for any road project in non forest areas, 10 new trees would be planted
- Amendment of Transit Rules of AFR 1891 – exempts 25 species from felling & transit purposes
- Under MGNREGA valuable trees like agar, sandalwood etc to be planted
- MOU with Central Silk Board for planting muga and eri host trees in forest fringe villages
- Promulgation of Assam Wood Based Industries (Promotion and Development) Rules, 2022
  - **Captive plantations by WBIs** for assured supply and augmenting income for farmers

## Ecosystem Services based Planning

- Responsible sourcing and responsible business practices have become prominent with the introduction of National Voluntary Guidelines and National Guidelines of Responsible Business Conduct. The issue has remained on how businesses take steps to address the concerns.
- The top 1000 listed business entities (by market capitalization) are mandated by SEBI to disclose nature risk mitigation measures and innovative solutions in the annual Business Responsibility and Sustainability Reporting under Principle 6 and this presents an opportunity to popularize the natural capitals valuation approach
- UN System of Environmental Economic Accounting (SEEA) – 69 countries have programs
- Reversing the notion that “Biodiversity loss is an unfortunate but necessary cost of economic and social advancement”
- Public involvement in BD issues is increasing and businesses are beginning to take heed of BD – often due to CS&ER, but also through recognition of its role in sustainable and cost efficient business models
- TEEB pilots would help in quantifying the effects of AF models / practices on ecosystem services and provide evidence based solutions for industry to invest in

## The Economics of Ecosystems and Biodiversity (TEEB) for Agriculture and Food – Making Nature's Value Visible



## Way Ahead

1. Wood balance studies to be conducted
2. Exemption of species from felling and transit rules; NTPS to be made functional [not applicable to NER in the present form]
3. Development of geo-referenced database of agroforestry – location, species, age class linked to land records
4. Strengthening in Krishi Vigyan Kendras including a domain expert and demo plots
5. Use of eNAM for electronic trading - intra and inter State [tradeable parameters to be prepared]
6. State / region level Buyer seller meets to understand market requirements
7. Contract farming – QPM, tech inputs, identified market and assured price
8. Availability of credit and insurance cover by adaptation of KCC and PMFBY respectively
9. Certification and adherence to international compliances for export of value added products
10. Core group in States – Forest + Agriculture + Industries + P & RD + farmer representatives + private industry

Thank You



## 17. National Agroforestry Policy implementation status and gaps: Sh. R.B. Sinha IFS Retd., Senior Policy Advisor (Natural Resources) & Project Director GEF Green-Ag Project, FAO

### Flow of presentation

- National Agroforestry Policy and its goals
- Pathways to achieve agroforestry policy deliverables, present status, and gaps

### National Agroforestry Policy and Goals

- GoI launched the National Agroforestry Policy in 2014, the first in the world; Agroforestry was mandated to the Department of Agriculture and Farmers' Welfare (DA&FW) at the Federal level
- Policy Goals:
  - Setting up a National Agroforestry Mission** or an Agroforestry Board to implement the National Policy by bringing coordination, convergence and synergy among various elements of agroforestry scattered in various existing, missions, programmes, schemes and agencies pertaining to agriculture, environment, forestry, and rural development sectors of the Government

### National Agroforestry Policy and Goals

- Improving the productivity, employment, income and livelihood** opportunities of rural households, especially of the **smallholder farmers** through agroforestry
- Meeting the ever-increasing demand for timber, food, fuel, fodder, fertilizer, fibre**, and other agroforestry products; **conserving the natural resources and forest**; protecting the environment & providing environmental security; and **increasing the forest/tree cover**, there is a need to increase the availability of these from outside the natural forests

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables   | Current Status  | Responsibility |
|---|---|----------------|
| Mainstreaming agroforestry in agriculture policies and strategies   | 1. Trees on farms have been included in every programme of the agriculture department<br>2. An Inter-Ministerial Committee (IMC) for overseeing the implementation of recommendations of NAP was constituted, however, the committee hardly meets regularly | DA&FW          |
| A dedicated corpus be created to leverage resources available under various schemes/programmes/missions in undertaking focused and synchronized interventions for agroforestry sector particularly in meeting the gaps and up-scaling the efforts in a coordinated manner | Sub-Mission on Agroforestry was approved and implemented from 2016 to March 2022. No Scheme operational as on date.   | DA&FW          |

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables  | Current Status   | Responsibility                  |
|--|--|---------------------------------|
| States to create enabling environment and legislation and simplify regulations related to forestry, land use & land tenure, especially those linked to harvesting and transportation of trees grown on farms   | 1. 26 states have relaxed transit regulations. However, there is a difference in species exempted from transit rules in different states. Therefore, no seamless transport of timber across the country despite the creation of an online portal for the issuance of transit pass by MoEFCC. | MoEFCC/State Forest Departments |
| States have to identify about 20 commonly grown trees species which can be grown on farmlands for the economic and ecological benefits of the farming community. These species have to be notified for exemption from any state regulatory regime, especially on growing, harvesting and transit | 2. Felling regulations have still not been addressed by the majority of states<br>3. 26 States have already relaxed regulations for 20 or more species. But, in certain states like, M.P. this had got stayed for years together.  |                                 |

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables   | Current Status  | Responsibility         |
|---|---|------------------------|
| States to ensure a secured land tenure system, safeguarding the interest of small and marginal farmers and create a sound base of land records and data for developing an MIS for agroforestry for a transparent and non-controversial operational system | Still no system in place for developing MIS for a transparent and non-controversial operational system at National level. Even the land records have not been digitized in all states despite the support being provided by the DoLR. Even in the states where land records have been digitized, they have not been updated vis-à-vis number of trees present in the landholdings | DoLR/State Governments |
| Providing quality and certified planting material, at local level through promotion of nurseries, duly registered and accredited by a third party, by involving government/private sector.  | Protocol certification of nursery still not being developed and approved for forestry species. For horticulture species, and Bamboo certification standard protocols have been established by DA&FW and nurseries being certified.  | MoEFCC                 |

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables   | Current Status   | Responsibility |
|---|--|----------------|
| Data collection with source of agroforestry produce at National level by recognized statistical organizations (viz. CSO, NSSO) to be done to have legality data of source of agroforestry produce to facilitate hassle free harvesting/transport/traceability of source/chain of custody  | • No such data is being collected at the National level. FSI in its biennial reports provides data for ToF but not exclusively for agroforestry land use<br>• FAO with the help of NRSC at the request of DA&FW have got developed the technology for the assessment of the agroforestry land use system and shared with DA&FW | DA&FW/MoEFCC   |
| Agroforestry research to be encouraged, both in government and private sector, particularly for multipurpose indigenous species with higher nitrogen-fixing ability, so as to meet the local needs for fuel, fodder and timber as well as improving the soil health. It should also focus on developing market driven models suitable to different ecological conditions to encourage farmers for adopting agroforestry as a viable enterprise. | Some models have been developed for different Agro-ecological regions by CAFRI and ICFRE. Nothing specific in the models regarding N-fixing ability, and market driven systems. DA&FW has not even taken up with the research institutions on this issue.  | DA&FW          |

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables   | Current Status  | Responsibility |
|---|---|----------------|
| National Research Centre for Agroforestry (NRCAF) may be upgraded to a National level Institute of Agroforestry with regional setups in major agro-climatic zones of the country. Agroforestry research wing of ICFRE also be strengthened and taken advantage of to provide stimulus and create an enabling environment for the growth of private research and extension services. | National Research Centre for Agroforestry has been upgraded to Central Agroforestry Research Institute (CAFRI) to improve the research and extension services on agroforestry in the country. | Complied       |
| Encouraging agroforestry as a course curriculum in school education and motivating youths to grow and conserve trees.   | Agroforestry is being taught in selected colleges/universities/institutes but not yet included as part of school course curriculum.   | DA&FW/CAR/MHRD |

### Agroforestry Policy Deliverables

| Pathways to achieve policy deliverables   | Current Status  | Responsibility |
|---|---|----------------|
| Appropriate extension mechanism equipped with scientific setup involving State Agriculture Universities (SAUs), Krishi Vigyan Kendras (KVKs), Van Chetna Kendras etc. to be put in place for agroforestry. Cost-effective extension models may be devised involving farmer's groups, NGOs, public/private agencies, Farmer Producer Companies, etc. to disseminate knowledge/information of this sector. Integrating agroforestry content in the agriculture extension packages and developing a unified extension system for all farming systems in the country. | • Although CAFRI have developed several packages of practices for agroforestry, still they have not been integrated well with the agriculture extension packages.<br>• The strength of KVK personnel was increased from 14 to 16, with a premise that one subject matter specialist of agroforestry will be posted in each KVK. However, nothing has moved in this direction.<br>• FAO in collaboration with CAFRI has developed an agroforestry extension services module at grass root level involving rural youths at the request of DA&FW | DA&FW/ICAR     |

| Agroforestry Policy Deliverables  |  |                |
|---|--|----------------|
| Pathways to achieve policy deliverables   | Current Status   | Responsibility |
| Marketing infrastructure including a market information system to be put in place with active collaboration of private sector. Contract farming, Public Private Partnerships, Special Purpose Vehicles mechanisms may also be explored to promote and upscale agroforestry. Roadside/canal side/barren community land/other non-forest wastelands to be encouraged for plantation of agroforestry tree species to provide opportunities of economic returns as well as contributing towards ecological benefits. These activities may be promoted through public-private partnership mode | <ul style="list-style-type: none"> <li>E-NAM already developed by DA&amp;FW. They have agreed in principle to provide access for the marketing of agroforestry produce on this platform with approved marketing standards. But tradable parameters need to be developed to enable marketing of Agroforestry produce. DA&amp;FW has neither taken up this matter with the relevant institutions; nor any research institution on its own has taken up this matter.</li> <li>On request of DA&amp;FW, FAO with the help of IIFM has developed a protocol for the identification of tradable parameters and also got identified tradable parameters for 5 agroforestry species in consultation with all the concerned stakeholders</li> </ul> | MoEFCC/DA&FW   |

| Agroforestry Policy Deliverables   |  |                 |
|--|--|-----------------|
| Pathways to achieve policy deliverables  | Current Status   | Responsibility  |
| Agroforestry farmers also to be considered eligible for incentives on input subsidy, post-harvest management facilities, interest moratorium etc. as are being provided to farmers growing agricultural crops. | <ul style="list-style-type: none"> <li>Under SMAF provision was made to provide subsidy to the farmers for adoption of agroforestry, and establishment of nurseries.</li> <li>'Trees on farms' have been added in the list of eligible item for input subsidy support in case of natural disaster under the National Disaster Relief Fund on the request of DA&amp;FW.</li> <li>Post harvest management and interest moratorium are still not in place.</li> </ul> | DA&FW           |
| To create an enabling environment to implement strategies for quantifying carbon sequestration and other environmental services for the economic benefit of farmers.   | No concrete steps taken for having simplified standards for measuring carbon sequestration and other environmental services. Some work on developing certification protocol undertaken by NCCF, but it is still not approved by competent Govt. authorities. Recently, DA&FW has initiated technical corporation project with FAO on carbon trading  | DA&FW<br>MoEFCC |

| Agroforestry Policy Deliverables  |   |                |
|---|---|----------------|
| Pathways to achieve policy deliverables   | Current Status  | Responsibility |
| Specific products/ special purpose vehicles may be devised to meet the credit and insurance needs of agroforestry sector. Interest subvention in the line of agricultural credit be extended to agroforestry sector. Agroforestry commodities also be enlisted under Warehouse Development and Regulation Act 2007 (WDRA) for ensuring adoption of quality standards of the "Warehousing Manual for Operationalizing of Warehousing (Development and Regulation) Act, 2007 so as to become eligible for availing finance for harvested produce of agroforestry. | Financial support for agroforestry from banking sector comes under priority sector lending but banks are not inclined to provide funds for promotion of agroforestry due to regulatory uncertainties. Additionally, DA&FW have not included this for being eligible for interest subvention as being provided to other agriculture crops. Further, there is no eligibility for coverage under PM Fasal Bima Yojna. No step undertaken by DA&FW w.r.t. facilitation under WDRA | DA&FW          |

