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GROW MORE, USE MORE

Vol. 1, Issue 3, October - December 2020

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Indian Council of Forestry Research and Education

(An Autonomous Body Under Ministry of Environment, Forest & Climate Change)

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(An Autonomous Council of Ministry of
Environment Forest and Climate Change,
Government of India)

To achieve long-term ecological stability, sustainable development and economic security through conservation and scientific management of forest ecosystems



To generate, advance and disseminate scientific knowledge and technologies for ecological security, improved productivity, livelihoods enhancement and sustainable use of forest resources through forestry research and education

- ☞ A new wood preservative which is comparable to CCA.
- ☞ Judicious use of preservative in a non-durable wood greatly enhances (6-8 folds) life of products.



- ☞ Developed improved germplasm of many forest tree species.
- ☞ Released 47 high performing and disease resistant clones of *Eucalyptus*, *Casuarina*, *Shisham*, *Melia* and *Sarpagandha* with a envisaged production gain of more than 20%. The developed germplasm are being made available to the State Forest Departments and farmers for use in plantations.



High performing and disease resistant
clone of *Melia* sp.



Casuarina Yield Calculator Utility Software (CYCUS v1.0) software has been developed to facilitate the farmer and other user agencies in yield estimation which requires only observations on girth of 100 sample trees per acre of plantation.

Wood welding is new to our country. In this technique wood joints can be made without using nails and adhesives making them more natural and chemical free. A wood welding machine has been designed and fabricated at Forest Research Institute, Dehradun. Success has been achieved in spin welding of wood pieces of few species.



Wood Welding Machine



Indian Council of Forestry Research and Education

New Initiatives

- ☛ Transparent wood- a flexible and biodegradable transparent wood has been fabricated using poplar wood veneer and water soluble polymer- polyvinyl alcohol. The transparent wood exhibited high optical transmittance, high haze and light diffusing property.



Natural wood (Left most), Lignin modified wood (middle) and Transparent wood (right most) placed on a paper with letters "IWST"

Heat storage based modified Solar Kiln

- ☛ Solar heat storage system based solar kiln has been developed by Forest Research Institute, Dehradun for timber drying. The solar heat is trapped using suitable phase change material (PCM). The New solar kiln is able to trap 39 % more heat in winters as compared to traditional green-house based traditional FRI solar kiln developed during 1970.



Head based storage Solar Kiln

Xylarium

- ☛ Collection of authentic wood samples both from India and other countries, depicting wood biodiversity of the country like lightest, heaviest, sweet-smelling, foul smelling, smoothest, streaked, variegated wood and wood of different colours, etc. The collection of wood cross sectional discs depicting variation in sapwood and heartwood colour is a unique feature of the xylarium.
- ☛ Wood identification services.



Xylarium- Collection of Authentic wood samples

Tree hollowness detection technique based on ultrasonic waves

- ☛ Forest Research Institute, Dehradun has developed ultrasonic techniques (Non-destructive testing) to detect the location and magnitude of the hollowness of the standing tree. This will help to remove the potential human hazards by way of falling down of such trees during a high wind regime in Urban Forestry.



Measurement of hollowness in a tree using ultrasonic detector

Agroforestry models

- ☛ Various agroforestry models (Poplar, Eucalyptus, Melia, Casuarina and Babool) have been developed to improve green cover, enhance farmers income and to mitigate climate change.



Poplar based agroforestry model with wheat

Innovative Bamboo Bottles

- ☛ Techniques for making bamboo bottles by using Bamboo Treatment Technologies of ICFRE. Most suitable bamboo species for making bottles are Shil Barak (*Bambusa salarkhanii*) & Barak (*Bambusa balcooa*). One full bamboo is sufficient for making 21 full size bottles and 12 small bottles.



Bamboo bottles

For further details please contact :

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Indian Council of Forestry Research and Education,
Dehradun - 248 006
Phone:- +91-135-222 4814, +91-135- 2755221,

WOOD POLYMER COMPOSITE

A Technology
from IWST

- ♦ The technology provides an opportunity to replace up to 50-60% plastics by environment friendly natural fibers.
- ♦ Any type of woody material like lops and tops, branches, wood waste, saw dust, bamboo, lantana, jute, coir, etc. can be used for this purpose.

These composites have a wide range of applications like light structural components, interiors (wall cladding), garden and outdoor products, injection molding products like hangers, pens, pencils, pen stands, trays, and other utility products.

The advantages of using wood polymer composite material:

- Cost effective compared to virgin thermoplastics
- Superior in strength and stiffness than plastics
- Dimensionally stable
- Recyclable and environment friendly than virgin plastics



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आर पी गुप्ता
R P Gupta



सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE



FOREWORD

Wood is an old-age fascinating traditional material being used by various sectors viz., construction, furniture, panel products, paper and pulp, sports goods, agricultural implements, etc. Unlike other materials, wood can fit into any setting and blend tastefully, be it modern, rustic, or traditional and its versatility extends from indoors to the outdoors. Among various sectors, furniture sector is the one where India can meet the domestic demand and simultaneously become 'a global factory in the world'. Indian wooden furniture has been influenced by numerous cultures and traditions from historic times and it has emerged as one of the finest artistic forms in the world. Despite the technological advances and highly skilled craftsmanship, India has failed to grow internationally to its full potential. The expansion of manufacturing centres, setting up of research institutes and organizing the scattered furniture industry are long-term development plan but the immediate focus should be on the promotion of traditional and cultural wooden furniture and revival of diminishing traditional furniture through set up of government-sponsored training centres and investment opportunities from MSME sector.

Furniture manufacturing in India is mostly driven by the designs chosen; the inputs come from in-house designers and market feedback. Manufacturers consider several aspects related to the customer (such as demography, lifestyle, motivation and aspiration, needs and preferences, etc.), raw material (type, quantity and availability) and internal capability (expertise, quantity and availability of labour, production process complexity and delivery time) for developing different designs, which in turn, determine the functionality of furniture, look, feel and value. Depending on the end-user requirements, the furniture produced in India falls into two broad categories: domestic furniture meant for home use and commercial furniture meant for office and hospitality sectors.

For this to happen, innovative designs, quality assurance and certification of the furniture are very important aspects with which this sector has to deal with. At the same time, the furniture sector of the country is facing many challenges which are to be addressed for desired growth of industry.

Institute of Wood Science and Technology (IWST), Bengaluru (an Institute under the Indian Council of Forestry Research and Education), besides doing research on wood science at national level, has been continuously working for development of skill enhancement programme by providing different kind of trainings in the area of woodworking to attain global competitiveness by using state-of-the-art machineries. The institute has come out with two issues of its quarterly magazine "Wood is Good: Grow More, Use More" to share the scientific knowledge and success stories with various stakeholders. The magazine has wide circulation to bring an awareness among wood users about the latest developments in wood utilization by various sectors.

I hope the 3rd issue of this quarterly magazine which has been focused on different aspects of furniture sector will act as a source of information to help furniture sector of the country to grow and grab the domestic as well as export markets.

(R P Gupta)

New Delhi
18th January, 2021

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Healthy homes are safe spaces where there can be no room for formaldehyde emissions. Ignoring poor indoor air quality may culminate into lasting problems like Chronic Obstructive Pulmonary Disorder (COPD). But not when Greenply is on guard, with a range of zero emission products at hand. While every product from the house of Greenply conforms to E-1 European standards, we have taken a step towards E-0 grade emission, thereby ensuring your safety and health. What's more, these products are also fortified with Virashield which makes them anti-viral* and anti-bacterial*.



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TESTING AND TRAINING SERVICES @ IWST

Testing Services

- ♦ Identification of wood
- ♦ Physical properties of wood tests (Specific Gravity/Density of Wood, Moisture Content, Shrinkage)
- ♦ Mechanical properties of wood (Static Bending, Compression Parallel to Grain, Compression Perpendicular to Grain, Tension Parallel to Grain, Tension Perpendicular to Grain, Hardness, Shear, Nail Holding Power, Screw Holding Power)
- ♦ Determination of calorific value of wood
- ♦ Thermo gravimetric analysis of lignocellulosic material
- ♦ Determination of penetration and retention of preservative in the treated wood
- ♦ Wood polymer composites
- ♦ Preservative solution analysis
- ♦ Proximate analyser (fixed carbon content, volatile content, ash content and moisture content)
- ♦ Estimation of percentage of Sandalwood oil and GC analysis of oil
- ♦ Distillation of essential oil and estimation of oil yield by hydro distillation method
- ♦ Identification services decay fungi/mould
- ♦ Supply of fungus culture per tube
- ♦ Testing of bio-efficacy of preservatives/ insecticides against borers
- ♦ Sandalwood farming and managing its health Consultancy
- ♦ Testing of wood preservatives/fire retardants
- ♦ Specific information by post

Short Term Training Courses (3/5 days)

- ♦ Bamboo: Tissue Culture
- ♦ Sandalwood: Tissue Culture Techniques
- ♦ Sandalwood: Seed Handling, Nursery and Plantation Technology
- ♦ Wood Seasoning and Preservation
- ♦ Sandalwood: Farming and Management of its Health
- ♦ Extraction and Quality Assessment of Sandalwood and other Essential Oils
- ♦ Wood Modification
- ♦ Field Identification of Important Timbers
- ♦ Clonal Propagation of *Melia dubia*
- ♦ Sandalwood: Establishment and Maintenance of Healthy Nurseries and Plantations
- ♦ Insect Pest Management
- ♦ Bamboo Agarbatti Stick Making

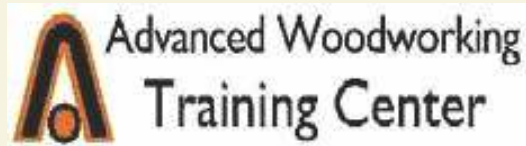
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The Advanced Woodworking Training Center (AWTC) started in 2003 as an Indo-Italian joint project between Institute of Wood Science and Technology (IWST), Bengaluru, Italian Trade commission (ICE) and the Italian Woodworking Machinery and Tools Manufacturer's Association (ACIMALL). The Centre, presently being run by IWST, is regularly offering throughout the year following two advanced woodworking training courses.

A. One Year Diploma Course in Advanced Woodworking

B. Certificate Course in Wood Product Designing and Development

Level 1: Conventional Woodworking and Finishing (4 Weeks)

Level 2: Product Designing and Development on CNC Router (4 Weeks)

Level 3: Product Designing and Development on PYTHA 3D (2 Weeks)

Aim of the Course: To enhance the skill in the area of woodworking to attain global competitiveness by using state of the art machineries. Upon successful completion of training, the trainees will be able to handle advanced woodworking machines for product development. The centre also liaison with wood based industries for placement.

Target Group: Individuals/students/carpenters/persons working in wood based industries.



DETAILS OF COURSES AT AWTC

A. Certificate Course in Wood Product Designing and Development

Level 1 – Conventional Woodworking and Finishing (4 Weeks)

Module I – Fundamentals of Woodworking

- Enrollment and introduction about AWTC "Wood as a Material" (Regarding tree, saw milling)
- "Wood as a Material" (Information about types of wood, identification of wood, defects in wood both natural and due to attack of insects)
- Properties and uses of wood and panel material (Physical properties, mechanical properties, electrical and acoustical properties)
- "Wood as a Material" (Information about types and advantages of seasoning the wood and drying defects during seasoning)

Module II – Basic Mechanical Wood Processing

- Basic workshop calculations like measurement of length, area & volume
- Working examples on measuring of length, area & volume in British and metric system
- Working examples on conversion on pressure, power, work done, cutting speed and feed, conversion of temperature
- "Wood as a layer composite material" like ply board, block board, flake board, glue lam, laminated veneer lumber, cross laminated timber
- "Wood as a particle composite material" like particle board, fibre board & chip board
- Bamboo as a construction material

Module III – Advanced Mechanical Wood Processing

- Basic engineering drawing –
- Demonstration on free hand sketching, pictorial drawing, lines and dimensions.
- Plan of cut, bill of material preparation, estimation and costing of panel furniture.
- Orthographic projection
- Wood protection technology
- Types of adhesives and properties and uses
- Wood finishing (surface preparation, types and selection of different grit sand paper, sealant, varnishing / polishing / procedure)
- Panel material finishing (lamination, painting, membrane and post forming procedure)
- Industrial Visit

Level 2 – Product Designing and Development on CNC Router (4 Weeks)

A. POD and Rail 3 Axis Router

Module I – Fundamentals of CNC POD & Rail in 3Axis Router

- Introduction about Conventional, NC and CNC Machines
- Machine details, axes details, configuration process

Module II – Basic Programming and Operations on CNC POD & Rail 3Axis router

- BIESSE WORKS software structure and details, ATS and FT machine details.
- BIESSE works window description drill un tooling and symmetry explanation
- Drill tool fixing and programming
- Practicing on system bore, generic bore and sawing operations

Module III – Advanced Programming and Operation on CNC Router

- Milling or routing and optimiser results
- TEXT writing
- Lessons exercise
- Pocketing, table tooling

B. KFT 1224 3-Axis Router

Module I – Fundamentals of CNC KFT 1224 in 3-Axis Router

- Difference between POD and rail
- & KFT 1224 CNC machines , Course Objectives
- Machine details, axes details configuration process

Module II – Basic Programming and Operations on CNC KFT 1224 3 Axis Router

- b-solid software structure and details, ATS and FT machine details.
- b-solid window description drill un tooling and symmetry explanation
- Drill tool fixing and programming
- Practicing on system bore, generic bore and sawing operations

Module III – Advanced Programming and Operation on CNC Router

- Milling or routing and optimiser results
- TEXT writing
- Lessons exercise
- Pocketing, table tooling

Level 3 – Product Designing and Development on PYTHA 3D (2 Weeks)

Module I – Fundamentals of 2D and 3D Engineering Drawing with PYTHA Software

- Introduction about PYTHA software, difference between 2D & 3D
- Movie Tutorial

Module II – Basic Programming and Operations on 2D & 3D with PYTHA Software

- Basic introduction about panel and important icons
- Library design & 4 view usage
- PYTHA 2D lessons practice