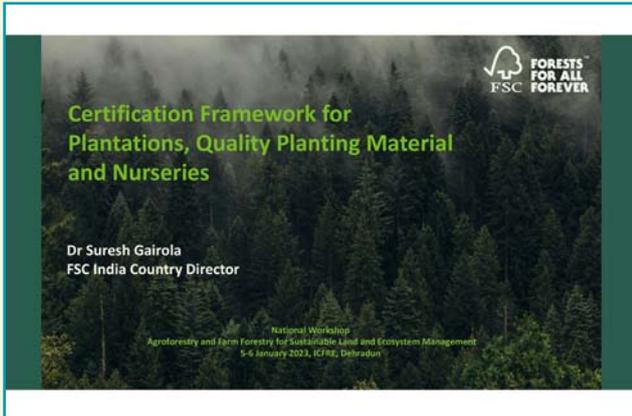
| Agroforestry Policy Deliverables   |  |                                 |
|--|--|---------------------------------|
| Pathways to achieve policy deliverables  | Current Status   | Responsibility                  |
| Industries to be encouraged as end user for promotion of agroforestry produce, value chain development, technology development and market information etc. | A guideline has been notified by MoEFCC for establishing new timber industries in 2017. However, the guidelines have not been incorporated into local acts by the majority of states. Some states like Madhya Pradesh, Punjab, Haryana, UP and West Bengal have implemented these guidelines and new licenses have been issued. However, no mechanism exists at the national level to monitor the progress with regard to implementation of the guidelines issued by the Ministry. Further, the guidelines need to have a relook in consultation with all relevant stakeholders. | MoEFCC/State Forest Departments |

- ### Agroforestry Policy Formulation
- Four rounds with an approach of a structured and deliberate process of clarifying views, considering evidence and reaching a consensus on the elements of a policy
  - First round:** meetings for sensitizing high-level government officials and other stakeholders
    - Over a period of three years, the first two meetings were held at intervals of one year, and thereafter seven meetings were held in the third year
  - Second round:** planning and developing the formulation process
    - 14 meetings and roundtable discussions, including two national consultations, six regular meetings by sector, and five roundtable discussions and planning meetings were organized
  - Third round:** from recommendations to accepted policy
  - Fourth round:** from accepted policy to implementation

- ### Agroforestry Policy Formulation
- Core group facilitated by NAC consisted of** MoA&FW, DA&FW, MoEFCC, MoRD, DoLR, ICAR, Planning Commission, ICRAF
  - Ensured the **same participants** from any particular institution (at least a few) were present in all meetings for institutional memory and continuity
  - Conduct **consultations by sectors** or departments or interest groups (policy formulation and governance, federal and state level institutions, industry, R&D institutions, financial institutions, etc.)
  - Provide the **views of one group to the other group**; the next group meeting had the cumulative position of the previous two groups and so on
  - Facilitators always played a **neutral role** and provided **unbiased feedback**



# 18. Certification framework for plantations, quality planting material and nurseries: Dr. Suresh Gairola, FSC India Country Director



### Certification, Accreditation & Standardization

**Certification** - Confirmation of certain characteristics (e.g. PC&I), normally through external review. Procedure by which an accredited third party (CB) gives written assurance that a product, process or service **conforms to specified requirements**

**Accreditation** - Formal recognition by an independent body that a **certification body** operates according to (inter)national standards and is **competent to carry out specific tasks**. (ASI/NABCB).

**Standardization** - It is the process of **developing and implementing technical standards** based on the consensus of all stakeholders. Ensures practices are at par with the corresponding global practices.

### FSC Standard for Smallholders in India

- This standard is being pilot tested only for smallholders with less than 20 ha. area
- The number of indicators has been reduced substantially to only 145.
- Greater flexibility in terms of implementation
- The smallholder can receive support from a group manager or an external body
- Cost reduction expected for the implementation and audit.
- Effective from 1 October 2022
- Pilot test to start soon

### 4-Step Approach

**STEP 1: Workshops**  
Successful participation  
a) CH: introduction session  
b) CB: introduction session and calibration (standard and auditing)

**STEP 2: Registry by CB**  
CB and CH agree on participation, CH to sign Declaration of Consent  
CH to register CH, including the Declaration of Consent signed by CH  
Fill in template and send to CTF at FSC International  
Register all CH on annual base

**STEP 3: Contracting**  
CBs to sign a legal Framework Agreement with FSC International (up to 5 years)  
CBs to sign ToTs on annual base (annually amended versions)

**STEP 4: Auditing and reporting**  
CB to conduct audit based on AP RFSS, including certification decision  
CB to fill in template  
CB to compare with NFSS and answer questions in the template  
CB to report back to FSC International  
Annual feedback session

### Seed Certification System in India

Objective is to ensure the acceptable standards of seed viability, vigour, purity and seed health.

The Seed Act, 1966 provides for the establishment of Seed Certification Agencies by the States. Seed - food crops, cotton, animal fodder; forest seeds not covered

- Central Seed Committee, Central Seed Laboratory and State Seed Laboratory
- Regulation of sale of seeds of notified kinds or varieties
- Certify as certification agency for notified kinds or varieties for meeting minimum limits of germination and purity

### The Seed Act, 1966 ...

Seed Certification is carried out in six broad phases:

- Application
- Verification of seed source and class
- Inspection of the seed crop for conformity to field standards
- Supervision at post-harvest stages
- Drawing of samples and analysis
- Grant of certificate, issue of certification tags, labelling, sealing etc.

The validity period nine months

**Need for a separate Seed Act for forest seeds or include forest seeds under the definition of 'seed' in The Seed Act, 1966**

### OECD Forest Seed and Plant Certification Scheme

Certification system to facilitate international trade in forest seeds and plants.

Ensures the implementation of a set of procedures, methods and standards which verify the origin and quality of forest reproductive materials and ensures their truthness to name.

Key components of the scheme include: Supervision of firm raising, Supervision of firm storage, Supervision of firm processing, Notification of the region on the production/ collection of firm growing/ collection and labelling of firm, Control and supervision of collection and labelling of firm, and Registration of basic material.

### What is Immediately doable?

- Seed Stands
- Seed Production Areas
- Seeding Seed Orchards
- Clonal Seed Orchards
- CPTs, PTs and elite trees
- Tissue Culture
- Seed Units/Labs (seed collection, selection, drying, cleaning, grading, storage, dormancy treatment, seed testing, purity, weight, germination, moisture)
- Provenance Trials

| Characters              | Seed sources                            |                                       |                                      |                                    |                           |
|-------------------------|---|---------------------------------------|--------------------------------------|------------------------------------|---------------------------|
|                         | unselected seed sources                 | seed trees                            | seed stands                          | seed production areas              | seed orchards             |
| Quality of mother trees | unselected trees from unselected stands | selected trees from unselected stands | selected stands, unthinned, untested | selected stands, thinned, untested | Selected and tested trees |
| Seed quality            | Poor                                    | Intermediate                          | Fairly good                          | Good                               | Very good                 |
| Level of management     | None                                    | Some                                  | Intermediate                         | Intensive                          | Very intensive            |

Mulawarman et al., 2003

## Certification of QPM



National Horticulture Board (NHB) has introduced a system of **registration, licensing, recognition and rating-system of horticulture nurseries**

**State Fruit Plant Nursery (Regulation) Acts** to provide for the licensing and regulation of fruit nurseries

'Guidelines to Produce QPM of Agroforestry Species' published by CAFRI-ICRAF in 2019

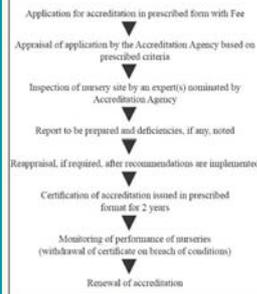
- Good practices of fruit collection, seed extraction and storage
- Procedure for Accreditation of Nurseries
- Procedure for Certification of QPM

Tree planting stock carrying the label of "Certified Quality Planting Material" sold from an Accredited Nursery will ensure:

- Correct species identity
- Uniform and established clonal identity
- Disease- and pest-free material
- Plant quality and health



## Procedure for Accreditation of Nurseries



## Procedure for Certification of Quality Planting Material



10

## Guidelines for Accreditation of Bamboo Nurseries, Tissue Culture Laboratories and Certification of Quality Planting Material

2019

### National Bamboo Mission

Department of Agriculture, Cooperation and Farmers Welfare  
Ministry of Agriculture and Farmers Welfare, Government of India  
Kulsi Bhubaneswar, New India

## NATIONAL CERTIFICATION SYSTEM FOR TISSUE CULTURE RAISED PLANTS (NCS-TCP)

Department of Biotechnology  
Ministry of Science & Technology  
Government of India

## EXPERT COMMITTEE REPORT



Government of India  
Ministry of Environment, Forest and Climate Change  
New Delhi  
2018

Thank you

धन्यवाद



Forest Stewardship Council®  
FSC® Global Development



For further details, please contact:  
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s.gairola@fsc.org

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T: +91 7588020450  
E: s.gairola@fsc.org  
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asiapacific.fsc.org



# 19. Standards for certification of agroforestry & farm forestry produces: Sh. A.M. Singh, IFS Retd., NCCF, Noida



## Presentation Outline

- Agroforestry/Farm forestry context in India
- Rationale to develop ToF standard
- Standard setting process for ToF
- ToF certification standard

## Agroforestry/Farm forestry context in India

## Country's Profile

India is 7th largest country in the world

- Total Geographical Area: **32,87,240 km<sup>2</sup>**
- Total Population: **1.38 billion**
- Population Density: **464 per Km<sup>2</sup>**

(Source: Food and Agriculture Organization and World Bank population estimates., 2020 )

- Major land-use**
  - Forest cover – 21.71%
  - Tree cover- 2.91%
  - Net sown area under agriculture – 42.4%
  - Waste land – 16.96%
  - Other land use – 18.93%
- 85% land holdings in India are small & marginal

## India's Forest & Agroforest Profile

Globally, India stands at 10<sup>th</sup> position accounting for 2% of total forest cover of the world.