Module III – Advanced Programming and Operation with PYTHA Software

- PYTHA 3D lessons practice & creating cabinets
- PYTHA 3D lessons practice & material list
- PYTHA 3D lessons practice & usage of bar code
- TEST, VIVA and Certificate Distribution



B. Diploma in Advanced Woodworking (One year)

FIRST SEMESTER

Module 1: Foundation: Materials

- Understanding of wood as a material
- Introduction to solid wood & panel boards
- Materials in modern furniture industry
- Legal aspects of wood transit

Module 2: Foundation: Engineering

- Elements of mechanical engineering
- Introduction to vacuum technology
- Introduction to Electrical and control technology
- Introduction to Pneumatics & Hydraulics
- Basic carpentry and hand tools

Module 3: Processing using machines

- Conventional woodworking machines
- Sizing machines
- CNC Routers & Processing Centres
- Edge banding machines
- Drilling & boring machines
- Introduction to CAD / CAM & application S/W

Module 4: Processing using machines & allied processes

- Hot Press
- Sanding machines
- Painting & finishing
- Tools, accessories and consumables
- Process planning & work flow

Module 5: Systems

- Loading & unloading systems
- Handling, storage and retrieval systems
- Dust extraction systems

SECOND SEMESTER

Module 6: Safety

- Machinery safety
- Safe practices in woodworking industry

Module 7: Maintenance

- Maintenance of woodworking machinery & equipment Troubleshooting

Module 8: Assembly & Joinery

- Hardware, Fittings, tools & equipment used for furniture assembly
- Productivity & cost estimation
- Supervision and management
- Cabinet assembly

Module 9: Advanced Topics

- Advanced application software (CNC, CAD/CAM & 3D Software)
- Advances in processing techniques
- Introduction to Smart Factory & Industry 4.0

Module 10: Project (Optional 10.1 or 10.2)

- Industrial attachment
- Project work: Cabinet making



IWST Activities during October-December, 2020

Webinar on Clonal Propagation of Tree Species

Institute of Wood Science and Technology, Bengaluru had conducted a virtual workshop on 'Clonal Propagation of Tree Species' on 7th October, 2020. The online event was inaugurated by the DG, ICFRE, who also released the book of abstracts received for the workshop. Director, IWST was the Chairman of the programme, with Sh. V.S. Shettepanavar as Co-ordinator, and Smt. Tresa Hamalton as Organising Secretary. Researchers working on various macro- & micro- propagation techniques and their applications presented their findings during the 3 technical sessions, and recommendations were framed by expert members during the plenary session. The workshop was attended by PCCFs and officers from SFDs, researchers from various institutes including ICFRE institutes, Agricultural universities, SFRIs etc.



HRD training programme for ICFRE Scientists



Institute of Wood Science and Technology, Bengaluru organized one day training programme on 'Integrated Pest and Disease Management' virtually for ICFRE Scientists and Officers on 22nd October, 2020 as a part of HRD training programme for ICFRE Scientists. More than 39 Scientists and Officers of ICFRE institutes took active participation in the training Programme through video conferencing. Shri A.S. Rawat, Director General, ICFRE Inaugurated the training programme during which he emphasized the need of urgency in controlling the sandal spike disease by doing holistic research including identification of the vectors

which are responsible for spreading of the disease. Director General released the Technical Bulletin titled "Disease alert on eruption of the Sandal Spike Disease (SSD) in conservation and cultivation of Indian Sandalwood (*Santalum album* Linn.)" authored by Dr. R. Sundararaj and Shri R. Raja Rishi, Scientists, IWST. The experts from IWST and other research organisations delivered lectures on pest and disease management aspects of sandalwood.

Webinar on Sustainable Sandalwood Plantation Management

Indian Institute of Plantation Management (IIPM) Bengaluru (An Autonomous Organisation of the Ministry of Commerce & Industry, GoI) in collaboration with Institute of Wood Science and Technology (IWST), Bengaluru organised a webinar on Sustainable Sandalwood Plantation Management (SPM) was held on 5th November, 2020 from 10.30 am to 1.15pm. Dr. Dhanakumar, Director IIPM informed the audience about how Sandalwood would be most sought after wood material in times to come as there is severe shortage and huge demand. He welcomed Dr. M. P. Singh, IFS, Director, IWST, speakers and the participants (110 participants) across the country. In his special address, Dr. M.P. Singh, emphasised how IWST and Indian Sandalwood has been closely associated for more than eight decades. Considering its dwindled population and to encourage growing of Sandalwood, IWST is trying its level best to enhance the human resource in Sandalwood research and also extend the information through regular training programmes.

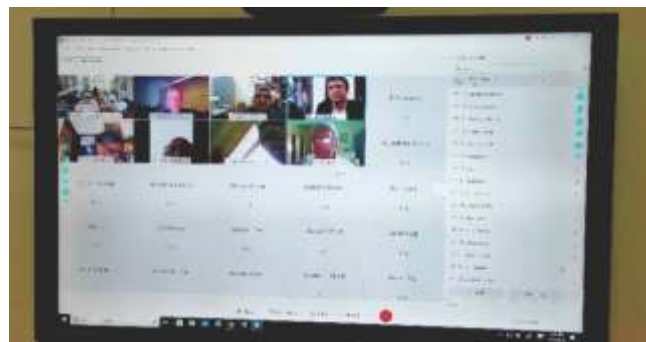


As IWST is seriously pursuing the process of forming a Sandalwood Development Board which would help in sustainable utilisation and conservation of this iconic species.

He emphasised that time has come for IIPM and IWST to foster a strong relationship and appreciate the initiative taken by IIPM. This was followed by five lectures on various aspects related to Sandalwood in which three were from IWST Scientists which focussed on providing overview about Indian Sandalwood, production practises and government regulations on Sandalwood cultivation, and marketing and export of Sandalwood by Dr. Arun Kumar, Scientist-F, Dr. Sundararaj R., Scientist-G and Mr. Soundararajan V, Scientist-D, respectively. The other two lectures were by Dr. Chidananda N. from Karnataka Soaps and Detergents Limited, and Tony Page, Senior Researcher, Tropical Forests and People Research, Centre University of Sunshine Coast, Australia. All the topics generated substantial interest and discussion among the participants.

Webinar on Wood Modification Technologies

A webinar on “Wood Modification Technologies” was organised by the Institute of Wood Science and Technology, Bengaluru on 19th November 2020 to discuss different types of wood modification processes (chemical and thermal modification) and applications of modified wood in various sectors. Wood modification is one of the effective and eco-friendly methods to improve quality of low durability wood for indoor and outdoor usages. It also help in climate change mitigation by enhancing carbon locking period in wood. The webinar was attended by about 120 participants representing wood based industries, forest corporations, researchers, foresters, architects, and students. Dr. M.P. Singh, Director IWST welcomed the participants. Sri A.S. Rawat, Director General, Indian Council of Forestry Research and Education (ICFRE), Dehradun inaugurated the webinar. Dr. K.K. Pandey, IWST, Bangalore made a presentation on overview of wood modification processes and work carried out at IWST in this field. Dr. Andy Pitman from Lignia wood Company, UK, made presentation on resin impregnation technology. Mr. Nirav Kapadia, Ritikaa Enterprises, Mumbai presented status on use of chemically modified wood (Accoya wood) in India. Dr. S.R. Shukla made presentation on thermal modification process



developed at IWST and Mr. Sanjay Goel of DAF Industries, Hyderabad presented about production of thermally modified wood in India. Dr. Shailendra Kumar talked about work being carried out at FRI Dehradun on Thermo-Hydro Mechanical process used for wood modification. The webinar generated a lot of interest amongst the participants' particularly wood-based industries to take different technologies developed by IWST further to industrial scales. It was emphasized that continuous interaction and collaboration is required between the research institutes and the industries for developing and adopting the indigenous technologies under 'Make in India' initiatives of Government of India.

Celebration of Constitution Day



Institute of Wood Science & Technology (IWST) celebrated the “Constitution Day” on 26th November, 2020 at Dr. B.R. Ambedkar Hall. The celebration started with reading of Preamble of the Constitution. The reading of preamble was followed by key note speech by Dr. V.P. Tewari, Scientist-G (Retd.) and Ex-Director of HFRI, Shimla. After the key note speech, discussion on constitutional values was held and all the officers/Scientists shared their views on the constitution values and all the staff members participated enthusiastically following strict social distancing.

Webinar on Forest Dynamics Plots: tracing the footprints of climate change impacts through vegetation

IWST, Bangalore and ICFRE, Dehra Dun has conducted a webinar on 02.12.2020 on "Forest Dynamics Plots: tracing the footprints of climate change impacts through vegetation". Dr. M.P Singh IFS, Director, inaugurated this event and highlighted the importance of long-term studies, and need for such meetings to strengthen cooperation among the ICFRE institutes, IISc, ATREE, KFRI and IFP for long-term studies on forests; also pointed out the outcome of the meetings will have a better scope on the ongoing all India co-ordinated research project titled "Study of Climate driven effects on Indian forests through long term monitoring", which is supported by MoEF & CC, Govt. of India. Sri Arun Singh Rawat IFS, Director General, ICFRE, in his opening remarks, stressed the significance of long-



term studies on effect of climate variability on forest ecosystem with the historical background of studies from India; and also opined that we all need to know, to what extent our forest are resilient to change in climate. Sri Sanjai

Mohan IFS, PCCF (HoFF) in his remark emphasized the need for such long term studies for understanding the effect of climatic change. He shared his experience based on studies carried out in Karnataka and suggested to look into past studies carried out by different workers and make use of the data. Prof. R. Sukumar, IISc, in his keynote address explained the gathering with the results from Mudumalai 50 ha permanent plot monitored over past 3 decades, and also introduced a complementary research program - long term ecological observation (LTEO). Experts Lt. Dr. E.S.K. Udupa (Sri JCBM College, Sringeri, Karnataka) Dr. H.S. Suresh (CES, IISc, Bengaluru), Dr. R. Ganesan (ATREE, Bengaluru), Dr. Ayyappan (French Institute, Pondicherry),

Dr. K.A. Sreejith (KFRI, Peechi, Thrissur, Kerala) and Dr. K.H. Vinay Kumar (EMPRI) presented their biodiversity monitoring studies, specifically on sampling methods with key results. Dr. T.N. Manohara (IWST, Bengaluru) proposed the plan of establishing two 5 ha plots in the Kudremukh National Park and a series of 3 ha plots in Dandeli-Anshi Tiger Reserve (Kali Tiger Reserve) in Karnataka. Dr. H.S. Suresh (CES) elaborated on plot laying and inventorying protocols for the long-term monitoring of forests. Shri N. Bala, National Programme Coordinator, AICRP-Climate change, FRI, Dehradun gave a concluding remarks with a thanks note to the organizers and participants of the webinar.

Workshop Training for IFS Officers

The health of trees is essentially important as their health is integrally linked with the balance and sustainability of ecosystems. With this preview, the Institute of Wood Science and Technology, Bangalore organized two days training workshop on “Integrated pest and disease management in nurseries, plantations and forests” from December 21-22, 2020 for serving IFS officers and 25 officers attended the training. The training was inaugurated by Dr. M.P. Singh, Director, IWST Bangalore. The topics presented in the first day were “Insects as pests and the potential of natural durability of timbers to manage them” by Dr. R. Sundararaj, Scientist-G, IWST; “Non Pesticidal approaches for the management of insect pests” by Dr. N. Bakthavatsalam, Director, NBAIR, Bangalore; “Emerging pathological problems in forests and their management by Dr. Amit Pandey, Scientist-G, FRI, Dehradun and “Importance of Biofertilizers in Forestry Practices” by Dr. V. Mohan, Scientist-G, IFGTB, Coimbatore. The topics presented in the 2nd day were “Containment of phytoplasma diseases through management of insect vectors and accreditation of seedlings” by Dr. Amit Yadav, Scientist-D, NCCS, Pune; “Urban tree health and role of tree transplantation” by Dr. A. Muthukumar, Scientist-E, IWST; “Challenges and



management of forestry important insect pests in nurseries and plantations” by Sh. R. Raja Rishi, Scientist-D, IWST, and “Good Silvicultural practices for the best health of trees with special reference to sandalwood” by Dr. R. Sundararaj, Scientist-G, IWST. Finally panel discussion was held under the chairmanship of Dr. M.P. Singh, Director, IWST and all the participants were delighted for getting maximum benefits from the training which will help them for suggesting the course of action for maintenance and management of healthy and sustainable forests, thereby achieving ecological and economical productivity.



THE INDIAN ACADEMY OF WOOD SCIENCE

Working Office: Institute of Wood Science & Technology Campus,

P.O. Malleswaram, Bengaluru-560 003 (India)

E-Mail: iaws.india@yahoo.com Website: <http://www.iaws.org.in>

The Indian Academy of Wood Science was founded in 1968 to advance the knowledge of wood science & technology and covers in its activities all the aspects related to wood, cellulose and their products such as logging, saw milling, wood working, plywood, fibre boards, particle boards, improved and composite woods, cellulose and cellulose based sciences and industries and allied fields. The Academy runs a Journal called "Journal of the Indian Academy of Wood Science". In addition to this, it also organises seminars and workshops. During some annual meetings, lectures from eminent scientists are also arranged. The Academy has joined hands with Springer, an internationally reputed publishing house, for bringing out the journal fully online for wider international readership. Authors may submit the manuscript of their research papers online following the Springer publication link <http://www.editorialmanager.com/jiaw>



APPLICATION FOR MEMBERSHIP

To,
The General Secretary
Indian Academy of Wood Science
Institute of Wood Science & Technology Campus
P.O. Malleswaram, Bangalore-560 003 (India)

Sir,
I wish to become a member of the Indian Academy of Wood Science and give below the necessary particulars for enrolling as "Corporate Member/Institutional Member/Individual Member" (as the case may be). Necessary remittance of Rs.* is made by a Demand Draft/Cash, which may please be acknowledged. I agree to abide by the constitution of the academy and agree to the code of ethics contained therein.

Place:

Date:

(Signature of the Applicant)

1. Name of applicant in full (in block capitals)	
2. (a) Date of Birth, (b) Age (in case of individuals only)	
3. Academic and professional qualifications (in case of individuals only)	
4. Present employment/how engaged and brief history of previous career in case of individuals (separate sheet may be attached, if necessary)	
5. Brief description of general activities in case of Corporate, Institutional Members	
6. Address to which communications should be sent including phone, fax & e-mail	

Demand Draft should be drawn in favour of 'Indian Academy of Wood Science' and payable at Bangalore.

Membership Type	Annual Fee	Life Time Fee
Indian:		
Corporate	N. A.	Rs. 100,000
Institutional	Rs. 2,000	N.A.
Individual	Rs. 500	Rs. 5000
Foreign:		
Corporate	N. A.	US \$ 2,500
Institutional	US \$ 50	N.A.
Individual	US \$ 20	US \$ 200

(To be Photocopied for Use)

Need an act to revive agro wood based industry sector

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As the advent of the latest National Forest Policy of India (1988) necessitated the paradigm shift of the then 'forest-based' industries to 'wood-based' industries, supply of raw material was limited as it was either from agroforestry ('AgriWood') or by imports. Dwindling imports due to the price escalations of wood raw materials in the international markets and related import tax issues presented challenges to the sustainability of wood-based industries. Organizing internal supply of wood raw materials was another challenge, as promotion of the production of AgriWood by farmers was necessary, but suffered from the absence of adequate legislation for exclusion of the same from restrictive legal provisions applicable on harvesting and transportation of trees planted on farmlands. All these

issues, emerging from Industries-Institute Meet held at Kolkata in December 2019, Bengaluru in January 2020 and Gandhidham in March 2020, were dealt in detail in the April-June 2020 issue of this publication.

The scope and implications of the 'Farmers (Empowerment and Protection) Agreement on Price Assurance, and Farm Services Act, 2020' and the 'Farmers Produce Trade and Commerce (Promotion and Facilitation) Act, 2020' are also uncertain as far as its benefits to AgriWood are concerned. The July-September 2020 issue of this publication carried an article demonstrating how plywood industries moved away from forest-based timber in 1990s to AgriWood grown on farmers lands by 2010s. But the industry has been almost stagnant for more than a decade. Government of India tried to bring in some changes in the establishment and regulation of these wood-based industries by amending the 'Wood Based Industries (Establishment and Regulation) Guidelines, 2016' in 2017. It is provided in Para 8 of said Guidelines that:

Following industries / processing plants not using round logs of domestic origin or operating without a band saw or re-saw or circular saw of more than thirty-centimeter diameter shall not require license

Industries /processing plants which use:

- a. *sawn timber, cane, bamboo, reed, plywood, veneers or imported wood, procured from legitimate sources*
- b. *block board, MDF or similar wood-based products, procured from legitimate sources*
- c. *round log/timber from species declared as agroforestry/agricultural crops and/or exempted from the purview of the felling and transit regime in the concerned state/UT, and procured from legitimate sources*

However, SLC of the concerned State may allow installation of circular saw of diameter up to 60 centimeter in such industries having specialized requirement. Such industries shall be registered with the Forest Department of the concerned state/UT and shall be regulated, details of which are to be prescribed by the concerned state/UT

Thus, it is clear that there is no requirement of license for establishment of MDF or Particle Boards since they don't use round logs. Residual wood used by these industries is obtained from lops and tops of agroforestry species. Even plywood industries sourcing agroforestry species will not require license for establishment and operation so long as other regulatory framework is in vogue. The conditions of registration and regulation of such industries have been entrusted to the Forest Department of the concerned State/UT to ensure procurement of raw material from legitimate sources. Therefore, it is the responsibility of the State Government to prescribe details of the regulation to ensure legality of raw materials for such industries while registering them for establishment and their operation. These guidelines have not resolved the issue of

establishment of new wood-based industries for more than a decade, resulting in lack of demand for AgriWood as compared to increasing supply from the farmlands.

The recent attempt in the State of Uttar Pradesh to establish new wood-based industries also met with same legal challenge. National Green Tribunal took the stand that wood-based industries can be allowed only after ensuring raw material availability to sustain such industries. This has to be ascertained in actual terms and not on mere assumption. NGT found the estimate given by Govt of UP not scientific. The required level of scrutiny laid down with the objective of conserving existing forests has, due to the precautionary spirit, extended to AgriWood obtained from farmlands, jeopardizing the growth of the wood sector in the country.

As a part of the actions contemplated for reviving the wood-based industries of the country, it is high time to take proactive steps for safeguarding the sector; IWST took certain catalytic actions of suggesting a new enactment, without which further sustenance of the timber and wood panel industries will be in doubt. The WhatsApp platforms organized by the Institute, 'AgriWood Agroforestry' and 'Wood Based Enterprises', paved the way for a virtual follow up of the deliberations to summarize a proposal to the government for new enactment.

Wood-based industries (WBI) consist of housing, construction, packaging, furniture, handicrafts, sports, railways, ship building, mining, bioenergy, pulp and paper, plywood and panel industries, and consume more than 70 million m³ of wood annually for producing wood products. As per the Paris Climate Agreement, India is committed to achieve the NDC targets by creating additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030. Trees outside Forests (ToFs) / agroforestry spearheaded by private people (farmers) in growing plantations of Poplar, Eucalyptus, Acacia, Silver Oak, Casuarina, Rubber Wood, Subabul, etc., has played an important role in catering to more than 90% domestic timber demand. The defined harvesting cycle of various important ToFs provides a great opportunity to lock the sequestered carbon. ToFs / agro-forestry if managed in a climate smart manner have a potential of achieving two-thirds of forestry sector NDC targets. The ToFs / agro-forestry plantations have also played an important role in stabilizing the forest and tree cover of the country by not only adding to area under tree cover but also providing a substitute to the timber harvested from forests and hence, conserving the same for ecological functions.

However, ToF/ agro-wood sector is facing several problems and requires separate mechanism to handle, resolve and facilitate the growth of ToFs / agroforestry sustainably. A new Act, with accompanying Rules and Regulations is required for promotion and facilitation of the ToFs / agroforestry on private / non-forest lands on following grounds:

- ♦ Trees outside the forest (ToF) are defined as all trees located on lands excluded from the definition of 'forest'. Trees outside forests, mainly growing on private land, are the main source of wood in the country for industry as well as domestic fuel wood. Absence of dedicated and focused national policy and a suitable institutional mechanism for ToF/ agroforestry, non-existence of any near- extension and institutional support mechanisms, lack of certified quality planting materials, inadequate research on agroforestry models suitable across various ecological regions of the country, inadequate marketing infrastructure and price discovery mechanisms, lack of

Unlocking Agroforestry in India

Proposal for Promoting and Facilitating Growing Trees on Private/Non-Forest Lands

An act to provide for the creation of an ecosystem where farmers growing trees in their private lands, traders and industries enjoy the freedom from any regulatory regime; to promote availability of certified/accredited quality planting stock; to provide for risk coverage from natural calamities; to promote efficient, transparent and barrier free interstate and intra state trade and commerce of wood grown on private lands, henceforth called AgriWood; to provide and facilitate framework for electronic certificate of origin and ownership; to facilitate remunerative prices through alternative trading channels; to provide for national framework on agreements with AgriWood business firms, wood based industries (plywood and panel, paper and pulp, pencil making, woodcrafts, saw-millers etc.), wholesale depots, exporters or large retailers for farm services and sale future produce at a mutually agreed remunerative price framework in a fair and transparent manner; to provide for unhindered establishment and promotion of AgriWood based enterprises and for matters connected therewith or incidental thereto.

post-harvest processing technologies, etc. are issues demotivating the farming communities from further expansion.

- ♦ Because of lack of appropriate Laws, Acts, Rules and Regulations support, it remains unclear whether to place trees on farms under forestry laws or under agriculture laws, since the cultivation is largely on agricultural land. While, there are many schemes dealing with tree planting/ agroforestry, dedicated and focused laws, acts and rules & regulations along with an institutional mechanism for co-ordination and convergence among the schemes/ ministries to pursue agroforestry in a thematic manner are absent.
- Restrictions are being imposed by the Central and State Governments on harvesting and transportation of ToF produce, especially those species which are found growing in the nearby forests. These restrictions were basically designed to prevent pilferage from government forests. However, the rationale for such restrictions is not

very convincing as the species are grown on private lands and not in forest lands or government owned lands. Obtaining permits for harvesting and transportation is cumbersome, costly and frustrating and hence, discourages farmers from undertaking tree planting on farm lands. Multiple agencies, including the State Revenue Department are involved in issuing these permits. Similarly, tax is imposed at various stages of the processing by multiple agencies. All such restrictions are negatively impacting the cultivation of ToFs, thereby jeopardizing local employment and resulting the domestic wood-based produce is losing grounds to imported materials.

- ♦ In spite of sporadic examples of some states taking steps for liberalization of above restrictions, such as exempting agroforestry species from the harvesting and transit permissions, this has not been uniformly done across the country. The extent of liberalization is also not widely known to many farmers and thus, their problem continues. A more flexible set up to facilitate the ToFs/ agroforestry and liberate them from the control regime under the present Forest policy, Laws, Acts, Rules and Regulations needs to be evolved.
- ♦ AgriWood farmers need empowerment in terms of facilitation for legality (legislation, rules, and rights) and timber marketing for avoiding unwarranted charges; many times, officials themselves are confused over which rules to apply in which situation. Streamlining of legislation and rules in relation to planting and harvesting is required with greater transparency. Ideally, small-scale timber farmers should be represented in national industry associations and local self-government bodies and should have strong linkages with forest industry companies, local and national forestry agencies and government legislature.
- ♦ Many times, advice from agriculture and forest extension staff can be of conflicting nature; agriculture staff may advise lopping trees for fuel wood at shoulder height; while forest staff may advise managing trees for longer stems and greater diameter to yield more logs. This could result in confused farmers and ineffective tree management. On the other hand, innovative farmers are developing silvicultural methods that fit their biophysical and socio-economic conditions. There is a strong need for farmer-to-farmer extension, and capacity building for farmers and extension staff in timber tree selection, management and marketing.
- ♦ As at present, there is no system of credible accreditation of nurseries and certification of quality planting stock,

investment and research in improvement of planting stock is getting discouraged. This leads to loss of opportunity in optimizing the production and productivity, and the farmers are not duly benefitted from the research and development happening in the field. There is need to have legal authorization for autonomous body like Indian Council of Forestry Research and Education (ICFRE) to undertake the responsibility of accreditation and certification of seeds and planting stocks for improved productivity and enhanced benefits to the farm wood growers.

- ♦ Wood coming from the plantation forests as per working plan prescriptions is from legal sources, covered with formal felling permits, transportation permits, conversion control forms etc. Farm wood or agri-wood of certain species may be freed from the compulsion of the transit permits of Forest Departments in some of the states but suffer from the liability of proving that they are from bonafide sources. Therefore, it is essential to authorise for the issuance of ownership certificates at the point of origin. Such system should be IT- based, on the principle of local third-party certification, being supported by competent autonomous R & D body like the ICFRE which has pan-India presence in the form of institutes and centres throughout the country. These certificates shall brand this timber in a different category from the forest timber, say, as 'AgriWood-India', so that it is accepted worldwide (Vocal for Local) for legality of sources and chain of custody.
- ♦ Schemes on insurance from natural calamities and diseases and funding support for tree growing facilitate tree growers in taking up tree cultivation and should be instituted
- ♦ Potential of growing trees can be realized by enabling small farmers to grow trees, harvest them scientifically, convert them efficiently and market them profitably. Enabling provision of small-scale machinery and equipment such as power saw and tractor-mounted saw bench should help the farmers to undertake on-farm conversion which usually enables them to capture higher profit margins and may provide additional local employment opportunities, and generates residues that can be used locally. Farmers may convert standing trees into sawn wood, season, treat and store them as per requirement or peel them as veneers themselves as per market demands. This will lead to cascading effect on cottage industries. Trees on the farms should be a form of living bank account for the owners.

Potential of growing trees can be realized by enabling small farmers to grow trees, harvest them scientifically, convert them efficiently and market them profitably.

- ♦ The tree species grown by farmers are not necessarily those sought by timber market. When farmers seek to plant non-local species, they have little control over the species made available to them. Scientists and extension agents may make this decision through reviews of literature and screening trials to meet the requirements of local biophysical conditions, often without considering markets or local uses. There is widespread mismatch between the demand and supply of Agriwood at local and regional level markets and linkages between different stakeholders or partners may be lacking many times. This linkage can be much easily and speedily established through electronic trading and transaction platforms by authorization for free inter-state or intra-state trade and commerce in a trade area following the chain of custody regime electronically. Trade area can be identified and demarcated by 'Wood Councils' established at district, state and national level on the principles of less transportation cost with better price to local wood-based industries (WBIs) on market chain analysis. Farmer Producer Organizations or companies shall be encouraged to represent in the Wood Councils the interests of tree growers.

It is necessary to provide a national framework on

agreement for farmers with wood-based enterprises for on-farm services for the production of wood and related issues such as sale of future produce at mutually agreed remunerative price framework in a fair and transparent manner.

- ♦ An authorization is necessary to competent autonomous R & D body such as the ICFRE or BIS to certify grading and marking of farm wood products as 'AgriWood products' which contributes to carbon fixation, additional income to small farmers and livelihood safeguard options to other marginalised indigenous people at local level on the lines of 'Agmark' for agricultural and other produce.

Farmers get distressed due to the lack of demand of their wood in the absence of market dynamics in this sector. Wood Council at the state level shall be the authorized advisory body for taking decisions on the establishment of wood-based industries such as sawmills, treatment plants, seasoning plants, peeling plants, plywood and panel plants, so as to provide impetus to farm wood production and utilization in the country so that farmers get encouragement in growing trees on their private lands.