- As per India State of Forest Report 2021:
  - Forest Cover = **7,13,789 sq. km** (21.71% of GA)
  - Tree Cover = **95,748 sq. km** (2.91% of GA)
  - Forest & Tree Cover = **8,09,537 sq. km** (24.62% of GA)
- The overall area under agroforestry for all 15 agroclimatic zones (ACZs) of India= **28,427 M ha/2,84,270 sq. km.** [8.65% of GA]<sup>[1]</sup>
- Highest agroforestry area- Maharashtra, Gujarat & Rajasthan<sup>[2]</sup>
- The scope of increasing area by another 28 M ha having a total of 53.23 M ha.<sup>[3]</sup>
- Requirement of fodder increases by 1.5 times, food grain & fuelwood by 2 times & timber by 3 times- Agroforestry has potential to meet the demand.<sup>[4]</sup>

<sup>1</sup> Anushakti, A., Rishi, R. M., Hanu, A. K., & Aronson, S. S. (2022). Agroforestry in India: area estimates and methods. CURRENT SCIENCE, 123(6), 743-746.  
<sup>2</sup> Forest Survey of India. India State of Forest Report. Ministry of Environment and Forests, Dehradun, India, 2017  
<sup>3</sup> GADRI. Vision 2030. Central Agroforestry Research Institute, Jabalpur, India, 2012.

## Rationale for ToF Certification Standard

## Need for ToF Certification Scheme in India

Despite a huge production from TOF resources, there are **no sustainability adherence systems as well as certification standard** for this resource at present.

As a result, Indian manufacturers or producers using TOF raw material are **unable to tap the global market and TOF value added products are not able to fetch desired price.**

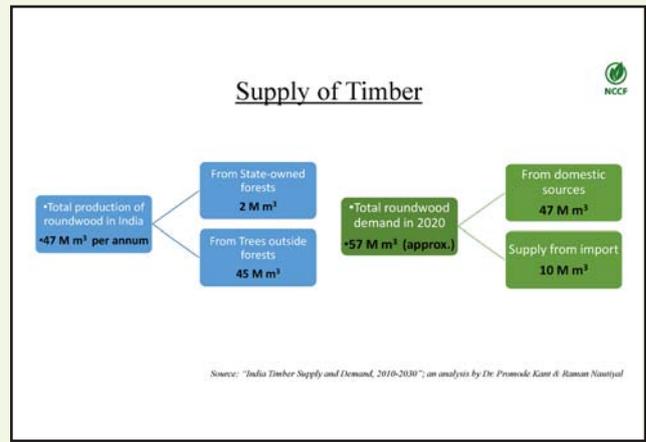
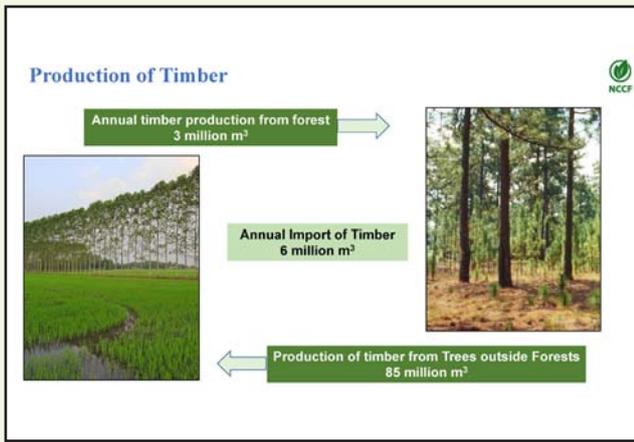
Farmers who mostly hold this resource and are already on the margin of the economy, get **adversely affected.**

Being in informal and private sector, there is a **lack of uniformity in silvicultural, management and other operational practices.**

## Unique Indian Scenario of Procurement

- WBIs faced challenges in consistent supplies of raw material procurement, desired species and grade
- Farmers due to small scale of plantations, are unable to fetch the benefits of inclusion under certified supply chains
- Industry and Farmer collaboration to grow desired species, ensuring buyback and sustained supply of raw material to WBIs

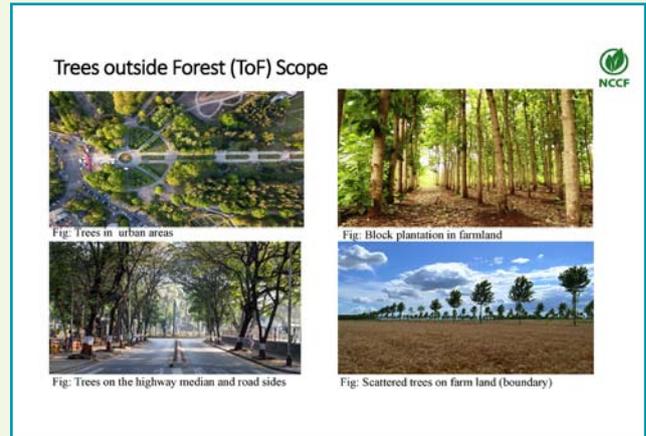
Source: High Level Expert Group Report on India's Agricultural Exports submitted to 15th Finance Commission



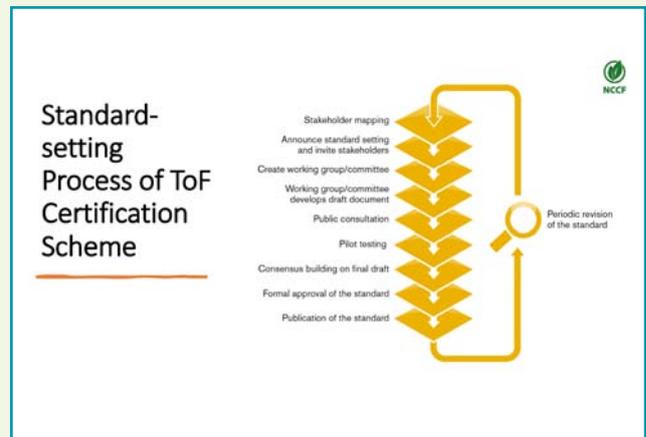
### ToF Definition in India

- All trees growing outside "recorded forest areas" are defined as trees outside forests (TOF).
- The recorded forests include "reserve", "protected" or "unclassified forests".
- TOF can occur in the form of block, linear and scattered stratum in urban or rural landscape.
- Trees grown in Social Forestry, linear plantations along road, railway or canal irrespective of "Recorded Forest" status also fall under TOF for implementation of NCCF Certification Scheme in the country.
- Ownership generally private, community or government.

**TOF contributes about 72% of the industrial wood consumption in India**



### Standard Setting Process

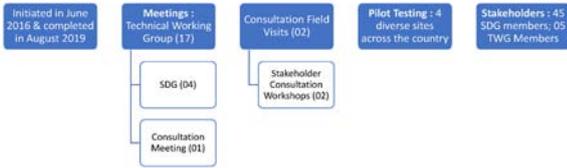


### Stakeholders of TOF

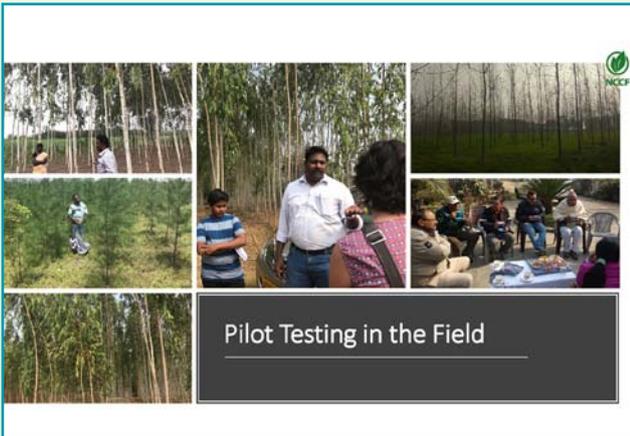
| Business & Industries   | Non-Governmental Organisations   | Government/ Local Authorities*  | International Stakeholders  | Scientific & Technological Community   |
|---|--|---|---|--|
| <ul style="list-style-type: none"> <li>ITC Limited</li> <li>Century Plywood</li> <li>Hindustan Pencils</li> <li>Star Papers</li> <li>Independent Consultants</li> <li>CL Gupta Exports Ltd</li> <li>KRIBHCO</li> <li>IORA Ecological</li> </ul> | <ul style="list-style-type: none"> <li>WWF India</li> <li>Centre for Science and Environment</li> <li>Centre for Indian Bamboo Resource and Technology</li> <li>Uthaa trust</li> <li>Development Alternatives</li> </ul> | <ul style="list-style-type: none"> <li>Ministry of Agriculture and Farmer Welfare</li> <li>Haryana Forest Development Corporation</li> <li>Uttar Pradesh Forest Department</li> <li>Punjab Forest Corporation</li> <li>Sikkim Forest Department</li> <li>Andaman &amp; Nicobar Forest Department</li> <li>National Highways Authority of India</li> </ul> | <ul style="list-style-type: none"> <li>World Agroforestry ICRAF</li> <li>International Union for Conservation of Nature</li> <li>GIZ</li> </ul> | <ul style="list-style-type: none"> <li>ICAR- CAFRI (Central Agroforestry Research Institute, Jhansi)</li> <li>TERI University</li> </ul> |



## Standard Development Process Milestones



## Consultation Meetings



## Pilot testing assessor and observer details

|                     | Sites  |  |  |                                    |
|---------------------|--|--|--|------------------------------------|
|                     | Karur (Tamil Nadu)                                 | Saharanpur (Uttar Pradesh)                       | Plantations along IG Canal, Bikaner (Rajasthan)    | New Delhi                          |
|                     | 19 <sup>th</sup> – 21 <sup>st</sup> September 2018 | 11 <sup>th</sup> – 13 <sup>th</sup> October 2018 | 05 <sup>th</sup> – 07 <sup>th</sup> September 2018 | 04 <sup>th</sup> February 2019     |
| <b>Assessor I</b>   | Dr. Jagdish Kishwan, IFS (retd.)                   | Dr. Jagdish Kishwan, IFS (retd.)                 | Mr. Arun Kumar Bansal, IFS (retd.)                 | Mr. Arun Kumar Bansal, IFS (retd.) |
| <b>Assessor II</b>  | Ms. Taruna, GIPL                                   |  |  | Ms. Taruna, GIPL                   |
| <b>Observer I</b>   | Dr. D. Rajasugumasekar, Scientist E, IFGTB         | Mr. Aditya Petwal, IUCN (India)                  | Dr. Devendra Pandey, IFS (retd.)                   | Dr. Devendra Pandey, IFS (retd.)   |
| <b>Observer II</b>  | Mr. Vishwesh Singh, Isha Foundation                | Mr. Varun Grover, NCCF                           | Dr. Ajay Kumar Saxena, NCCF                        | Mr. Aditya Petwal, IUCN (India)    |
| <b>Observer III</b> |  |  | Mr. Varun Grover, NCCF                             | Mr. Kundan Burmal, GIZ (India)     |
| <b>Observer IV</b>  |  |  |  | Mr. Varun Grover, NCCF             |