Growing Trees Outside Forests (Promotion and Facilitation) Act (Draft to unlock the potential of Trees outside Forests or Agroforestry in India)

An Act to promote and facilitate growing of trees outside forests (henceforth, "farm wood"); to promote availability of certified/accredited quality planting stock; to provide a framework for electronic Certificate of Origin and Ownership and establish a standard for legality of farm wood; to promote efficient, transparent, and barrier-free inter-state and intra-state trade and commerce of farm wood; to establish a national framework on agreements for farm wood; to facilitate establishment and promotion of farm wood-based enterprises and matters connected therewith or incidental thereto.

WHEREAS increasing tree cover is an effective mechanism to fight the climate change crisis arising out of increased greenhouse gases in the atmosphere;

AND WHEREAS the agricultural lands in India provide an opportunity to supply wood along with food, while simultaneously meeting the objective of creating carbon sinks, which is also in line with India's commitment to the Paris Climate Agreement;

AND WHEREAS forests in India, although seemingly adequate in area, are primarily committed to demands such as fuel, fodder and timber for indigenous people, and are required to be maintained and improved for various ecosystem services and conservation of biological

diversity, hence limiting the production of wood;

AND WHEREAS growing of trees on private lands outside forests has played an important role in catering to domestic timber demand in India and stabilizing the forest and tree cover of the country, by not only adding to area under tree cover but also providing a substitute to the timber harvested from forests and hence, conserving the forests for ecological functions;

AND, it is necessary to transcend the boundaries of the forests in order to meet India's wood requirements from within the country (Atmanirbharta), to reduce pressure on the forests, and consequently, to increase carbon sequestration by various landscapes to fight global warming;

AND, it is necessary to have a standard for the legality and chain of custody of farm wood that is accepted worldwide (Vocal for Local);

NOW, THEREFORE, it is expedient to enact a legal framework for hassle-free transportation, marketing and utilization of wood grown on non-forest lands in order to promote the growing of trees outside forests and double the income of farmers.

BE it enacted by Parliament in the _____ Year of the Republic of India as follows:—

CHAPTER 1 PRELIMINARY

1. Short title, extent and commencement -

- (1) This Act may be called the Growing Trees Outside Forests (Promotion and Facilitation) Act, 2021.
- (2) It extends to the whole of India.
- (3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint.

2. Definitions — In this Act, unless the context otherwise requires -

- (i) “Agwood-India” means the standard developed for timber legality assessment and verification of legality and legal origin of farm wood and farm wood products in India.
- (ii) “Trees outside forests” mean trees located on all lands excluded from the definition of forests as per prevalent laws and their interpretation, subject to the limitation of their applicability to private property. They include:
 - (a) Trees on farmlands and built-up areas, both in rural and urban areas;
 - (b) Planted or domesticated trees on private lands;
 - (c) Trees growing in meadows, pastoral areas and on farms, or in towns, gardens and parks; and
 - (d) Trees growing on lands using alley cropping and shifting cultivation, permanent tree cover crops (e.g. coffee, cocoa), windbreaks, hedgerows, home gardens and fruit-tree plantations.
- (iii) “Farm wood” includes timber, small timber, fuelwood and all other parts of trees outside forests when they have fallen or have been felled, and all wood, whether cut up or fashioned or hollowed out for any purpose or not; and this farm wood and its products:
 - (a) Shall not be understood as 'Forest Produce' or 'Specified Forest Produce' within the meaning of the provisions of the Indian Forest Act, 1927 or any other State or Central Acts; (16 of 1927)
 - (b) May be understood as 'Farmers' Produce' within the meaning of the provisions of the Farmers Produce Trade and Commerce (Promotion and Facilitation) Act 2020; (21 of 2020)
 - (c) May be understood as 'Farm Produce' within the meaning of the provisions of the Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020; (20 of 2020)
 - (d) Shall be understood as 'Scheduled Farmers' Produce' under any State APMC Act or Regulation;
 - (e) Shall not be understood as 'Biological Resources' within the meaning of the provisions of the Biological Diversity Act, 2002. (18 of 2003)
- (iv) “Imported wood” means all wood and wood products imported from other countries.
- (v) “Tree growers” mean individuals or organizations engaged in the production of farm wood by themselves or by hired labour or otherwise, and includes farmers, Farmer Producer Organisations, Forest Protection Committees, wood-based industries, companies, partnership firms, limited liability partnerships, co-operative societies, societies, and any associations or body of persons duly incorporated or recognized as a group under any ongoing programmes, schemes or resolutions of the Central Government or the State Government.
- (vi) “Trader or agent” means a person who buys farm wood or imported wood by way of inter-state or intra-state trade or a combination thereof, either for self or on behalf of one or more persons for the purpose of wholesale trade, retail, end-use, value addition, processing, manufacturing, export, consumption or for such other purpose.
- (vii) “Inter-state trade” means the act of buying or selling of farm wood, wherein a trader or agent of one state buys farm wood from tree growers or a trader of another state and such farm wood is transported to a State other than the State in which the trader purchased such farm wood or where such farm wood originated.
- (viii) “Intra-state trade” means the act of buying or selling of farm wood, wherein a trader of one State buys the farm wood from a tree grower or a trader of the same State in which the trader purchased such farm wood or where such farm wood originated.
- (ix) “Electronic trading and transaction platform” means a platform set up to facilitate direct and online buying and selling for conduct of trade and commerce of farm wood through a network of electronic devices and internet applications, where each such transaction results in physical delivery of farm wood.
- (x) “State” means State or Union Territory (UT).
- (xi) “State Agriculture Produce Market Committee Act” or “State APMC Act” means any State legislation in force in India, by whatever name called, which regulates markets for agricultural produce in that State.
- (xii) “Trade area” means an area designated for supply of

farm wood.

- (xiii) “Farming agreement” means a written agreement between the tree grower and sponsor, such as:
 - (a) Trade and commerce agreement', where the ownership of farm wood remains with the tree grower during production and he gets the price of produce on its delivery as per the agreed terms with the sponsor;
 - (b) Production agreement', where the sponsor agrees to provide farm services, either fully or partially, and to bear the risk of output; and
 - (c) Any other such agreements or a combination of the agreements specified above.
- (xiv) “Sponsor” means a person, trader or agent who has entered into a farming agreement with the tree grower for growing trees.

- (xv) “Local bodies” means Panchayats and Municipalities, by whatever name called, within the meaning of Article 243B (1) and Article 243Q (1) of the Constitution of India, and, in the absence of any Panchayat or Municipality, institutions of self-government constituted under any other provision of the Constitution of India or any Central or State act, and in their absence, the Biodiversity Management Committee under Biodiversity Diversity Act 2002.
- (xvi) “Wood-based industries” include housing, construction, packaging, furniture, handicrafts, sports, railways, ship building, mining, bioenergy, pulp and paper, plywood and panel industries, and such other industries. (18 of 2003)

CHAPTER 2 GENERAL

3. Power to make rules with regard to planting stock — The Central Government shall have the power to make rules to do the following:

- (i) Regulate the release new clones or cultivars;
- (ii) Authenticate wood productivity claims by commercial entities;
- (iii) Prescribe a system of credible accreditation of nurseries and certification of seeds and quality planting stock; and
- (iv) Authorise any autonomous body or Central or State Government body to undertake the responsibility of accreditation and certification.

4. Power to make rules regarding the legality of farm wood — The Central Government shall make rules to:

- (i) establish an Information Technology-based system for issuance of Certificate of Origin and Ownership (“COO”) to all tree growers, which may be used for all purposes of trading and transaction of farm wood, insurance and collateral guarantee for banking support including future trading;
- (ii) to authorise local bodies to be second-party certifiers for the issuance of COO to the first party (tree growers);
- (iii) to authorise a body such as Indian Council of Forestry Research and Education (“ICFRE”), an autonomous body of Ministry of Ministry of Environment, Forests and Climate Change, to be the third-party certifier owning the Agwood-India standard;
- (iv) to authorize the above-mentioned body to mark and grade farm wood according to the Agwood-India standard;

- (v) to prescribe a system in India for electronic registration of a trader or agent, and of the modalities of chain of custody along production, harvesting, transport, trading and consumption, in order to corroborate the legality and chain of custody of farm wood with minimal cost to tree growers and sponsors;
- (vi) to prescribe rules for establishment and redesignation of AgWood-based industries and enterprises so as to promote demand for such farm wood and help farmers double their income;
- (vii) to establish a national registry of trees outside forests in order to build up inventory, validate and verify the coverage under trees outside forests.

5. Application of the Farmers Produce Trade and Commerce (Promotion and Facilitation) Act 2020 — Subject to the provisions of this Act, any tree grower, trader, or electronic trading and transaction platform shall have the freedom to carry on inter-state or intra-state trade and commerce in farm wood in a trade area as per the provisions of the Farmers Produce Trade and Commerce (Promotion and Facilitation) Act 2020 with regard to 'Farmers' Produce' under Section 2 of the said Act.

6. Power to make rules for national framework on farming agreements — The Central Government shall prescribe rules or guidelines for a national framework on farming agreements between tree growers (farmers) and sponsors for growing trees that protects and empowers tree growers to engage with sponsors at a mutually agreed remunerative price framework in a fair and transparent manner, and for matters connected therewith or incidental thereto.

CHAPTER 3 OF WOOD COUNCILS

7. Constitution of Wood Council of India -

- (1) The Central Government shall prescribe for the constitution of the Wood Council of India to provide for improved linkages between tree growers, traders or agents, wood-based industries or enterprises, research institutes and related government representatives.
- (2) The Wood Council of India shall be under the Chairmanship of Minister-in-charge, Ministry of Environment, Forests and Climate Change.
- (3) The Secretariat of the Wood Council of India shall function at the Institute of Wood Science and Technology, Bengaluru, an institute under ICFRE.

8. Constitution of Wood Council at the State level and the regional level -

- (1) Wood Councils shall be constituted at the State level as well as the regional or district level by resolutions of respective State Government. The State-level Wood Council shall be under the Chairmanship of the Chief Minister of the respective State.
- (2) The State and regional or district-level Wood Councils shall function under the overall guidance of the Wood Council of India, and the decisions of the Wood Council of India shall be binding on them.
- (3) The regional or district-level Wood Councils shall function under the overall guidance of their respective State-level Wood Councils, and the decisions of their respective State-level Wood Councils shall be binding on them.

9. Functions of State-level and regional-level Wood Councils — The State-level and regional-level Wood Councils:

- (1) Shall facilitate vertical integration of the above-mentioned linkages between all stakeholders;
- (2) Shall ensure less transportation cost and fix minimum and maximum price of local farm wood in trade areas based on market chain analysis;
- (3) Shall remove the widespread mismatch between demand and supply of farm wood at the State and the regional level;
- (4) May have their own electronic trading and transaction platform for intra-state trade and commerce in a trade area following the chain of custody regime electronically.

10. Functions and powers of State-level Wood Councils -

- (1) The State-level Wood Council shall be the final authority on the establishment of farm wood-based industries to maintain sustainable demand of such wood in the State.
- (2) The State-level Wood Council shall be the final authority on demarcation and designation of trade area for trader, agent and sponsor so as to encourage tree growers (farmers) to grow trees on their lands.
- (3) The State-level Wood Council shall be empowered to provide for upgradation and deployment of tools and techniques for on-site harvesting, conversion, peeling, veneering, impregnation, modification, seasoning, storage and other such value additions to farm wood, notwithstanding any other provisions in any other Acts.

CHAPTER 4 PENALTIES AND JURISDICTION

11. Power to levy fine - Whoever contravenes the provisions of this Act or the rules made thereunder shall be liable to pay a fine levied by the regional-level or State-level Wood Council or the Wood Council of India, which shall be not be less than twenty five thousand rupees but which may extend up to twenty five lakh rupees, and where contravention is a continuing one, further penalty not exceeding five thousand rupees for each day after the first day during which the contravention continues.

12. Appeals - (1) Appeal against the decision of regional or district level Wood Council shall lie only to State-level Wood Council.

(2) Appeal against the decision of Wood Council of India or the State-level Wood Council shall only lie to National Green Tribunal constituted under National Green Tribunal Act 2010.

13. Bar of jurisdiction of civil court — No civil court shall have jurisdiction to entertain any suit or proceedings in respect of any matter, the cognizance of which can be taken and disposed of by any authority empowered by or under this Act or the rules made thereunder.

CHAPTER 5 MISCELLANEOUS

14. Power of Central Government to give directions — The Central Government may, for carrying out the provisions of this Act, give such instructions, directions, orders or issue guidelines as it may deem necessary to any authority or officer subordinate to the Central Government, any State Government or any authority or officer subordinate to a State Government, and traders and sponsors.

15. Indemnity for acts done in good faith — No suit, prosecution or other legal proceedings shall lie against the Central Government or the State

Government, or any officer of the Central Government or the State Government or any other person in respect of anything which is, in good faith, done or intended to be done under this Act or of any rules or orders made thereunder.

16. Act to override other laws — Save as otherwise provided in this Act, the provisions of this Act shall have effect, notwithstanding anything inconsistent therewith contained in any State Act or any other law for time being in force or any custom or usage or any instrument having effect by virtue of any law.

Plywood and panel industry in India: current scenario and key issues

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Industry background

The history of plywood industry in India is old. It is more than 100 years that this industry was started here on a very modest scale. It was in the year 1906-07 that plywood was imported in India for the first time-valued at Rs.32 lacs. Imports rose steadily and by 1924-25 it was worth Rs.90 lacs. Tea Industry in Assam, West Bengal and Kerala was steadily developing and it was thought that plywood industry in the form of Tea Chests production mainly for export should be developed. Accordingly, two plywood factories were started in Assam in 1923-24 but their development was slow and steady and not phenomenal. These were the pioneers and the resourcefulness and courage shown by them in the early stages of growth of Plywood Industry was remarkable and the industry owes gratitude to these courageous entrepreneurs.