## Pilot testing sites and Rationale for selection

| Rationale for selection               | Sites  |   |   |   |
|---------------------------------------|--|---|---|---|
|                                       | Karur (Tamil Nadu)   | Saharanpur (Uttar Pradesh)  | Plantations along IG Canal, Bikaner (Rajasthan)   | New Delhi   |
| <b>TOF Model</b>                      | Agroforestry/ Scattered Trees  | Agroforestry/ Scattered Trees   | Linear Plantations  | Urban forest  |
| <b>TOF Intensity</b>                  | High   | High  | High  | High  |
| <b>Industries in vicinity</b>         | Paper and Pulp   | Plywood, MDF, Matchsticks, Packaging  | Handicraft Industry   | NA  |
| <b>Existing Timber Species</b>        | Eucalyptus, Casuarina  | Eucalyptus, Poplar, Sheoak  | Babool, Balsa, Sheoak, Neem, Acacia torilis   | Mixed Avenue Plantations  |
| <b>Use of chemicals</b>               | High   | High  | High  | -   |
| <b>Rationale for selection</b>        | TOF, Farm Forestry<br>Captive Plantations managed by TNPL  | • Bigger landscape<br>• Involved in certification.  | Unique plantation model for PF and wood is supplied to handicraft industry                      | • Rising issues in Delhi-NCR around tree felling<br>• Urban Forests<br>• Multiple greening agencies |
| <b>Primary Contact (Organisation)</b> | 1. Tamil Nadu Newsprint and Papers Limited   | 1. Star Paper, 2. Himani Forest Development, Corporation, 3. Himani Forest Department   | 1. Rajasthan Forest Department  | 1. Delhi Forest Department  |
| <b>Approach</b>                       | 1. Captive plantations<br>2. Farm Forestry plantations<br>3. Group Certification/ Cooperative model currently FSC/PM certified | 1. Star Paper supplies planting material to Farmers<br>2. Sourcing seeds from market/ suppliers and not directly from farmers<br>3. Farm forestry plantations | 1. Along the Indira Gandhi Canal stretch in Bikaner<br>2. Wood is supplied to handicraft sector | 1. PF for avenue plantations, urban forests and parks   |

## Structure and Components of TOF Certification Standard

| Theme   | Description  |
|---------|--|
| Theme A | <b>Legality Compliance with Legal Requirements</b><br>(compliance to laws, ownership, land records etc.)                     |
| Theme B | <b>Management Plan and Practices</b><br>(only for block plantation types of ToF)   |
| Theme C | <b>Health and Vitality of ToF Resources</b><br>(checks on application of pesticides, chemicals, etc.)                        |
| Theme D | <b>Maintenance and enhancement of productive functions</b><br>(sustainability, harvesting techniques, record keeping, etc.)  |
| Theme E | <b>Socio-Economic Responsibility</b><br>(social protection, labour laws, minimum wage act etc.)                              |
| Theme F | <b>Conservation and Environmental Safeguards</b><br>(avoidance of invasive species, soil water quality, protection RED spp.) |

## Criteria-Indicators across the different model

| Theme          | Block Plantations | Linear/Agroforest/Urban Forest | Standalone Tree Model |
|----------------|-------------------|--------------------------------|-----------------------|
| <b>Theme A</b> | Criteria: 03      | Criteria: 03                   | Criteria: 03          |
|                | Indicators: 10    | Indicators: 10                 | Indicators: 10        |
| <b>Theme B</b> | C: 08             | C: 08                          | Not Applicable        |
|                | I: 29             | I: 29                          |                       |
| <b>Theme C</b> | C: 05             | C: 05                          | C: 03                 |
|                | I: 20             | I: 20                          | I: 11                 |
| <b>Theme D</b> | C: 04             | C: 04                          | C: 03                 |
|                | I: 13             | I: 13                          | I: 08                 |
| <b>Theme E</b> | C: 04             | C: 04                          | C: 03                 |
|                | I: 15             | I: 15                          | I: 11                 |
| <b>Theme F</b> | C: 04             | C: 04                          | C: 04                 |
|                | I: 11             | I: 11                          | I: 08                 |
| <b>Total</b>   | C: 28             | C: 28                          | C: 16                 |
|                | I: 98             | I: 98                          | I: 48                 |

## Implementation of NCCF-TOF Certification Standard



## Components of a credible certification system

Assessing the competence of CBs: by an Independent Accreditation Body



## Associated CoC CBs'

1. Alko – Cert GmbH
2. Control Union Certifications B.V.
3. NEPCON OU
4. Scientific Certification Systems Global Services (SCS)
5. SGS Société Générale de Surveillance SA (SGS)
6. TÜV NORD CERT GmbH
7. TÜV SÜD Czech s.r.o.
8. Soil Association Certification Ltd.
9. GICIA India Pvt Ltd.
10. Platinum Shauffmantz Veritas
11. GCL International Ltd.



## Ambit of NCCF ToF Std

1. ToF STD: Sustainable resource management of ToF, includes the legality aspect of the Trees outside Forests (ToF)
1. Incorporate the PBI with regard to the issues of land use changes, deforestation and forest degradation as per upcoming international legislations: Amendments in EUTR etc.
- Conservation or enhancement of Biodiversity etc. is taken care of, wherever applicable.
- Cultural Aspects: Inclusion of protecting sacred groves, indigenous trees of cultural importance and RET species.
- Endorsement of NCCF ToF standard by PEFC: Recognition at International platform
- Suitability of Std towards needs of all industry segments
- Pulp and paper, plywood and composite products, handicrafts, furniture, packaging, pencil, toy industries and many more.



- PEFC is the world's leading forest certification system
- NCCF's ToF Standard is under PEFC Endorsement process

PEFC: accepted and recognized by international legislations & regulations



Brands who included PEFC in their procurement policies



Thank You!!

[NCCF-STD-ToF-02/2022](#)



**Network for Certification and Conservation of Forests**

By  
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Mobile: +91-9435730125

20. Certification in Indian context-forest and agroforestry: Dr. M.P. Singh, Director, IWST, Bengaluru

# Certification in Indian Context- Forest and Agroforestry

Dr. M. P. Singh, IFS  
Director  
Institute of Wood science and Technology  
Bengaluru, India

## Forest Certification – Global perspective

Failure of international bodies to address the deforestation led to a growing concern about use of wood products from unsustainably managed forest in tropics in 70's and 80's

Idea of a mechanism to allow wood products to be traced back their forest sources, to verify that same forest was well managed developed in 90's.

Forest Certification emerged as a Market driven approach for ensuring SFM

Forest Certification - Assesses the quality of forest management in relation to a set of predetermined standards

Globally well-known FC NGOs – FSC and PEFC

## Forest Certification – Global perspective

FSC contains 10 principles, 55 criteria and 200 indicators for SFM

PEFC has 7 SFM standards and endorses national forest certification systems

- India – NCCF - 59 Criteria and 239 indicators in 2018
- American Tree Farm System (ATFS) certification program with 8 standards
- China Forest Certification Scheme 2014

Malaysia and Indonesia established National accreditation body in each country independent of FSC or PEFC

- Certified wood is not mandatory in many countries but they recognise "Legal wood" (Lacey Act of USA, EUTR, Australian Illegal Logging Prohibition Act etc.) where legitimacy of forest produce should be proved with "due diligence" process.

## Salient features of Global Certification

| SC Principles  | PEFC standards   |
|--|--|
| Compliance with laws   | Maintenance & appropriate enhancement of forest resources & their contribution to the carbon cycle |
| Workers Rights and Employment Conditions   | Maintenance & enhancement of forest ecosystem health and vitality                                  |
| Indigenous Peoples' Rights   | Maintenance and encouragement of productive functions of forests (wood and non-wood)               |
| Community Relations  | Maintenance, conservation & enhancement of bio-diversity   |
| Long term economic viability of benefits from forests                              | Maintenance and enhancement of protective functions in forest management (soil & water)            |
| Environmental Values and Impacts   | Maintenance of socioeconomic functions and conditions  |
| Management plan consistent with policies and objectives                            | Compliance with legal requirements   |
| Monitoring and Assessment  |  |
| Maintain and enhance the High Conservation Values by precautionary approach        |  |
| Implementation of Management Activities in compliance with principles and Criteria |  |

All these Principles / Standards have already been inculcated in Indian Forestry

## SFM: Indian Scenario

- Modern India: paradigm shift from timber production to forest conservation (FCA 1980; NFP 1988; Godavarman case 1996)
- Forestry activity shall be taken up only with approved working plan
- Working plans - revised in every 10 yrs after thorough assessment of the forest resources and locality factors
- Felling in Forests should commensurate with regeneration – MoEF&CC core group shall monitor and approve proposals
- In India there is no unsustainable felling and no Forest land is diverted without compensatory afforestation (since 1980)

India is still considered as a high risk country with regard to import of legal timber

The contents of the majority of the Timber Legality Risk Assessments was developed by Forest Stewardship Council through FSC Risk Assessments.

## Need of Indian Certification System

- Indian forests are predominantly managed by Government
  - Why NGOs certify government system?
- Most of the timber exporting countries have private owned forests
  - Global standards are useful in absence of stringent government system.
- Principles/ Standards of global certification systems have already been inculcated in Indian forest management
- NWPC of India has incorporated C&I of Bhopal India process

## Need of Indian Certification System

- BIP has adopted C&I approach for SFM under the aegis of ITTO. (8 Criteria and 37 Indicators for SFM)
- The C&I of BIP were tested in some of the states
- The C&I of BIP should be translated to a system of certification
- India needs an independent, reliable, 3<sup>rd</sup> party Certification system of its own in a globally acceptable form
- IIFM Bhopal may take initiative to develop Indian Forest Certification based on BIP
- Separate system of Certification is needed for Agroforestry

- National Forest Policy of India (1988) necessitated the paradigm shift in the then 'forest-based' industries to 'farm wood' based industries
- Agroforestry is the potential sector for boosting the production of raw material for industry as well as enhancing farmers' income

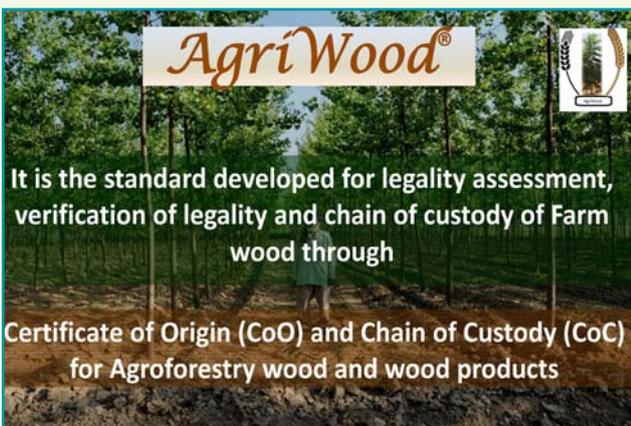


Timber from Forest: 2.7 million m<sup>3</sup> (<3%)  
 Timber from TOF: 85.16 million m<sup>3</sup> (>90%)  
 Timber from import: 6 million m<sup>3</sup>

- There are a number of certification systems prevailing across the globe for certifying timber from private forest, most of these certifications are directed towards supply of timber from forest land
- None of them suit the certification of agri-wood produced from the Indian agroforestry systems as most of the farmers in India are small and marginal.

### Relevance of Certification of farm grown Wood

- Timber in India is considered as forest produce, therefore the present system requires felling permissions and transit pass for every lot.
- This system generates hindrance among farmers to grow more trees in farmlands
- Wood industries will also not get assured supply of wood which is considered as 'legal' for export purpose.
- Indian timber is not recognized in International markets as legally produced timber. Because, Indian timber is not certified as per the norms of International certifying agencies.
- India needs certification of Agroforestry produced timber as legal wood which is distinct from that of forests.