With the outbreak of Second World War, necessity of manufacturing tea chests locally was very much felt and Plywood Industry in form of Tea Chests Industry started on a large scale. It will not be exaggerated that Plywood Industry in India is a gift of Second World War. Now that tea chests must be produced, Forest Departments in different States started thinking in terms of finding suitable timber for manufacturing tea chests. Experiments were made at Forest Research Institute; Dehra Dun and it was found that plywood made from Indian timbers were as good as imported products and therefore advised forest entrepreneurs to set up modern factories in different States. Accordingly, well equipped factories were started in different places viz. Sitapur, Bangalore, Baliapatam, Dandeli and Coochbehar.

Some of these factories suffered setbacks in the post war years, as after cessation of war the vested interests tried to sabotage this industry by trying to restart imports of tea chest. Tariff Board enquiry was held and the Government imposed a lien on the importers to purchase Indian products equivalent to the quantity allowed to be imported. Slowly and slowly, the Government imposed total ban on imports and this thoughtful action of the Government encouraged the Indian entrepreneurs to modernize their plants and invest substantial capital in this industry.

After 1947-48, the industry resorted to diversification of its products and block boards, flush doors, commercial plywood, decorative plywood, marine and aircraft plywoods, produced in Indian factories came into the market which were second to none in the world in quality and diversity of its products.

The industry came under Industrial Licensing, which is governed by Industries (Development and Regulation) Act, 1951, which mandated that the applicant was required to obtain an Industrial License which was being considered by Ministry of Industry after consulting various Ministries including

Ministry of Environment & Forests. Forest Ministry was being consulted for ascertaining sustainable raw material of Timber for a particular project; the Wood based Industry was more or less in Medium and Large scale. Until 1996 most of the plywood was produced in NE India in the states of Assam, Arunachal Pradesh and Nagaland. Since the banning of forestry activities in NE by Hon'ble Supreme Court of India in the year 1996, the plywood plants were set-up in Yamunanagar as a hub to start with, but very soon thereafter the plywood industries came up throughout India in varied proportions due to availability of abundant plantation timber. The industry is now producing more plywood than it has produced during the last 60 years. The most popular forest wood used in India for making plywood was Gurjan wood. The medium hardwood obtained from these trees was of good quality and was engineered to produce the plywood sheets by Indian Plywood industries. The Indian wood based industries especially plywood & decorative veneer units are highly dependent upon plantation wood for core veneers and filler and on imported good quality wood to meet their raw material requirement of face veneer / decorative veneer, which is only 5% of the total consumption of wood for plywood manufacturing. Due to the ban on cutting and felling of trees in the forests and considering the national forest policy to conserve the country's forests, it has now become essential to import timber logs / face veneer for meeting the wood requirements for India's wood based panel industry in addition to the indigenous plantation timber.

With rapidly developing economy and Government's plan to establish smart cities, besides constructing 50 Million houses for poor people in



coming five years, production and consumption of plywood is increasing rapidly. On the basis of end-use the market is segmented as commercial and residential. The residential sector is the largest consumer for plywood in the country, accounting for more than 60% of the market. Although in last decade, production and consumption of other alternative / substitute panel products like Medium Density Fibre Boards (MDF) and Particle Boards (PB), has also been growing rapidly, Plywood has retained its dominance and constitutes almost 80 to 85% of share in all panel products. These panel products are for mass consumption, used extensively in housing and furniture manufacturing, mostly catering to the lower- and middle-income segment of the society. Wood Panel Industry can play a major role in furnishings affordable houses and therefore it is all the more necessary that its cost of production remains low and wherever possible, brought down, to make the products more affordable to common man.

With the change in availability of agro-forestry wood scenario in the country now a day, plywood and other panel products manufacturers started to use plantation / agro-forestry wood, such as Poplar & Eucalyptus in northern India and Rubber wood & Silver oak in southern India. The industry provides direct employment to more than one Million people and almost equal number of people are employed indirectly, mainly in rural India.

Agro-forestry and farm forestry have taken deep roots in the country. These Trees outside Forests (ToF) are contributing to the increase in country's forest cover and are enhancing ecosystem, besides meeting bulk of the country's demand for wood. Most importantly, agro-forestry is providing a steady and climate resilient income to the farmers. Thus, promoting use of wood obtained from sustainably managed agro-forestry would play a significant role in mitigating climate change and ensuring sustainable living.

It is worth pointing out here that, realizing the importance of agro-forestry, many states like Punjab, Haryana, Karnataka, Tamil Nadu, Andhra Pradesh, Gujarat, Uttar Pradesh and others have already initiated massive plantation program.

Production & consumption pattern of industrial wood

The Forest Survey of India, had in 2017, estimated annual production of Timber from Agro-Forestry (Tree Outside Forests) at 74.5 Million cbm. Besides this, the annual availability of

Timber from Government Forests was estimated at 2.4 to 3 Million cbm, and another 6-7 Million cbm Timber was estimated as being imported annually. Thus, from the total availability of Timber of about 83.5 Million cbm, only 3 Million cbm - less than 4% is out of the Government Forests. Agro-Forestry constitutes major source (nearly 90%) of timber required for industrial purposes – Saw Mills, Ply & Veneer Mills and Paper Mills.

While timber availability from Agro-Forestry is estimated at 74.5 Million cbm, as per Indian Council of Forestry Research and Education (ICFRE-2012 report) the requirement of Timber for all industrial purposes has

1.	Saw Mills	29 Million cbm
2.	Ply & Veneer Mills	19 Million cbm
3.	Paper Mill	9 Million cbm
4.	MDF and PB	5 Million cbm
	Total	62 Million cbm

been estimated at only 62 Million cbm, the break-up of which is as under:

In view of the above facts and figures, it is quite evident that Timber produced from Agro-Forestry itself is more than estimated requirement for industrial purposes. Therefore, the need of the hour is to set up more and more such Agro-Forestry based industries. Product wise distribution of industrial wood consumption is shown below.

Plywood and panel industry

Indian Plywood & Panel Industry, as on date, consists of around 3,300 units (small, medium and large units), supporting directly around 1 million livelihoods. Out of these 3,300 units, nearly 3,200 units are in the un-organized sector. Plywood is the most significant product in terms of the overall demand for wood panels and the market size for Indian plywood industry is approx. INR 25,000 crore. In the last five years, the segment witnessed a CAGR of 6-7%. The Indian plywood industry is highly fragmented with ~80% of the market share controlled by the unorganised sector, while the residual 20% is with the organised segment. Moreover, among the few organised players; Century Plyboards India Ltd. and Greenply Industries Ltd. are the two pan India companies which dominate the organised market share of nearly 50% (25% each).



MDF industry

Presently, industry's installed capacity is estimated at 1.4 million cubic meter while another 0.35 million cubic meter is imported annually. Currently country's production is 1.15 million cubic meter which is 80% of total installed capacity. Indian MDF industry has a market size of nearly 1,800 crores. In the past five years,

the industry grew at a CAGR of 20%. Century, Action and Green Panel dominate the local MDF market. Presently, roughly 30% of the MDF is imported but it is expected that the share of imports will decline to 15% by FY21, as Indian companies ramp up the MDF capacity. There are more companies which are already in the developmental stage and in the pipeline.



Particle board

There are about 30 particle board units in the country. Except few, most of them are in un-organised sector. Plantation timber lops and tops, wood wastes and agro residue are the basic raw material used by this sector. Very few units manufacture the products as per BIS quality norms. The industry produces nearly 1 million cubic meter of boards in different thicknesses. To meet the gap between demand and supply India imports nearly 0.16 million cubic meter of particle board.

Plywood & panel production for last 3 years

Product Quantity	(Million cbm)		
	2017	2018	2019
Plywood	8.93	9.50	10
Particle Board, OSB and similar boards	1.07	1.14	1.2
Fibre Board-HDF / MDF	0.89	0.95	1.0

Import - export gap

Sl. No.	Description	Year	Import (Crores)	Export (Crores)	import-export gap (Crores)
1	Plywood, Veneered Panels and Similar Laminated Wood	2016 -2017	516.09	184.71	331.4
		2017 -2018	718.08	213.02	505.1
		2018 -2019	825.25	226.04	599.2
2	Particle Board and Similar board of Wood other Lignocellulosic Materials W/N Aglomrtd with Resin or other Organic Bindg Substs	2016 -2017	222.50	23.64	198.9
		2017 -2018	208.15	28.75	179.4
		2018 -2019	280.19	46.82	233.4
3	Fibre Board of Wood or other Lignocellulosic Materials W/N Bonded with Resin/other Organic Subtracts	2016 -2017	561.02	100.78	460.2
		2017 -2018	778.53	117.80	660.7
		2018 -2019	793.15	157.64	635.5
4	Other Furniture and Parts Thereof	2016 -2017	3,607.91	3,865.18	257.3
		2017 -2018	4,104.04	4,424.05	320.0
		2018 -2019	4,225.03	5,647.03	1422.0
5	Wood Sawn or Chipped Lengthwise, Sliced or Peeled, Whether or Not Planed, Sanded or End jointed, of a Thickness Exceeding	2016 -2017	1,805.55	119.42	1686.1
		2017 -2018	2,615.18	50.42	2564.8
		2018 -2019	3,092.05	33.47	3058.6
6	Wood in the Rough, Whether or Not Stripped of Bark or Sapwood, or Roughly Squared	2016 -2017	7,801.00	300.59	7500.4
		2017 -2018	8,314.77	275.05	8039.7
		2018 -2019	7,631.48	630.14	7001.3
Grand Total (1+2+3+4+5+6)		2016-2019	48099.9	16444.6	31655.4

Source : DGCIS - Kolkata

It can be seen that the share of Imports in Total Turnover is still quite high, more so in PB and MDF. This is because imported panel products are available at a cheaper rate than locally manufactured PB and MDF. With increasing thrust on agro-forestry, wood availability for manufacturing these products will increase and more units for manufacturing panel products can easily come up in the country. If encouraged properly, the demand and production of panel products will increase at a much faster pace, which in turn will increase the demand for agro-forestry wood. The entire chain – farmers involved in agro-forestry, workers employed in mfg. units, common man – who is the main consumer – housing & furniture products, and the governments who can earn higher revenues on increased production, save foreign exchange due to reduction in imports, earn foreign exchange due to increase in exports. Everyone single person / entity in the chain will be benefited.

Key Issues

- The industry needs to be supported in a big way, not only by promoting Agro-Forestry to ensure availability of its wood requirements on a sustainable basis, but also by relaxing / liberalizing the Licensing/Permits requirements for transportation and processing of Agro-Forestry Timber. It is therefore suggested that Govt. should address the following key policy issue for the further development and future growth of this sector.
- Remove the licensing of Wood based industries solely dependent on plantation wood like Eucalyptus/ Poplar/ Silver Oak/ Rubber wood/ Melia dubia etc. and on imported wood from outside India. Most of such industries are in the nature of cottage and small industries. These convert the Plantation wood to raw-materials for Plywood industry. The bureaucratic mind-set that the licensing helps check the illegal wood flow from natural and reserved forests is totally absurd and illogical. Plantation wood is less than half the price of any natural forest structural wood and totally non-competitive in the changed scenario of Wood based industry. Removal of licensing will result in more and more Veneer mills at the plantation sites and help improve the farmers income, which is reduced significantly because of transportation and other logistics cost. The limited demand results in low pricing for the wood given the fact that there is a big gap in demand and supply of wood and this imbalance is on the rise.
- Arbitrary Phytosanitary requirement on Timber import should be rationalised. Several representations are pending without any outcome. There is a Schedule-III in P&Q Order 2003 which deals with prohibited timber.

There are two schedules VI and VII permitting import under specified conditions. The sacrosanct condition is Methyl Bromide fumigation (MB) before export. Most Countries have banned it. There is a 5 times penalty on those who import timber with other fumigants approved in the country of export besides re-fumigation in India. Request is to allow any and all wood which is not on Schedule III by condition of MB fumigation in India without any penalty. Many good quantity species and competitively priced wood cannot be imported because of harsh conditions in P&Q Order 2003.

- Setting aside part of the forest area for commercial high value (species) forestry besides giving tax incentives for capital investment in farm forestry.
- Bringing direct and indirect taxes to zero. Declaring agro-forestry produce as Agro-based produce which enjoy all the tax benefits that is derived by agricultural produces.
- Rationalisation of felling and transit permit regime.

Conclusions

Establishment of plywood and panel industries is the vehicle for the sustainable development of Agro-forestry timber in the country on one hand and creating employment opportunity in the rural India on the other hand besides increasing green/tree cover in the country. Most of these agro- forestry species grown by the farmers are generally harvested at shorter rotation as such it helps in more carbon sequestration. These Agro-Forestry plantations not only increased the Forest / Green Cover, but in a short time also significantly increase the availability of timber for mfg. of Plywood, MDF, PB and other wood based products.

1. To sustain this Agro-Forestry drive, the Government has to make sure that enough processing facilities are set up in the country, so that the increased supply of such short duration timber, is absorbed, and the farmers continue to get remunerative prices for their Agro-Forestry timber.
2. In 2009, China was producing 59 Million CBM of Plywood, which now in 2018 has crossed 195 Million CBM – an increase of 229 %. Similarly, China's production of PB in 2009 was 14 Million CBM, which in 2018 has crossed 33 Million CBM – an increase of 134%. And China's production of MDF which was 33 Million CBM in 2009, has now touched to 50 Million in 2018 – an increase of 50%.
3. From a Net Importer, China has now become the Largest Exporter of these products.