## AgriWood®

It is the standard developed for legality assessment, verification of legality and chain of custody of Farm wood through Certificate of Origin (CoO) and Chain of Custody (CoC) for Agroforestry wood and wood products

### Scope of AgriWood®

- Serve as the broad framework for the development of a certification system for farm wood in India
- Elaborates on how to establish the Certificate of Origin and the Chain of Custody and Traceability across the Supply Chain
- Elaborates the related processes and standards as described in the ISO 38200 standard on CoC of wood and wood-based products
- Provide an understanding of the IT concepts and products that can be leveraged to provide automation of the process

### Certificate of Origin

- The local bodies or designated field officer shall be the verifier in case of state governments or state-owned agencies functioning as a certifying body.
- Similarly, a trader or an agent shall be designated as the verifier in case of other private organizations or companies accredited to act as a certifying body.



IT Application

Ownership details | Farm details | Tree details

### Certificate of Origin

- Information and documents needed to fulfil the requirement of the due diligence system:
  - Description:** name of the species and its scientific name.
  - Quantity:** of the relevant product (No./mass/volume)
  - Identification of area** (Village, Taluk, district, state) of production
  - Geo-coordinates** of all the plots of land where the relevant products were produced with the date
  - Name and address** of the business/persons from whom they have been supplied relevant products and to whom the products have been supplied.

### Certificate of Origin

The process of certification of origin and ownership involves the following steps:

- Aadhar based authentication of the owner
- Validation of land records from local self-government /Panchayat office or e-records
- Developing GIS based farm survey application for demarcation of farmland and Geo-tagging of trees within farmland
- Placing IT based solution for QR code based tracing and tracking that feeds to CoC certification.

### Chain of Custody Certification



Farmers → Consumers

Certification of Farm wood | Verification at Sawmill | Verification at Factory | Verification by Distributor | Verification by Retailer



## Chain of Custody Certification

Guiding principles to provide for a credible, third-party independent and operational CoC system:

1. CoC certification is a **voluntary activity** and it seeks to assure buyers that the certified wood products they purchase are from **farm land/participating processing/manufacturing companies**.
2. The CoC system is used to **track wood and wood products** to meet the certification needs of all organizations along the chain.
3. Accredited, independent, 3<sup>rd</sup> party **certification bodies will be responsible** for verification and auditing of the performance requirements of CoC system.
4. Organizations in the chain are responsible for **ensuring credibility** of CoC system as their day to day business affects the outcomes of CoC system.
5. Continual improvement in the **AgriWood®** standard is necessary to ensure that criteria and requirements are regularly reviewed and revised to incorporate changes.

## Chain of custody requirements

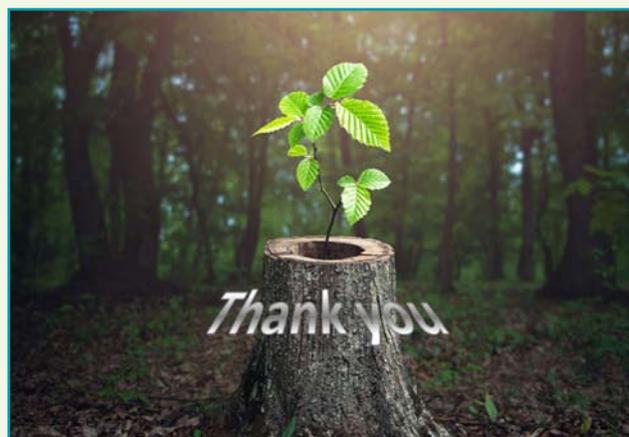
Guiding principles to provide for a credible, third-party independent and operational CoC system:

**Block chain Technology:** Decentralized ledger system impervious to hacking, immutable, and anonymous



## Benefits of *AgriWood®* in nutshell...

- Agriwood standard for certification provides a **win-win situation** for both farmers and wood based industries
- Application of IT in Agriwood system provides a platform for **better trade opportunities** and ease of business
- Agriwood provides legality to the farm wood and hence boost the export wood products to many countries who demand “**Legal Wood**”
- Enhance **C sequestration** in farmlands and contribute to India’s international commitment of reducing GHG emissions
- It also contributes to satisfy the domestic need & **saves foreign exchange**
- It plays an important role in **reducing the pressure on natural forests** and indirectly promote biodiversity conservation



## 21. Carbon market certification for agroforestry and farm forestry: Dr. Lokesh Chandra Dube, Senior Standard Manager, the Gold Standard Foundation

**CARBON MARKET CERTIFICATION FOR AGROFORESTRY AND FARM FORESTRY**

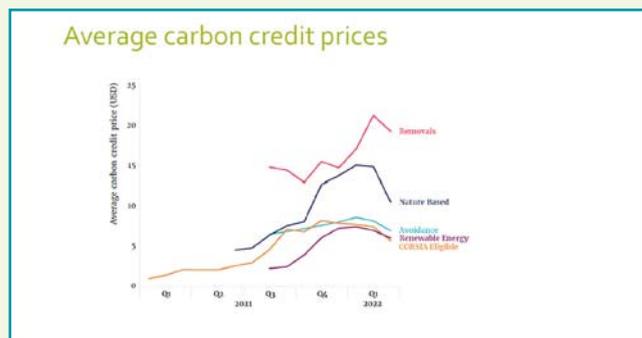
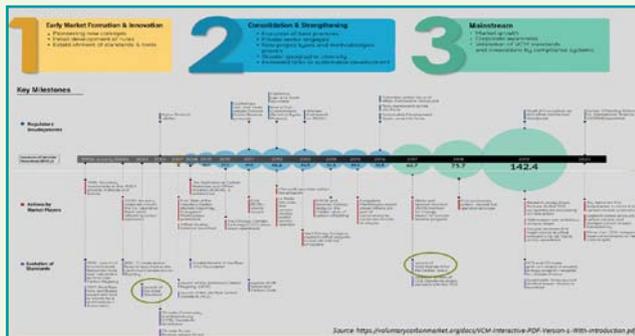
Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management  
ICFRE, Dehradun  
06 January 2023

Dr. Lokesh Chandra Dube  
Senior Manager  
The Gold Standard Foundation

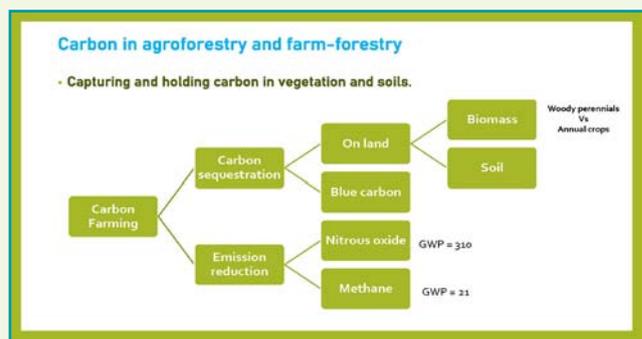
**Gold Standard**

### Contents

- Evolution of Carbon Market
- Current status of forest-based carbon market
- Carbon in Agroforestry and Farm Forestry
- Applicable certification standards
- How to select a suitable standard?
- The Gold Standard Difference

Forest Carbon in Climate Change Supermarket in India Prepared to Sell?



### Applicable certification Standards

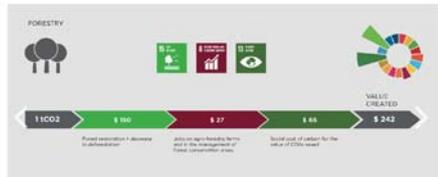
### Selecting a suitable standard



## Gold Standard

## Gold Standard

- Afforestation and Reforestation
- Improved Forest Management
- Agroforestry
- Soil Organic Carbon



## The Gold Standard Difference

- Greater impact + value, through mandatory and verified SDG contribution
- Streamlined project development process through certification body- SustainCert
- Brand reputation
- Ensuring environmental integrity
- REDD+ not supported
- 20% contribution for a pooled compliance buffer, which, unlike other standards, remains untouched even after the crediting period of the project, further reducing the risk of reversal and non-permanence
- Safeguarding principles
- Planned Emission Reductions- may be traded (but retired only when converted to VERRs)
- Avoidance of double counting/ claiming- tagging of projects/ credits for Article 6 Corresponding Adjustments

### Comparison of provisions on environmental and social safeguards

| No. | Criterion   | CDM                           | GS  | VCS                      | SD VCSa                  | CCBS                     |
|-----|---|-------------------------------|-----|--------------------------|--------------------------|--------------------------|
| 1   | Identification and mitigation of negative impacts: Does the program or standard require project developers to identify potential negative environmental and social impacts, including any likely risks to local and affected communities, and to mitigate them? | Not required for A.6 projects | Yes | Yes                      | Yes                      | Yes                      |
| 2   | Monitoring impacts: Does the program or standard require the monitoring of potential negative environmental and social impacts on an ongoing basis?   | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 3   | Third party verification: Does the program or standard require that the evaluation of environmental and social impacts by the project parties is validated by a third party prior to project registration?  | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 4   | grievance: Does the program or standard have a grievance mechanism in place?  | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 5   | Timing of stakeholder consultation: Does the program or standard require that global and local stakeholder consultations are conducted prior to project implementation?   | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 6   | Specific safeguards: Does the program or standard have specific safeguards in place, e.g. in relation to cultural heritage, health, labor rights, indigenous people, environmental health?  | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 7   | Displacement: Does the program or standard have provisions to avoid or prevent and economic displacement to ensure that any displacement is managed through appropriate forms of legal protection and compensation?   | Not required                  | Yes | Yes                      | Yes                      | Yes                      |
| 8   | Consent of indigenous, tribal or traditional peoples: Does the program or standard require free, prior and informed consent of indigenous, tribal or traditional peoples are directly affected by a project?  | Not required                  | Yes | Yes for ancestral rights | Yes for ancestral rights | Yes for ancestral rights |
| 9   | Gender policy: Does the program or standard have a gender policy in place?  | Not required                  | Yes | Yes                      | Yes                      | Yes                      |

Colour coding indicates fulfillment of criterion:  
 Green = fulfilled  
 Yellow = partially fulfilled  
 Red = not fulfilled

### Comparison of the provision of sustainable development impact assessments

| No. | Criterion  | CDM SD Tool    | GS             | SD VCSa        | CCBS                        |
|-----|--|----------------|----------------|----------------|-----------------------------|
| 1   | Does the program or standard provide methodologies to assess sustainable development impacts of projects (beyond the environmental impact assessment) in a structured way? | Not applicable | Yes            | Yes            | Only CCBS specific benefits |
| 2   | If not, is the assessment mandatory?   | Not applicable | Yes            | Yes            | Only CCBS specific benefits |
| 3   | Do the program or standard require (mandatory) methodologies refer to the SDG framework?   | Not applicable | Yes            | Yes            | Only CCBS specific benefits |
| 4   | If so, is the SDG impact assessed at SDG goal or target level?   | Not applicable | Not applicable | Target         | Not applicable              |
| 5   | Does the assessment include both positive and negative sustainable development impacts?  | Not applicable | Not applicable | Not applicable | Not applicable              |
| 6   | Does the program or standard require a comparison of sustainable development impacts with a baseline or reference scenario?  | Not applicable | Not applicable | Not applicable | Not applicable              |
| 7   | Does the program or standard require a quantitative or qualitative assessment of sustainable development impacts?  | Not applicable | Not applicable | Not applicable | Not applicable              |
| 8   | Does the program or standard require that the sustainable development assessment is validated by a third party?  | Not applicable | Not applicable | Not applicable | Not applicable              |
| 9   | Does the program or standard provide guidance on how any or some monitoring of sustainable development impacts should be conducted?  | Not applicable | Not applicable | Not applicable | Only CCBS specific benefits |
| 10  | If so, is the ongoing monitoring of SD impacts mandatory?  | Not applicable | Not applicable | Not applicable | Only CCBS specific benefits |

Colour coding indicates fulfillment of criterion:  
 Green = fulfilled  
 Yellow = partially fulfilled  
 Red = not fulfilled  
 Not applicable



THANK YOU!