4. Today China boasts of 75% of World's Plywood production, 43% of World's MDF Production and 27% of World's PB Production.
5. As against that, India produces a meagre 4% of World's Plywood. And its share in the production of PB and MDF are not even worth mentioning – less than 1% of World's production. It may be argued that the land mass of China is almost 3 times more than India and so China will have more area for such plantations. However, if you see the topography of China, almost 60 - 65% of its land mass is snow bound and / or non-cultivable, leaving hardly any difference in the area available for cultivation in China and India. And when we also factor in the figures of population of China and India, this negligible difference also vanishes.
6. India, can very well adopt few progressive policies of China, which will soon make India, as the second largest mfg. hub of Agro-Forestry based wood products in the world.
7. Just to cite an example of UP state where a large number of farmers have already adopted Agro-Forestry Plantation, which is supplementing their income from agriculture to a great extent. The SLC approved granting of Provisional Licenses to number of applicants. However, on a petition of some NGO(s), NGT had first vide its order dated 10th August, 2019, directed UP State Govt. to review its decision of granting Provisional Licences, and later on vide another order dated 1st October, 2019, directed State Government to maintain "Status Quo" in this matter and finally cancelled all the licenses.
8. However, in absence of adequate Agro-Forestry Timber processing facilities in their vicinity / region, farmers have to cart away a large quantity of their produce to the neighbouring states – Uttarakhand, Haryana and even Punjab, where adequate processing facilities have already come up, and further more are coming up. Close look at the number of trucks carrying Agro- Forestry timber out of UP on a daily basis, will easily substantiate this.
9. Since the farmers themselves are not in a position to cart their produce to these faraway places, they are forced to sell it to some middlemen and have to be content with whatever price the middlemen offer to them, which is generally much lower than what the processing industry actually pays.
10. The need of the hour is, that more and more of Agro-Forestry Timber based industries / processing plants come up within the state, and possibly in close vicinity of such plantations.
11. This will in turn ...
 - a. Encourage the farmers to go in for more Agro-Forestry Plantations.
 - b. Increase Forest / Green Cover in the State and thereby in the Country.
 - c. Increase / Supplement and provide Stability in Farm Income.
 - d. Reduce dependence on Govt. for sale of traditional/cash crops (which is already being produced in excess of requirements).
 - e. Provide Employment in Rural areas.
 - f. Reduce migration of people to urban areas, both within the state as well as outside states, thereby reducing burden / pressure on the infrastructure of urban areas.
 - g. Augment State Revenues - instead of exporting timber or semi-finished products from the state, the state will produce and export Finished / Value Added Products, fetching higher revenues.
 - h. Abundant availability of Plywood, MDF and PB within the state, will pave the way for development of organized Furniture Mfg. Units in the state, which would further enhance revenues and employment opportunities in the state.
12. For the benefit of the plywood and panel industry MOEF&CC has recently issued guidelines, i.e. "Industries / Processing plants which use "round log / timber from species declared as agro-forestry / agricultural crop and / or exempted from the purview of the felling and transit regime in the concerned state / UT, and procurement from legitimate sources" do not require License." However, for establishing the agro-plantation based industry, they require only registration with forest department as mandated by MOEF.
13. RESPECTING THE "INTENT" OF THE GUIDELINES ISSUED BY THE MOEF&CC, IT IS SUGGESTED THAT THE LICENSING REQUIREMENTS FOR ALL INDUSTRIES / PROCESSING PLANTS (MDF, PB, PLYWOOD, VENEER AND SAW MILLS), USING AGRO-FORESTRY/ AGRICULTURAL CROP, BE DISPENSED WITH BY ALL THE STATES AND UNION TERRITORIES IN INDIA.
14. IN THE MEANTIME, GOVERNMENT OF INDIA SHOULD ENACT A SUITABLE ACT TO PROMOTE AND FACILITATE SUCH INDUSTRIES BASED ON SUPPLY OF TIMBER FROM AGROFORESTRY.



INDIAN PLYWOOD INDUSTRIES RESEARCH & TRAINING INSTITUTE (IPIRTI)

(Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India)

Headquarters in Bangalore with two centres in Kolkata and Mohali. IPIRTI is dedicated to Research & Development, Training, Testing and Extension activities in the field of composites based on wood, bamboo, agrowastes and other renewable natural fibres.

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- Technology transfer of eco-friendly products
- Panel Industry related problems

TESTING

- NABL accredited mechanical and chemical laboratories
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- Modern testing facility for fire resistance doors
- Synthetic resin adhesives used in panels
- Raw material analysis of chemicals used in resins
- Identification/classification of timbers/binders used in panels
- Retention of preservative chemicals in treated wood/plywood
- Fungal/borer/termite resistance of wood/wood-based products
- Specialized testing such as thermal conductivity, acoustic properties, weathering studies, emission of formaldehyde in panels etc.



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Furniture industry in India: view of industry federation

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Introduction

Furniture is one of the most important components of any household. Furniture makes a person's space more suitable and comfortable for living and working. The concept of furniture developed as early as 3100-2500 B.C. Dressers, cupboards and beds were among the first forms of furniture. Over the years, the concept of functional furniture in household has exploded while keeping the artwork aspect displayed in the olden times. This has made way for furniture in our culture that is both functional in our everyday lives but also a form of artwork that are pleasant to look at.

The basic design of most furniture has remained the same for most part though material and stability has become stronger and longer lasting with more focus on comfort and luxury in our modern lives. Chairs have become designed as more than just a place to sit, but as a place to relax with items such as recliners and rocking features. The design change in furniture, in a way, shows the evolution of our society from mere survival to live of luxury and privilege.

The furniture industry is increasing by leaps and bounds worldwide and sustainability has become one of the most important features of the furniture industry. Wooden furniture has been

growing in demand because of its luxurious appearance, longevity and sustainability, as wood locks carbon. India imports Rs. 2.5 lakhs crore worth furniture from abroad; even though China is the dominant exporter; due to national interests, import from China is getting discouraged. On the Atmanirbhar call by our Honorable Prime Minister, even though some webinars on wooden furniture were organized by DPIIT and FICCI, attention was distracted on large-scale investors like IKEA only.

The Covid pandemic has slowed down the growth of furniture industry and needs proper examination of the present and future scenario, the problems need to be identified and unique solution should be devised to promote the growth of wooden furniture.

Current Situation of the Furniture Industry

The demand of the furniture could be classified into residential furniture, commercial furniture, hotel and other furniture. In India, the furniture manufacturing for residential purposes is done by the local carpenters with available tool and locally available timber is used. Whereas for commercial use, mostly artificial wood is used or pre-fabricated and imported wood panels are used and similar situation is with the hotel furniture. The furniture for schools and government establishments is mostly made from metals and very small extent is made of wood. The demand for

artistic wooden furniture is low because of cost factor, as non-availability of skilled craftsmen/carpentry workers causing price escalation of the products. Since the cost factor is one of the major considerations in the market, the imported furniture is filling the market demand as the imported furniture is artistic and considerably cheaper than local furniture.

Availability of Raw Material

The major commercial timbers are getting scarce and costly. The technology used to make secondary timbers durable and usable is yet to be widely made use of in the local furniture sector. The timber availability from forests and government sources is reducing day by day. It is the local timbers that are available from agroforestry ('Agro Wood') or Trees Outside Forests (TOFs) are meeting the small timber requirements.

The total forest cover of the country is 7, 12,249 km² which is around 21.7% of the geographical area of the country. The Total growing stock of wood in the country is estimated to be about 5,915.8 million cubic meters comprising 4,273.5 million cubic meters inside forest areas and 1,642.3 million cubic meters outside the forest, from TOF, as per the report of the Forest Survey of India (FSI). The cost of extraction of the wood raw material available within the country is high. Forest resources cannot be depended upon any more for the future wood requirement for furniture industry.



Labour

Due to various reasons, skilled workers are not available to the extent of requirement. The cost of labour in the country is high when compared to prominent furniture making of the South-East Asian countries. The avenues for skill up-gradation are also less. The youths' aspiration to enter this sector is low and existing workforce is looking for other sectors for better wages and facilities. The furniture sector could not offer competitive wages compared to other employment options. This further develops discontent among the labour force.

Future Scenario

The demand for furniture in India is increasing annually at the rate of around 15%. The market is moving more towards organized sector, as the present customer preference is towards high-end readymade and branded low maintenance, quickly installable wooden furniture products. Simple designs are preferred trend compared to traditional artistic furniture.

NSSO employment data gives the total employment figure for furniture sector as 21,41,362, out of which 50% of the total employment is reported to be concentrated in five States, namely, West Bengal, Uttar Pradesh, Maharashtra, Bihar and Gujarat.

Global data on furniture export is as follows:

Name of the Exporting Country	Export (in billion US\$) in 2018	Share in world exports
China	96.4	37.5
Germany	18.1	7.0
Poland	14.8	5.8
Italy 14.5	5.7	
USA 10.8	4.2	
Mexico	10.6	4.1
India	1.65	0.6

The key factors which are to be considered for improving the Indian furniture industry are:

- Legislation
- Hybrid business model
- Skill up-gradation
- Raw material availability
- Reduction of imports
- Export incentives and support
- Government support in utilization



Legislation

The system of procuring of different licenses from Industries, Forest, Labour and other departments acts as inhibiting factor in setting up of new units. The liberalized approach by way of single window clearance may give boost in expanding the furniture sector.

Hybrid Business Model

The furniture business as stand-alone unit may not give expected economic benefits. The sector may include in itself and integrate with the other sectors such as plywood, glass and hardware, etc., for making the enterprises viable.

Skill Upgradation

As per the NSSO study, about 97% of the workforce in furniture sector is school drop-outs. Most of them are only into traditional carpentry. The technology to use modern machinery in furniture making is to be imparted to them, so that they can produce artistic furniture, special designs with less physical efforts and more production per person could be possible. For this, the number of Industrial Training Institutes in Government as well as private sector has to be increased.

Raw Material Availability

The raw material availability from Government sales is reducing day by day and hence there is a need to introduce techniques to convert the less important secondary timbers to furniture grade by preservative treatment for enhancing durability and seasoning (preferably by solar seasoning, considering savings in energy costs) for

dimensional stability and protection from biodegradation of the wooden products.

Reduction of Imports

International brands which are given free entry have to be controlled or the furniture imports may be stopped to promote local furniture makers as well to oblige the Admanirbhar call.

Export Incentives and Support

Small furniture makers are seldom aware on the market demands and may not have the necessary technical knowledge to handle the procedures. A platform has to be created to handle the certification, permissions, etc. for facilitating legal or regulated exports. The export duties and licenses have to be liberalized.

Government Support in Utilization

Government Departments and Indian Railways, some of the major consumers of furniture, have almost stopped using wooden furniture. The use of wooden furniture in Government sector needs to be encouraged to promote local wooden furniture manufacturers; such an action can gradually increase the demand of wooden furniture. Through the following initiatives, Government of India is planning to support the wooden furniture sector, which the industry needs to exploit through organizational activities for a better future and to get awakened from the pandemic downfall:

1. The Indian Domestic Furniture Market is expanding at an average rate of 12%. The market demand is increasing for readymade branded furniture with low maintenance, easy installation and customization. With proper inputs the wooden furniture industry can again make a come-back and thus help millions of skilled and semi-skilled and un-skilled wood working persons to earn their livelihood. This will further pave a way for the sustenance of the under-privileged local furniture-making sector.
2. Ministry of Shipping & Commerce recommended/offered Kandla, Kakinada & Agra Expressway but except big foreign companies it will be difficult for small wood based industries to invest unless some incentives are offered by government.
3. The Federation of All India Timber Merchants, Saw Millers & Allied Industries identified no dearth of efficient carpenters; what is needed is to promote small clusters within one or two districts pan India with every new technology and tools thereby strengthening the marginalized artisans trying to leave the sector in want of self-employment and to widen the scope of confidence building among similarly skilled labor forces. The Federation is planning to collaborate



with IWST and the Skill Development Council (Ministry of Textiles, GOI) to initiate the establishment of Training Centre for Wood Workers.

4. Future of small scale local wooden furniture industry lies in the use of properly treated and seasoned Agro Wood; small units of Rajasthan have already opened stores and selling promoting local furniture made of treated and seasoned Agro Wood, which could be taken as business model for other areas. Government may also try to ensure enough minimum support price system for the trees grown by farmers, as they are forced to sale the same at cheaper rates to big industries, many times even to multi-nationals too.

Exploit 'SCALE' Developments for Uplifting Wooden Furniture Sector

The 'Steering Committee for Advancing Local Value-Add and Exports' (SCALE), conceptualized as a joint Government-Industry Panel tasked with fast-tracking growth of the Indian manufacturing sector, immediately after the clamping of the lockdown in March and formalized in July, has facilitated the formation of two dozen Working Groups to look at specific issues that need to be addressed to accelerate local manufacturing. Each working group has a representation from at least 6-7 companies in one manufacturing segment and they liaison with their respective ministry. SCALE has identified opportunities to create \$350-380 billion of local value addition in the coming decade. The committee has identified that the four broad sectors including furniture (air conditioners, medical devices, automotive components, and furniture) have a local value-addition potential of \$75 billion in the coming five to eight years, and the bottlenecks in these sectors are being addressed

on a priority. The consultative exercise under this committee, the widest in the country so far, has its core agenda in building manufacturing competitiveness through economies of scale, importing less, exporting more and boosting domestic demand, as India seeks to grow manufacturing into a \$1 trillion industry. There is a serious intent from both the government and industry to win in manufacturing and to invest enough on R&D and IPR. The SCALE committee is identifying four to five critical issues for each sector, which if addressed, could trigger immediate recovery and bring long-term benefits in the post-Covid scenario. Broader issues of expensive industrial power, inefficient logistics such as bottlenecks at ports and challenges from free trade agreements, which have an impact on the broad manufacturing sector, are also being collated by various groups. The discussions include policy changes, infrastructure issues and tax sops; eminent consultants such as McKinsey, BCG, Avlon and AT Kearney were also brought on board to look for a solution wherever needed. Industry Associations such as CII, FICCI and ASSOCHAM were also put into deep involved in the exercise. The measures taken by SCALE are expected to play a very important role in pushing the share of manufacturing in gross domestic product from 16% at present to 25%. The committee is seeking Government's support to ease the burden of over regulation, remove embedded taxes and reduce logistic cost by 30%. Other demands include bringing down power tariff, having FTAs that benefit the local industry and encouraging industry to build scale, invest in technology

and R&D and focus on skill development to make India globally cost competitive.

Issues were already identified, acknowledged and understood; rectification measures are expected to initiate in a quick fashion. Initiatives like production-linked incentives (PLIs) were orchestrated as building blocks which would make Indian manufacturing globally competitive. PLI schemes announced so far can potentially improve 4-5% on cost of manufacturing. SCALE will look into more measures to incentivize local production, build competitiveness by creating scale and export more; Government desires to quicken the pace of reforms and ensure that regulatory hurdles didn't come in the way of progress. To be sure, there are complex issues which require intervention from multiple authorities, hence alignment sometimes takes time. The committee is helping in accelerating the same. It is reported that there is clear understanding on what is required at the apex committee level, and the goal is to arrive at a mid-path being cognizant of the challenges and limitations faced by the government and industry alike. The trade war as well as supply chain challenges emanating from the Covid 19 pandemic have made global companies to look at China-plus-one strategy, and this is the best time for India to capitalize on it. The SCALE window of opportunity opened right now may be rightly made use of by the wooden furniture industry of the country for the immediate recovery of the Covid impact as well as for long-term benefits.



Steering Committee for Advancing Local Value – Addition and Exports (SCALE) : Potential for Furniture

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The webinar on 'Future of Furniture Industry' organized by FICCI on September 30, 2020 brought together leading Indian and global players in the wooden furniture manufacturing, policymakers and experts to collaborate, share experiences and deliberate on influential trends and opportunities in the wooden furniture sector. Mr. Anil Agrawal, IPS, Joint Secretary, DPIIT, Ministry of Commerce, Government of India spoke on initiatives envisaged by the Government to catapult India into a Global Player in wooden furniture. Dr. Neeraj Mittal, IAS, MD & CEO, Tamil Nadu Industrial Guidance and Export Promotion Bureau, Government of Tamil Nadu spoke on possibility of developing a Furniture Hub at land near Thoothukudi Port. Presentation was given by Industries Department of the Government of Andhra Pradesh on developing another Furniture Hub at land near Krishnapatnam Port. Leading global players from Furniture industry including Mr. Alex Bellos, President of West Elm, Williams-Sonoma, Inc., Mr. Peter Betzel, CEO of IKEA India, Dr. Andreas Hettich, Chairman of the Advisory Board of Hettich Group, Mr. William Bissell, Chairman of Fab India shared their vision on future of furniture industry. Mr. Rudra Chatterjee, Chair of FICCI Furniture Group, FICCI WBSC and Chairman, Manor & Mews moderated the session. Other key speakers included Dr. Pawan Goenka, MD & CEO of Mahindra & Mahindra, Chairman, SCALE Committee, DPIIT, Government of India, Mr. Anil S Mathur, COO, Godrej Interio and Mr. Dilip Chenoy, Secretary General, FICCI. The webinar was attended by furniture manufacturers, exporters, global buyers, retailers, e-commerce companies, timber and plywood companies, Furniture, Plywood & Panel, Timber and Laminate Manufacturers' Associations and Furniture Training/Design Institutes.



Wood Technologist Association (WTA) is India's apex non-government organisation of plywood & other wood-panel based industries, providing a unique platform for all stakeholders: Government - Research Institutions-Industry-Machine Manufacturers-Technologists-Agroforestry Farmer, to interact and introduce path-breaking measures for progress of the industry.

WTA strives to make true the vision of Hon'ble Prime Minister Shri Narendra Modi of making wood-sector "Atmanirbhar" and for past 12 years has been relentlessly pursuing the cause of its stakeholders, addressing their key issues and seeking suitable policy-changes with Government agencies (MoEFCC, FRI, IPRITI, FIPPI, IWST and others).

WTA, led by President: Shri S.C. Jolly & a team of professionals' technologists / field-experts, also collaborates with international wood chambers / associations for mutual co-operation & adoption of best practises in the industry. WTA has organised host of conferences, seminars, training workshops, awareness campaigns and industry meets for taking forward initiatives of the industry.

WTA is a member of:

- ♦ Bureau of Indian Standards (BIS) CED-9 CED-20 Committees.
- ♦ President WTA (Shri S.C. Jolly) is a Member of Managing Committee of FIPPI.
- ♦ President WTA (Shri S.C. Jolly) is a Member of Steering Committee of IPRITI.
- ♦ President WTA (Shri S.C. Jolly) is a Member of Steering Committee of IPRITI.
- ♦ President WTA (Shri S.C. Jolly) is a Life Member of IWST, Bangalore.
- ♦ WTA, since the past decade, is in continuous dialogue with Ministry of Environment, Forests & Climate Change (MoEF&CC) and made representations to their Hon'ble Ministers: Shri Jairam Ramesh, Shri Anil Madhav Dave, Dr. Harsh Vardhan and recently to SHri Prakash Javdekar for bringing forth relevant issues of plywood industry.
- ♦ WTA submitted memorandums to MoEF&CC on various occasions for considering demands of the industry / Stakeholders for driving suitable policy-changes like reduction in GST, lease of barren-land to farmers for enhancing green cover by plantation drives, research & development on Melia Dubia as substitute of face veneer, foreign currency savings through reduction in imports, transportation subsidy and similar issues. Recently on WTA's perusal, the e-Transport facility for farmers was agreed upon by Government of India.
- ♦ WTA and FRI (Dehradun) collaborated under Green India Mission to organize industry institute Farmer meets at Ludhiana (Punjab), Yamunanagar (Haryana) and Pantnagar (U.P.)
- ♦ WTA's key role in agroforestry was explained to Shri C.K. Mishra (Secretary, MoEF & CC) by Shri Manoj Gwari (Secretary, WTA) at a meet organised at forest Research Institute, Dehradun
- ♦ WTA hosted international delegations from Malaysia, China and Ghana for partnership dialogue with Indian Plywood Business Groups. In a recent visit of Sarawak Timber Association from Malaysia, WTA coordinated and organized their meetings with IPRITI and other agencies
- ♦ WTA under aegis of Shri S.C. Jolly, started the National WhatsApp Group: "Agroforestry" bringing together key decision making administrators, leading industrialists and other subject matter experts, during the COVID times for suggesting and implementing the way forward for overcoming challenges being faced. The patronage and active participation of all members including Additional Secretary Dr. Alka Bhargava, Dr. Arun Rawat (DG, ICFRE & Director, FRI), Dr. M.P. Singh (Director IPRITI & IWST), and other eminent personalities (Industry Association heads, senior - Industrialists & Technical experts) has brought out innovative & viable solutions.
- ♦ WTA participated and organised multiple webinars in which leading subject experts shared views / opinion about how to tackle the problems being faced by each stakeholder
- ♦ WTA (Shri G. Rajput, V.P) participated in R & D work with Senior Scientist Shri D.P. Khali, FRI.
- ♦ WTA organized numerous hands on trainings with the industry for aspiring Technologists
- ♦ WTA assists in Industry placement of Technologists pan-India as per their skill set.

WTA in coming times, endeavours to take forward the best interest of Indian Plywood Industry!!

WOOD TECHNOLOGIST ASSOCIATION

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Is Indian furniture industry prepared to take on the world?

Rahul Mehta

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C OVID has given different perspectives to the world that we knew. Some see it as a challenge and others as an opportunity to grow beyond their limits. The Indian government has shortlisted Furniture Manufacturing amongst the 12 Champion Sectors for creating the Manufacturing hub, and while the debate whether we can compete China or even Vietnam can go on, it is important to reflect and see where we stand today?

Are we ready? Do we have enough and the right resources? Are we truly competitive?

Outside the industry, we are still fighting the societal Myths & false perceptions like Furniture Making is limited to Carpentry or Wood Working is same as Carpentry or Carpentry is limited to a certain set of people who have been traditionally doing it.

For long now, this has curtailed the Career Opportunities of the vast Furniture Industry from becoming mainstream. This has also hampered the growth of an organised ecosystem to train and nurture talent for the Furniture Industry, like we have for Medicine, Engineering, Management, Law or even Sports now.

A report prepared recently by BCG group on India's potential as a Furniture Manufacturing Hub highlights raw material and skilled workforce as the key challenges in the way of India becoming a Manufacturing hub of the world. It lays emphasis on Driving Skills and Capability building across all levels as these hubs can generate 4 to 5 lakh employment opportunities in just furniture & panel manufacturing.

While the Physical Infrastructure can be set up with the investment of money, creating the right Social Infrastructure takes investment of time in training.

ROLE OF SKILLING

The challenge of having the Right Manpower has always been there, especially in the unorganized or informally structured industries like Furniture Manufacturing. As such our efficiency & productivity have always been below the world standards.

Does this mean we don't have enough manpower or skilled people in the country? The study by the Labour

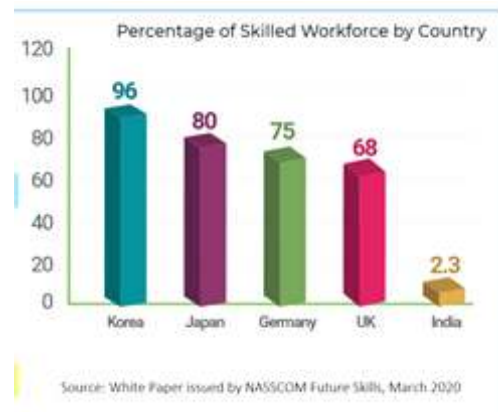
Commerce Ministry working to identify key sectors for making India a manufacturing hub

"There are 12 champion sectors which can be looked upon. These include modular furniture, toys, food processing like ready-to-eat food, agro-chemicals, textiles like man-made fibres, air conditioners, capital goods, pharma and auto components," one of the sources said.

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Bureau below showcases that the real challenge is not having Occupational Standards and as such lack of proper training, recognition & strategic development.

India is the fastest growing economy in the world and is expected to have 104.62 million fresh entrants in the labor market by 2022.¹ However, a report by Labor Bureau suggests, that the present skilled workforce in India is only 2.3 percent, much lower than the developing nations like Korea (96%), Japan (80%), Germany (75%) and the UK (68%).² Is this because India simply lacks skilled manpower or is it because we have simply not been able to count the number of skilled manpower we have as well as the other countries have? The lack of common definitions and classifications, one of the most important applications of Occupational Standards, could be a major reason.



The difference between the developed nations like Korea, Japan, Germany, UK, etc. and India can be understood by a simple comparison of the fact that they have above 75% skilled workforce and a sustainable model of creating right talent due, as they have been practicing Occupational Standardization for more than 30 years now.

An instance of what Germany has achieved can be seen through this video -
<https://www.youtube.com/watch?v=mtBgiosPyE4&t=1s>

Building A Robust Skilling Ecosystem For Furniture Industry

Clearly, to build a robust Skilling Ecosystem for such a vast fragmented and unorganised industry like ours, there are certain pre-requisites.

1. **One Industry, One Voice** - A Unified platform for Skill Development
2. **One Industry, One Standard** - Formalizing Job Roles with National Occupational Standards
3. **Industry Led & Supported Training Infrastructure**, Centre of Excellence
4. Break the Job Role related Stereotypes and **creating aspirational value by mainstreaming career opportunities** - recognising existing talent and creating new
5. **Power of Digital to empower** & connect the aspirants & industry, establish demand & supply

There is an urgent need to understand our existing skilled workforce capacity, empower them with upskilling initiatives and engage young talent via fresh skilling programs build at world standards.

Thankfully, under the aegis of the Ministry of Skill Development and Entrepreneurship (MSDE) and with support from National Skill Development Corporation (NSDC) & CII, **Furniture & Fittings Skill Council (FFSC)** is working towards achieving the Skill India Mission.

Formed in 2015, FFSC is focused on establishing an effective and efficient skilling eco-system for development and imparting of skills for the Interiors, Furniture, & Enabler industry to enhance the employability of the Indian workforce nationally & globally.

In layman terms, consider FFSC plays the role of the industry's unified skilled manpower solutions provider, by defining the Occupational Standards, Job Roles, and

required competencies for performing those jobs, etc.

Role of Industry as Skill Ambassadors

FFSC being an Industry Led body, role & support of industry members & professionals from the given sector is critical in building appropriate Standards & Training Infrastructure.

Over the last 5 years, quite a few industry players from various sectors such Furniture Manufacturing (Wood, Panel, Metal, Bamboo, Wicker, etc.), Interior Designing, Furniture Installation, Raw Material supplies, etc. have collaborated and contributed towards making our industry & country more competitive.



Steering forward with an innovative & pragmatic approach, through its Flagship initiatives like FFSC Skill Ambassador Program, FFSC Skilled India Talk and the FFSC Skill Pavilion, in the year 2020 so far, FFSC has connected with over 30000+ industry participants from across various sub-sectors, and has benefitted over 15000 people under RPL, STT & other programs.

Together with Industry, FFSC has created the right platform and given a great opportunity for industry players from various sub-sectors, be it manufacturing or supply side, to Collaborate, Contribute and make the industry more Competitive at the World level.

Collaborate – To lead the mission as Skill Ambassadors & harness the power of Skills

Contribute – To set the right Occupational Standards and build the right Training Infra

Competitive – By growing sustainably with the power of right skills & right people

It is time to make the Skill India initiative an Industry Initiative, our own initiative, and benefit as a whole.