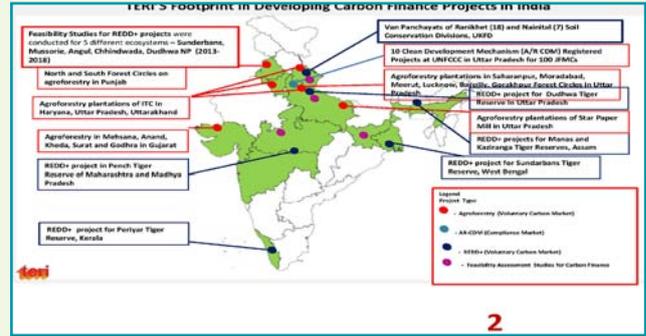
lokesh.dube@goldstandard.org



## 22. Supporting market mechanism under agroforestry through carbon finance and minimum support price: Dr. Syed Arif Wali, TERI, New Delhi

**Supporting Market Mechanism Under Agroforestry through Carbon Finance and Minimum Support Price**

Syed Arif Wali, Ph.D., Senior Fellow and Area Convener, Centre for Sustainable Land Management  
6th<sup>th</sup> January 2023



**Present Scenario of fulfilment demand of wood and wood products**

| S. No. | Timber              | Percent |
|--------|---------------------|---------|
| 1      | Agroforestry sector | > 80    |
| 2      | Natural Forest      | 6       |
| 3      | Import              | 12      |

**Future of Agroforestry in India**

| S. No. | Agroforestry produce   | Demand increment |
|--------|------------------------|------------------|
| 1      | Fodder                 | 1.5 times        |
| 2      | Food grain & fuel wood | 02 times         |
| 3      | Timber                 | 03 times         |

In 2050, the demand (According to CAFRI)

### Compliance vs Voluntary Markets

**Compliance Markets** generate and trade greenhouse gas emission reductions known as Certified Emission Reductions (CERs) that are regulated and directly initiated under the Kyoto Protocol's Clean Development Mechanism (CDM)

- High transaction cost
- Binding targets
- Stringent guidelines
- Mandatory Government Approvals

*Post 2020 new CDM projects can not be registered due to expiry of Kyoto Protocol*

**Voluntary Markets** is a market parallel to CDM. Generate and trade greenhouse gas emission reductions that are not regulated or directly initiated by the Kyoto Protocol and known as Verified Emission Reductions or (VERs).

- No binding targets ;
- Low transaction cost
- Comparatively easier norms;
- No mandatory government approvals;
- Attractive even for small scale community based projects

### Types of Voluntary Carbon Markets

- Largest voluntary standard in the world, having certified reductions of more than 200 million tCO<sub>2</sub>e
- VERRA is the most accepted standard
- VERRA is considered to be universal and base quality standard
- It has reduced administrative burden and costs
- It has the highest market share
- It has a systemized process for registry
- There is no separate process of verification and approve proposals
- VERRA continues to make sure that their VCS Program issues only credits that have environmental integrity and take into account evolving NDC implementation and technological advances

### Entities Involved in Project Formulation

**Project Proponent/ Owner**

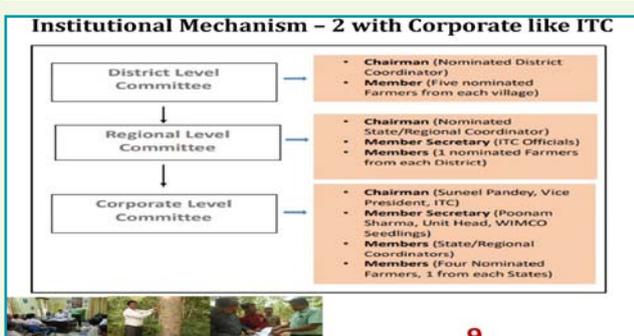
- shall ensure the project implementation details/activities
- assist TERI in conducting the Carbon Finance project
- provide support on the ground and data and information required

**Carbon Development Expert**

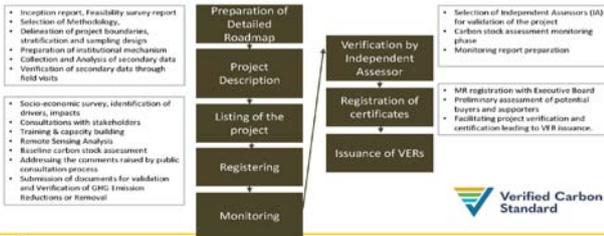
- Act as technical partners in developing the PD, MR and assisting the Validation and Verification process.
- Contact Baseline survey and Biomass estimation.
- Developing IM and conducting stakeholder consultations etc.

**Project Developers**

- Register the project under VCS on VERRA Platform
- Appoint a third party for validation and verification
- Undertaking all the required actions on the VERRA platform



### Process of Developing Carbon Finance Project through VERRA



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### Benefit to Farmers

- It would promote and support farmers by providing additional assured financial benefits out of carbon sequestration done by the plantations at rate of USD\$6 per ton of CO2 equivalent.
- Farmers will be free to sale timber /wood in the market as per the primary objective of the plantation
- In this regard, wood-based industries (WBI) can be made self-reliant for procuring the indigenously grown timber through agroforestry plantations. This would not only strengthen the livelihood opportunities of the farmers but also help to improve their income by providing compensation for carbon sequestration in the form of carbon finance as motivational source.



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### Initiation of the project



Satellite Data GPS Survey Ground Truthing PRA Exercise



13

### Stages of baseline verification



14

### Stages of Assessment of VERs by validator



15

### STR



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### Measurement of carbon pools



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### Agroforestry Projects



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### Improving Rural Livelihood through Agroforestry Practices in Punjab

| Registered under:       | Total Beneficiaries (no. of farmers) | Actual Realised Credits (Long Term Average) (in tCO2e) | Status of the Project |
|-------------------------|--------------------------------------|--|-----------------------|
| Cluster - I (VCS 2552)  | 1,864                                | 1,290,764  | Under Verification    |
| Cluster - II (VCS 2555) | 1,822                                | 640,121  | Under Verification    |



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### Voluntary Carbon Market Project for Agroforestry Plantation in Gujarat

| Registered under:    | Total Beneficiaries (no. of farmers) | Actual Realised Credits (Long Term Average) (in tCO2e) | Status of the Project |
|----------------------|--------------------------------------|--|-----------------------|
| Mehsana (VCS 2756)   | 1,966                                | 279,440  | Under Verification    |
| Ahmedabad (VCS 2557) | 4,416                                | 1,449,914  | Under Verification    |
| Godhra (VCS 2758)    | 1,781                                | 471,268  | Under Verification    |
| Surat (VCS 2558)     | 1,618                                | 222,563  | Under Verification    |



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### Strengthening Rural Livelihood through Carbon Finance: Agroforestry Practices in Uttar Pradesh

| Registered under:<br>Type: ARR | Total Beneficiaries<br>(no. of farmers) | Estimated ERs<br>(in tCO2e) | Status of the Project |
|--------------------------------|---|-----------------------------|-----------------------|
| Saharanpur (VCS 3663)          | 8,855                                   | 900,000                     | PD Listed             |
| Moradabad (VCS 3661)           | 2,763                                   | 600,000                     | PD Listed             |
| Meerut (VCS 3698)              | 3,487                                   | 450,000                     | PD Listed             |



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### Strengthening Rural Livelihood through Carbon Finance: Agroforestry Practices in Uttar Pradesh

| Registered under:<br>Type: ARR | Total Beneficiaries<br>(no. of farmers) | Estimated ERs<br>(in tCO2e) | Status of the Project              |
|--------------------------------|---|-----------------------------|------------------------------------|
| Lucknow                        | 2,792                                   | 400,000                     | Stakeholder consultation completed |
| Bareilly (VCS 3661)            | 3,000                                   | 750,000                     | Stakeholder consultation completed |
| Gorakhpur (VCS 3698)           | 2,500                                   | 400,000                     | Stakeholder consultation completed |



**22**

### TERI's Study in Uttar Pradesh -A/R CDM

Area covered - 3,776.88 ha

Saplings planted - 18,84,659, Tree species - 51 belonging to 21 families

CERs Generated - 1, 06, 175.

- Each rotation cycle - 20 years. Period of each verification after 5 years of intervals
- It can be further renewed for another two more rotation cycles.
- Practically the project can be functional till 60 years

Under first verification a total of 1,06,175 CERs are requested for issuance. Out of which more than 24000 CERs issued and rest are under request for review for the first cycle

Each discrete patch of the land has been provided a unique identification number



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### Screenshot of UNFCCC Registered 10 UPCDM Projects of TERI

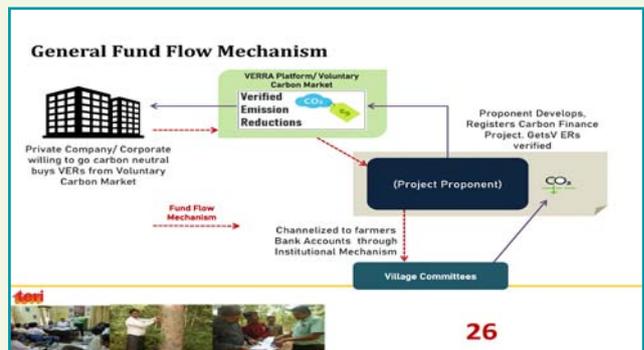


**24**

**Thank you...**



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# POSTER PRESENTATIONS



## Performance of Wheat as Intercrop in Eucalyptus based Boundary Agroforestry System on Farmland of Sahaspur, Dehradun (Uttarakhand)

<sup>1\*</sup> Anshu Kumari, <sup>2\*</sup> Jitender Singh, <sup>3\*</sup> Hitesh Gupta  
<sup>1\*</sup> Forest Research Institute (Deemed to be) University Dehradun, Uttarakhand; <sup>2\*</sup> College of Forestry, Veer Chandra Singh Garhwal Uttarakhand University of Horticulture and Forestry, Ramnagar, Uttarakhand, India - 249199

### INTRODUCTION

Interactions are an inevitable part of the ecosystem. Multiple species coexisting in the same environment, as in agroforestry, results in a distinctive set of ecological interactions between various species. Agri-silviculture is a land-use system that combines annual food crops with woody perennials to increase productivity and assure sustainability while still generating environmental advantages. Eucalyptus (*Eucalyptus tereticornis*) commonly known as **blue gum** is a tree species native to eastern Australia and southern New Guinea. It is a multipurpose fast-growing valuable timber species and has emerged as one of the most suitable tree species for the agri-silviculture system. Eucalyptus is grown by farmers because of its short lifespan, ease of regeneration, easy availability of high-quality planting material, high market demand, and compatibility with agricultural products. Wheat (*Triticum aestivum* L.) belongs to the family Poaceae and is the most pervasive and significant food crop under the agroforestry framework in North Indian states. The easiest way to meet the necessary food and industrial raw materials through the sustainable use of natural resources is through intercropping with short rotation, high-density tree species. Combining wheat with tree cultivation offers several advantages in terms of crop productivity, tree products, improved soil quality, etc.

| Positive effects         | Negative effects           |
|--------------------------|----------------------------|
| Improves soil fertility  | Competition for soil water |
| Improves microclimate    | Competition for light      |
| Reduces wind and erosion | Competition for nutrients  |
| Improves crop growth     | Provides shading effect    |

### OBJECTIVES

- To analyze the effect of trees on growth and productivity (Yield) of wheat crop in the understory.
- To investigate the economics of affected and unaffected wheat crops under the Eucalyptus-based agroforestry system.

### Materials and Methods

#### Experimental setup and treatment details

Name of the crop-Wheat (*Triticum aestivum* L.)

Name of the tree -Eucalyptus (*Eucalyptus tereticornis* Sm.)

Treatment 1-Tree line (0-2 m)

Treatment 2-Away tree line i.e., control (Wheat crop without tree)

No. of quadrates-10

Total field area-100 m × 100 m

Date of sowing of wheat- November, 2021

Year of planting of eucalyptus-2017

Experimental design-Simple random design

#### Methodology

The quadrate of 1 m × 1 m was laid randomly within the tree line (0-2 m) and in control. Ten quadrates of 1 square meter each on the tree line and away tree line were taken on the experimental site (Dehradun district) (Fig 1). All parameters related to crop growth were studied in each quadrate and the data collected from each quadrate were averaged to get the average value of each parameter related to crop growth on the tree line and in control. The results were compared to see the effect of 4-5 years old eucalyptus tree with a small canopy that had a crown spread up to 2 m i.e., on the tree line and in open. Economics of wheat with the life cycle of one growing season and eucalyptus with six years were also computed on a per hectare basis.

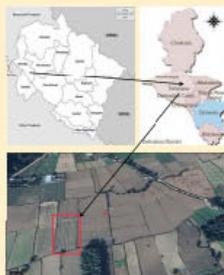


Fig 1: Location of the experimental site

### RESULTS

Table 1: Yield of various components of wheat

| Treatment      | Grain yield (kg/ha) | Straw yield (kg/ha) | Biological yield (kg/ha) | Harvest index (%) |
|----------------|---------------------|---------------------|--------------------------|-------------------|
| Tree line      | 1000                | 1800                | 2800                     | 35                |
| Away tree line | 3000                | 4200                | 7200                     | 41.33             |
| [t] value      | 8.58                | 9.49                | 9.18                     | 6.62              |
| p-value        | <0.001              | <0.001              | <0.001                   | <0.001            |

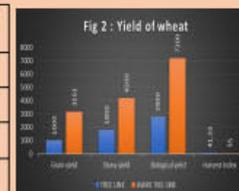


Table 2: Crop growth parameters

| Treatment      | Germination count (%) | No. of tillers | Plant height | Spike length | No. of spikelet/spike | No. of grains/spike |
|----------------|-----------------------|----------------|--------------|--------------|-----------------------|---------------------|
| Tree line      | 60                    | 384            | 84.5         | 12           | 30.00                 | 14.00               |
| Away tree line | 80                    | 630            | 96.9         | 14.73        | 36.00                 | 47                  |
| [t] value      | 11.2                  | 8.02           | 11.28        | 6.73         | 6.33                  | 8.13                |
| p-value        | <0.001                | <0.001         | <0.001       | <0.001       | <0.001                | <0.001              |

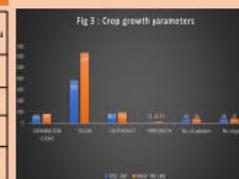


Table 3: Economics of different components

|                 | Yield (quintal/ha) | Market price (Rs/quintal) | Total sale price (Rs/quintal) | Gross return (Rs/ha) | Cost incurred (Rs/ha) | Net return (Rs/ha) | B:C ratio |
|-----------------|--------------------|---------------------------|-------------------------------|----------------------|-----------------------|--------------------|-----------|
| Unaffected crop |                    |                           |                               |                      |                       |                    |           |
| Grain yield     | 30                 | 2000                      | 60000                         | 61000                | 30000                 | 51000              | 1.7       |
| Straw yield     | 42                 | 500                       | 21000                         |                      |                       |                    |           |
| Affected crop   |                    |                           |                               |                      |                       |                    |           |
| Grain yield     | 10                 | 2000                      | 20000                         | 29000                | 30000                 | -1000              | 0.83      |
| Straw yield     | 18                 | 500                       | 9000                          |                      |                       |                    |           |

Table 4: Economic gain of tree and wheat crop

| Product     | Production (quintal/ha) | Total cost incurred (Rs) | Total sale price (Rs) | Economic gain (Rs) | B:C Ratio |
|-------------|-------------------------|--------------------------|-----------------------|--------------------|-----------|
| Wheat crop  |                         |                          |                       |                    |           |
| Grain yield | 240                     | 1,80,000                 | 4,80,000              |                    |           |
| Straw yield | 360                     |                          | 1,80,000              | 4,80,000           |           |
| Grand total |                         | 1,99,000                 | 6,60,000              | 12,21,000          | 6.14      |

### CONCLUSION

Nowadays, eucalyptus and wheat-based agroforestry system is being practiced on a commercial basis in the **Tarai region of Uttarakhand**. Farmers are growing eucalyptus and other tree species with their agriculture crops for different purposes and prefer eucalyptus boundary planting because it causes less hindrance with agricultural operations. Amongst the different parameters, the germination count in control (80%) (Table 2) was maximum as compared to the tree line (60%), no. of tillers in control (630) (Table 2) was higher as compared to the tree line (384), wheat crop height in control (96.9 cm) (Table 2) was maximum as compared to tree line (84.5 cm), spike length in control (14.73 cm) (Table 2) was maximum as compared to tree line (12 cm), no. of spikelet in control (36) (Table 2) was higher as compared to tree line (30), no. of grains in control (47) (Table 2) was higher as compared to tree line (34), grain yield in control (3000kg/ha) (Table 1) was maximum as compared to the tree line (1000kg/ha), straw yield in control (4200kg/ha) (Table 1) was higher as compared to tree line (1800kg/ha), biological yield in control (7200kg/ha) (Table 1) was maximum as compared to tree line (2800kg/ha), and harvest index in control (41.33%) (Table 1) was higher as compared to tree line (35%). Maximum net return (Rs51,000/ha) and B.C ratio (1.7) (Table 3) was obtained from the unaffected crop compared to affected crop. Economic return of (Rs12,21,000/ha) and B.C ratio of (6.14) of eucalyptus and wheat-based agroforestry system (Table 4) was estimated in 6 years. However, the loss in crop yield, and economic return in eucalyptus-based agroforestry is due to antagonistic interaction but can be compensated by the return obtained by eucalyptus.

# Role of Mustard Crops in Carbon sequestration under Agroforestry

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## Introduction

Forest carbon Absorption of carbon dioxide from the atmosphere and conversion to biomass through photosynthesis. The fixed carbon accumulates then in the form of biomass, deadwood, foliage and in forest soils. Agroforestry and farm Forestry is one of the best tools that have potential to sequester carbon in other resources which are already exist in nature. These tools are created with proper management of forest trees on wasteland as well as agricultural crops for agricultural production sustainably. The oil production in India has however lagged behind its consumption, necessitating import of edible oils. India is the world's second-largest consumer and number one importer of vegetable oil (Bhosale Jayashree (2022)). This imported oil seed minimize with Agroforestry and Farm forestry. This research based to increase production of mustard crops under Agroforestry System.

## Methodology

This experiment conducted in Forestry research farm at JNKVV Jabalpur and data analysis by FRBD, with 2 Factor (*Gmelina* and *Dalbergia*) under 3 fertility level of NPK@ Recommend dose of fertilizer (RDF) i.e. F<sub>1</sub>-75% NPK, F<sub>2</sub>-100% NPK and F<sub>3</sub>-125% NPK, the RDF for mustard crop 60:40:40 kg ha<sup>-1</sup> with 4 replication.

## Results and Discussion

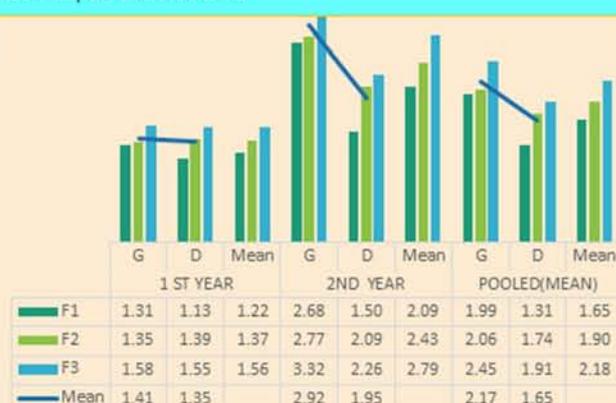
Carbon stock and sequestration in mustard differ from system to system and also significantly changes under different fertility levels. The result showed that total carbon stock in mustard was estimated on systems significantly higher total carbon stock (1.11, 2.31 and 1.71 t ha<sup>-1</sup>)

## Conclusion

Carbon stock and Carbon sequestration in mustard was estimated on systems significantly higher total carbon stock of mustard had recorded in *Gmelina arborea* as compared to *Dalbergia sissoo* during both year and pooled data respectively. The agricultural crops also two way work firstly gave to production oil seeds and second to sink the atmospheric carbon.

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of mustard were recorded in *Gmelina arborea* as compared to *Dalbergia sissoo* (1.07, 1.54 and 1.30 t ha<sup>-1</sup>) during both year and pooled data respectively. moreover under different fertilizer levels had significant effect on total carbon stock of mustard during significant in both year and pooled data were significantly maximum carbon stock 1.23, 2.20 and 1.72 t ha<sup>-1</sup> were noted as F<sub>3</sub> fertilizer levels, this finding are in common with Saha and Ghosh (2013), Parit *et al.*, (2020) and Singh *et al.*, (2021).

Carbon sequestration under systems significantly to (0.23, 0.48 and 0.35 t ha<sup>-1</sup>) of mustard was recorded in *Gmelina arborea* as compared to *Dalbergia sissoo* (0.22, 0.32 and 0.27 t ha<sup>-1</sup>) during both years and pooled data respectively. The fertilizer levels had a significant effect on carbon sequestration of mustard significantly in both years and pooled data were significantly maximum carbon sequestration 0.25, 0.45 and 0.35 t ha<sup>-1</sup> were noted as F<sub>3</sub> fertilizer levels this result just the same finding out through Pramanik *et al.*, (2021).

# Wood based industries, Agroforestry and Quality planting material

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Demand of timber raw material for wood-based industries follows an exponential trend. Timber import is seen as one of the prominent sources of wood which apart from being detrimental for country's economy also makes wood-based industries to be incompetent in the global markets. Trees outside forests (TOF) grown through Agroforestry and farm forestry is the need of the hour which is capable of increasing the timber output from agricultural land helping to check timber import.

## Introduction

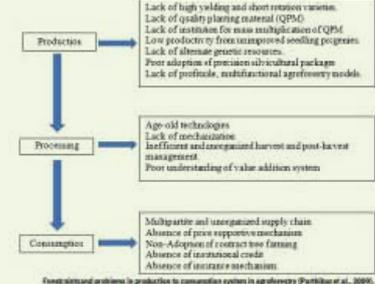
The demand and supply gap of roundwood would be 22.44 million cubic meters (MCUM) in 2025 (Srinivasan et al., 2018). To satisfy the growing timber raw material demand of wood-based industries, trees outside forests (TOF) emerged as promising alternate source. Plantation timber from agroforestry and farm forestry supplies a major portion of the total timber demand. As defined in national agroforestry policy 2014, Agroforestry is the land use system which integrate trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. Agroforestry is the boon for wood-based industries as it is the only sustainable source of timber raw material discouraging the timber import which has a negative effect on the country's economy. Apart from its shortcomings with respect to the country's economy by consuming huge foreign exchange timber import shall also create uncertainty in timber availability and associated market prices (Vanam B, 2019). Though agroforestry is a major tool in mitigating the timber shortage, it has to overcome a major challenge which is the availability of quality planting material that will yield more timber biomass in a given area for the plantation to be successful. Survival of the trees during growth, adaptation to the regional climate, the growth rate etc. depends on the quality of the planting material to a great extent.



9 Month old Plantation of Melia dubia at Hiriyur Taluk, Karnataka

| Year | Pulp and Paper | Furniture | Physical and other wood based industries | Construction | Total |
|------|----------------|-----------|--|--------------|-------|
| 2020 | 12.5           | 8.98      | 15.45                                    | 22.71        | 59.64 |
| 2022 | 12.5           | 9.47      | 17.88                                    | 21.79        | 61.64 |
| 2023 | 12.5           | 9.95      | 20.48                                    | 20.88        | 64.01 |
| 2024 | 12.5           | 10.44     | 23.34                                    | 19.96        | 66.24 |
| 2025 | 12.5           | 10.92     | 27.70                                    | 19.05        | 70.17 |
| 2026 | 12.5           | 11.40     | 32.06                                    | 18.14        | 74.11 |
| 2027 | 12.5           | 11.88     | 37.30                                    | 17.23        | 78.71 |
| 2028 | 12.5           | 12.37     | 42.93                                    | 16.31        | 84.11 |
| 2029 | 12.5           | 12.86     | 49.08                                    | 15.39        | 90.41 |
| 2030 | 12.5           | 13.34     | 57.49                                    | 14.48        | 97.81 |

India, roundwood demand forecasts by wood-based sector, 2021-2030 (million m<sup>3</sup> RME)  
Source: ITTO Technical Report (Kant, P. and Nautiyal, R., 2021)



Structural problems in production to consumption system in agroforestry (Parthiban et al., 2009)



## Quality planting material – Key to successful Agro and Farm Forestry:

Quality Planting Material (QPM) is a prerequisite input in agroforestry for maximizing the timber yield, improving adaptability to adverse environmental conditions to produce raw material of acceptable quality in a short rotation. The basic goal of having quality seedlings is to accomplish the best growth possible and have the highest amount of desired outputs. It is a well-known fact that more than any other input, improved planting material is the key to enhanced farm productivity and increased income generation (Hassan et al., 2001; Minot 2008). Planting material of authentic vegetative or seed origin produced in advanced technology nurseries or tissue culture labs, with proven track record of high survival percentage in the field, faster growth, higher yield, resistance to pest and diseases, adaptability to local bio-physical, climatic and socio-economic conditions, and with high market demand, will be eligible to qualify as Quality Planting Material. Guaranteed performance in terms of higher yield and quality of crops could be achieved with reliable planting material and good management practices. Nursery-raised seedlings of appropriate quality to raise agroforestry plantations are of primary importance. Efforts put in planting trees in a large scale ruins the results if poor quality seedlings are planted. The benefits expected from agroforestry depends mainly on choice of species, seedling quality and the silvicultural management (Handa et al., 2019). Important agroforestry species such as *Ailanthus excelsa*, *Anthocephalus cadamba*, *Albizia lebbeck*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Melia dubia*, *Populus deltoides*, *Tectora grandis* etc. and their cultivation practices for best yield are documented (Chaturvedi et al., 2017 and Handa et al., 2019).

### Issues:

Lack of quality planting material is one of the major hindrances for agroforestry and farm forestry in India. Many a times planting material sold by private nurseries is not affordable by small scale farmers and also farmers are misled by the private nurseries by means of erroneous information with the sole intentions of selling the seedlings. Farmers are not supported to scientifically manage the planted seedlings which lead to non-performance of the seedlings failing the plantation miserably. Plantation should be taken up based on the anticipated timber requirement which should be arrived at by suitable scientific approach and not with assumptions. Age at which the species can be harvested should be taken into consideration while making such forecast of timber requirement. Mass plantations taken up without any prior scientific studies leads to surplus supply of the timber which in turn causes an avalanche in the selling price of the timber which brands that particular timber as invaluable.

### Solutions:

There is a need to diversify forest plantations by increasing the number of suitable indigenous fast-growing trees species adaptive to wide range of agro climatic condition of India (Parthiban et al., 2009). Research on genetically modified planting material is conducted so that the timber harvested shall be ideally suitable for specific end use applications as a result of which the grown timber can be utilized in an optimal manner which contributes to minimal wastage. The research output such as tree improvement, growing methodologies and other such technical improvements can only be realized if subsistence farmers have access to quality planting material. Improving the genetic and physical properties of planting material can trigger yield increases of up to 40%. Apart from availability of quality planting material, policy must promote farm forestry and afforestation of wastelands and marginal agricultural lands through innovative policy changes, fiscal incentives and tax benefits (Lal, 2000). Small groups involving stakeholders like farmers, industries and scientist from research institutes are to be formed to make agro forestry and farm forestry attractive. In doing so, farmers can be protected from being misled by groups having mendacious propaganda for selling seedlings at high cost making false promises. One example of this pattern is Consortium of Industrial Agroforestry (CIAF) established by Tamilnadu agricultural university (TNAU).

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## Performance of Legumes in the Allies of Gamhar in Coastal Odisha

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A study was conducted in the experimental site of AICRP on Agroforestry, OUAT, India during 2021 and 2022.

### Research Objective:

To study the growth, biomass, total carbon stock potential and economics of Gamhar based agrisilviculture system.

Experimental Design: RBD  
Replication: 03, Treatment: 07

- T<sub>1</sub>- G. arborea + Arhar
- T<sub>2</sub>- G. arborea +Cowpea
- T<sub>3</sub>- G. arborea + Greengram
- T<sub>4</sub>-Sole G. arborea
- T<sub>5</sub>-Sole Arhar
- T<sub>6</sub>-Sole Cowpea
- T<sub>7</sub>-Sole Greengram

### Research Outcomes:

Among the seven treatments in agrisilvicultural system the highest inter crop yield of Cowpea 843 kg ha<sup>-1</sup> was from *Gmelina arborea* + Cowpea system. *Gmelina arborea* attained maximum growth in association with Greengram i.e tree height (7.28 m), basal girth (35.87 cm) and crown spread (5.82 m) after 66 months of planting (MAP).

The highest biomass of 55.38 Mg ha<sup>-1</sup> was recorded with *Gmelina arborea* + Greengram system. Similarly, the highest total carbon stock (27.69 Mg ha<sup>-1</sup>) CO<sub>2</sub> assimilation of 101.62 Mg ha<sup>-1</sup> was recorded with *Gmelina arborea* + Greengram system. The highest net return of Rs 69,880 ha<sup>-1</sup> and benefit cost ratio of 2.86 was recorded in *Gmelina arborea* + Arhar system followed by *Gmelina arborea* + Cowpea system Rs. 62,961 ha<sup>-1</sup> net return and BCR 2.70.



Gamhar with legume in early vegetative stage



Gamhar + Cowpea



Gamhar + Arhar



Sole Gamhar

**Table: Growth, Biomass, Carbon Stock, CO<sub>2</sub> Assimilation, Yield and Economics of Gamhar & Legumes in the Agrisilvicultural System (Pool data of 2021 and 2022)**

| Treatment                               | Tree height (m) |        | Basal Girth (cm) |        | Crown Spread (m) |        | Total biomass (Mg ha <sup>-1</sup> ) | Total Carbon Stock (Mg. ha <sup>-1</sup> ) | CO <sub>2</sub> assimilation (Mg. ha <sup>-1</sup> ) | Yield (kg ha <sup>-1</sup> ) | Arhar equi. yield (kg ha <sup>-1</sup> ) | Net return (Rs ha <sup>-1</sup> ) | Benefit Cost Ratio |
|---|-----------------|--------|------------------|--------|------------------|--------|--------------------------------------|--|--|------------------------------|--|-----------------------------------|--------------------|
|   | 54 MAP          | 66 MAP | 54 MAP           | 66 MAP | 54 MAP           | 66 MAP |                                      |  |  |                              |  |                                   |                    |
| T <sub>1</sub> - G. arborea + Arhar     | 4.86            | 5.82   | 27.62            | 31.14  | 3.48             | 4.51   | 42.83                                | 21.41                                      | 78.57  | 734                          | 734                                      | 69880                             | 2.86               |
| T <sub>2</sub> - G. arborea +Cowpea     | 5.24            | 6.56   | 28.43            | 32.66  | 3.87             | 4.74   | 47.03                                | 23.51                                      | 86.28  | 843                          | 644.6                                    | 62961                             | 2.70               |
| T <sub>3</sub> - G. arborea + Greengram | 6.12            | 7.28   | 30.51            | 35.87  | 4.65             | 5.82   | 55.38                                | 27.69                                      | 101.62   | 552                          | 533                                      | 54395                             | 2.51               |
| T <sub>4</sub> -Sole G. arborea         | 4.77            | 5.52   | 25.84            | 30.51  | 3.10             | 3.96   | 38.00                                | 19.00                                      | 69.73  | -                            | -  | 35000                             | 3.27               |
| T <sub>5</sub> -Sole Arhar              | -               | -      | -                | -      | -                | -      | 3.21                                 | 1.60                                       | 5.82   | 840                          | 840                                      | 43890                             | 2.59               |
| T <sub>6</sub> -Sole Cowpea             | -               | -      | -                | -      | -                | -      | 2.21                                 | 1.10                                       | 4.03   | 927                          | 708.8                                    | 33418                             | 2.24               |
| T <sub>7</sub> -Sole Greengram          | -               | -      | -                | -      | -                | -      | 2.59                                 | 1.29                                       | 4.73   | 640                          | 617.4                                    | 26569                             | 2.02               |
| SEm (±)                                 | 0.17            | 0.24   | 0.78             | 0.87   | 0.18             | 0.19   | 0.77                                 | 0.61                                       | 0.67   | -                            | 17.67                                    | 1017                              | -                  |
| CD (p= 0.05)                            | 0.50            | 0.71   | 2.29             | 2.56   | 0.53             | 0.59   | 2.27                                 | 1.82                                       | 1.98   | 734                          | 53.31                                    | 3215                              | -                  |

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# NATIONAL WORKSHOP for Agroforestry and Farm Forestry Sustainable Land and Ecosystem Management

under  
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