FFSC WAY FORWARD
Key Initiatives

FFSC Skill Ambassador Program V.2
One Industry, One Voice for Skill Development

FFSC Skill Pavilion
Industry's earliest platform for Skilled Manpower Solution


FFSC Skilled India Talk
Leaders collaborate to make you competitive

FFSC Meri Skill, Meri Pelichaan
One Industry, One Standard, One Identification


FFSC Skill Competitions Fund
Breaking Stereotypes by creating aspirational value & mainstreaming career opportunities






FFSC Skills-In-Sight
Keep you updated with the latest happenings from the Skill Ecosystem

FFSC Career Management Cell
Bridge the gap between learning & livelihood



Areas of Association



Lead Skill India Mission	Skilled Manpower Development & Supply	Technical Empowerment	Brand Building Avenues	New Business Opportunities
				
<ul style="list-style-type: none"> Lead the Mission to Skill India with FFSC for Interiors, Furniture & Enabler Industry Become part of the Indian Skilling Ecosystem, supported by Ministry of Skill Development & Entrepreneurship (MSDE) & NSDC Platform for Productive Collaborations with Industry, Academia, & complete Skill Ecosystem 	<ul style="list-style-type: none"> Pan India Outreach to Industry Ready, RPL certified candidates through SMIS Align your organisation as per National Occupational Map of Industry Forecast Recruitment & Training needs as per the Right Job Role Participate in the Placement Drives & Career Workshops Avail Apprenticeship Benefits 	<ul style="list-style-type: none"> Certify your teams as per National Occupation Standards (NOS) Train your teams as per existing NOS based curriculum Customize your own Training Programs using Training Repository Access to growing pan-India network of Institutions, Training providers, Trainers, Assessors 	<ul style="list-style-type: none"> Participate in the various India & World Skills Competition Participate in the flagship events like FFSC Skill Ambassador Campaign FFSC Skill Pavilion at India Level Exhibitions & more FFSC Skilled India Talk: Knowledge-sharing Workshops, Webinars, etc. Skill India Updates: Newsletter, etc. 	<ul style="list-style-type: none"> Become a Nationally Affiliated & Recognised Skill Training Provider & Assessment Agency and avail benefits of government funded programs Subject Matter Experts can associate as Trainers & Assessors at National Level Government supported & Funded initiatives – Centre of Excellence (COE) & PMKK, World Skills Academy



AGRO FORESTRY



RURAL EMPLOYMENT



TECHNOLOGY



GROWTH with SUSTAINABILITY

Sustainability is at the core of India's Paper industry. Paper is one of the most environmentally sustainable products as it is biodegradable, recyclable and is produced from sources which are renewable and sustainable.

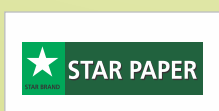
Paper Industry is not only conserving the environment but also regenerating natural resources. Through the agro-forestry initiative of the Indian Paper Industry, more than 1.2 million hectares of land has turned green and thousands of jobs in rural India have been created.

Of the total demand for wood by India's Paper Industry, over 90% is sourced from industry driven agro-forestry. The industry is wood-positive, that is, it plants more trees than it harvests. Pioneering work has been carried out by the industry over the last three decades in producing tree saplings (e.g. Eucalyptus, Subabul, Casuarina, etc.) which are disease and drought resistant and can be grown in a variety of agro climatic conditions. Substantial amounts have been spent by the industry on plantation R&D, production of high quality clonal saplings, technical extension services and hand holding of marginal farmers.

Indian Paper Manufacturers Association

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IPMA Members



Indian wooden furniture: a tale of culture and ethnicity

Mishra Swati Anand and R. Sundararaj

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Wood makes up more than the sum of its parts; it is a sensory-rich immersive experience that kindles the aesthetics and creativity. The utility, durability, and functionality render it as a cosmopolitan material. The arresting and emotive sensation of the mere grain in isolation brings the richness, warmth and finesse that defines a space. Thereby wood constitutes as an integral part of human lives from ancient times to the modern societies. Wood is an old age fascinating traditional material to create furniture; showcasing rich texture and shades of hues varying from light coloured to rich darker tones and reflects a distinctive combination of utility, elegance and incomparable structural integrity. Wood, unlike other materials can fit into any setting and blend tastefully, be it modern, rustic, or traditional furniture and its versatility



extend from indoors to the outdoors.

The furniture industry relies extensively on wood and wood-based materials as it excels in performance, manufacturing, appearance characteristics, and ease of assembly of wood pieces with other materials and it can be readily available with varnishes and paints. Wooden furniture is the most common consumer choice cause of its innate stability and reliability, pleasant appearance, sustainability and good economic value over the long term (Pakarinen, 2001).

Indian furniture is internationally synonymous with wooden furniture. The unique and vibrant traditional furniture art reflecting customs and culture has created a niche for Indian furniture in the global competitive market. It is also influenced by availability of natural

resources, terrain and topography, climate and socio-economic factors. These attributes aligned with sustainable management practices and sensitized consumer market would lead India as the potential global leader in the sector.

Wood demand in Indian and global market

Wood and wood-based materials are revolutionizing the furniture sector globally. Around 60 percent of the furniture market, worldwide, is dominated by wood and was expected to grow by 5.1 percent CAGR through 2026 but with the pandemic, the expected growth is at the rate of two percent (Woodworking Network, 2019). The growth in wooden furniture is foreseen as wood is one of the raw materials that is naturally available in abundance and can be used in the production of almost all types of furniture. In India, wood accounts for 65 percent of the Indian furniture, and of that Teak accounts for almost 50 percent while Sal and Deodar account for about 20 percent and the balance includes Mahogany, Cedar and other tree types. Hardwoods are preferred more over softwoods because the

higher density wood has superior manufacturing characteristics such as better machining and finishing, and higher strength. Additionally, hardwoods have a more interesting colour and appearance. Solid Wood is widely preferred in furniture manufacturing owing to its durability and resistance

characteristics in the longer term (Anon., n.d.a).

Solid wood is the primary form used but there has been an increased use of veneer, plywood and composite panels, high density engineered products such as laminated veneer lumber and parallel strand lumber are picking up pace. The increased and cheaper imports along with plantations promote the market for engineered woods. Although much of the low-to-medium value furniture produced may use vinyl or other polymer materials as face laminates, high-grade hardwood veneers are the laminate choice for high-value furniture. In furniture uses, composite materials have the advantage over solid wood of being cheaper and providing better dimensional stability in the interior environment.

Most Commonly Used Wood in Indian Furniture

Type of wood	Colour	Characteristics
<i>Tectona grandis</i> (Teak wood)	Deep yellow to dark brown	Aesthetic appeal, durable and resistant to rot and decay.
<i>Chloroxylon swietenia</i> (Satin wood)	Warm and bright yellow	Fine grained and lustrous, Provides vintage appearance, requires regular polishing
<i>Melia azederach</i> (White cedar wood)	Pale brown or tan	Most durable type of timber, resistant to termites and very strong. Used mainly to make shoe racks, chests, drawers and trunks
<i>Shorea robusta</i> (Sal wood)	Very light in colour but may turn dark when exposed to the sun	Beautiful texture, aesthetic appeal and versatile.
<i>Dalbergia latifolia</i> (Indian rosewood)	Dark	Attractive wood grain, versatile nature, robust and durable
<i>Dalbergia sisoo</i> (Shisham)	Varies from golden to deep reddish-brown	Strong, Durable, rich finesse
<i>Cedrus deodara</i> (Deodar)	Yellowish to brown	Sturdy, rot-resistant, close-grained and can take up the deep polish to give a good finish, absorbs color in varying degrees which makes it useful in making ornate objects and furniture, aromatic
<i>Swietenia macrophylla</i> (Mahogany)	Dark	Doesn't decay under water, the finest wood, therefore, can be sculpted easily, pores absorb paint so well that it gives an elegant glossy finish that makes it a perfect choice for making furniture.

Style, design and versatility of Indian furniture

Style and Design are reflections of ideas and culture which have been improvising over the time. It unites function, fantasy, tradition and sustainability. Designs are considered intuitive but are never devoid of personality and experience. Today, furniture is made using modern techniques and designs adapted from around the world. It is important to equip our designs based on the natural settings that we live in and it should tell a tale of local cultures and experiences. When tradition blends with this ecological material, there is extensive potential for design innovation to create an alluring piece of furniture.

IKEA is the most influential and widespread furniture brand today but lacks cultural sensitization and adaptation. Back in 1974, when IKEA entered the Japanese furniture market without learning about their way of living and culture and introduced the designs valid to European lifestyle, it faced a huge setback and had to withdraw. It successfully made its comeback in 2006 after rethinking its market strategies:

- Taking into account the local ways and standard of living
- Addressing customers experience and peculiarities



- Maintaining compatible prices and quality

Sadly, IKEA India doesn't provide the cultural touch but continues with the uniform strategies as the Western countries. But there has been an increasing demand in traditional furniture across India and many firms have been meeting with the demand for traditional furniture styles.

Historical influences on Indian furniture

India has the most diversified culture and heritage that has brought a unique blend of styles and influences to Indian Wood Furniture. Despite the rich and diverse

history of culture, there was a lack of emphasis on household furniture. People practiced sleeping on the floor and enjoying meals while seated on the floor. Therefore, homes usually consisted of cushions for seating or the low height stools.

However, some Indian Empires, for example Vijayanagar Kingdom in the southern part of India were known for their architecture and wooden furniture making. Even after the popularization of furniture by Mughals in India, furniture remained as an object of luxury or ceremonial purpose.

European Influence

India around 15th century was invaded by the European countries and the migration and settlements of the Europeans influenced furniture styles and materials. Consequently, Indian furniture styles and design are a blend of those from the East and West which is often termed as Indo-European furniture majorly depicting the Portuguese and Dutch influence.

The Mughal Style



The major Indo-Islamic influence on furniture of northern India was seen during Mughal reign. The Mughal style exhibited tables and writing desks amongst household furniture made from dark hardwoods like ebony and decorated with inlaid bone or ivory.

Indo-Portuguese Style

This style is a crossover of Mughal and Portuguese style. This style has intricate inlaid and incised geometric decorations on furniture and the most symbolic furniture



of this style are chested drawers and screen separators. Goan furniture majorly exhibits the Portuguese influence.

Indo-Dutch Style

Indo-Dutch style of furniture included light-colored



hardwoods with incised and inlaid decorations and furniture made from dark woods and elaborate floral carvings.

Traditional English Styles

The 18th century was marked by the British invasion and brought a predominant change in lifestyle and style of furniture. The furniture was made with Indian wood materials and decoration styles. 'Charpoy' or locally called 'charpai' influenced the English style of furniture because of its versatile utility. The British upgraded their diwan style furniture with bolsters and cushioning which



was influenced by Indian culture. Diwan is one of the core components of Indian household furniture in present time.



Cane and bamboo weaving techniques are extensively used in Northeast Indian states and also in Himachal Pradesh. This style of furniture has been used since colonial times and continues to be one of the preferred choices of furniture for casual interior design and a perfect addition to an outdoor setting.

Sankheda Furniture

Sankheda furniture gets its name from Sankheda village where the style is popularized. It is made from colorful teakwood which is treated with lacquer and



Painted in traditional colors of maroon and gold. The designs look fragile but it is durable. To promote the furniture art form, a training institute for Sankheda furniture has been established in Ahmedabad.

Chettinad Furniture

Chettinad furniture is a blend of South Indian culture and the European style of design. The furniture is made mainly from teakwood and embellished with marble. Chettinad is one of the most distinctive Indian furniture art while the patterns of grids and flora keep it on par with contemporary architecture (Anon., n.d.,b).

Heritage of Saharanpur



The history of woodcarving in Saharanpur dates back to the 15th century with the settlement of Afghani artisans in the outskirts of Saharanpur. Carved wooden furniture of Saharanpur can be found anywhere from different regions of India to Bahrain's kingdom. The furniture is known for its intricate carved patterns on the wood that requires utmost precision and skills; the indigenous design and quality have exhibited their furniture as world-class and have been in demand internationally. The export of Saharanpur heritage furniture art has flourished the industry but the local artisans need a reform to uplift their economies and create a better and safer work environment. This furniture has created a niche for itself



in the international market owing to its luxurious appearance, durability and ethnic designs and are now projected on e-commerce platform.

Wooden Street: Rajasthan's Endeavours of Growth

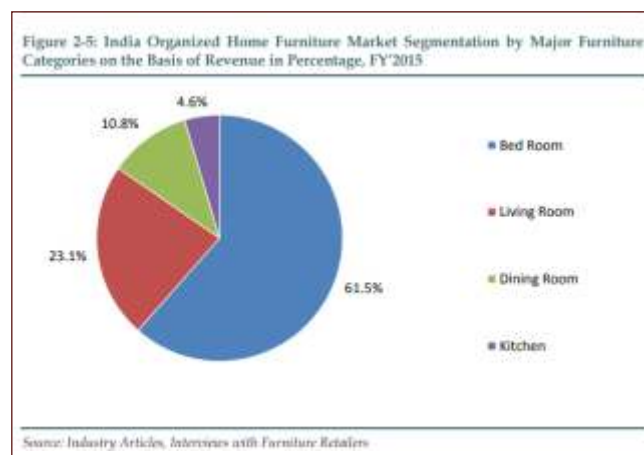
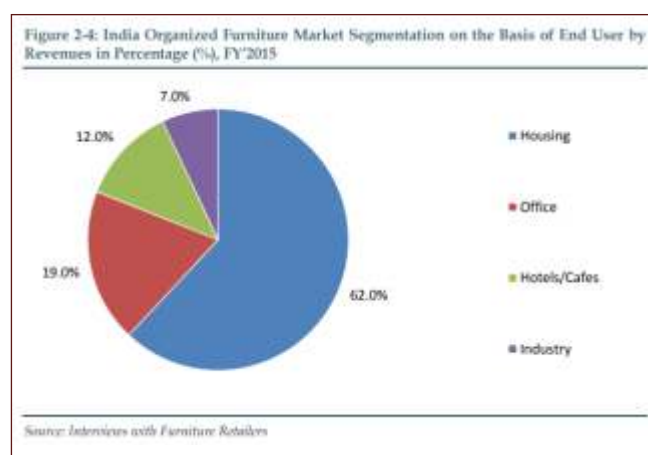
Rajasthan is synonymous with wooden furniture art at its core and the huge scale of wooden furniture industries. The furniture is recognized for its artistic representation of fauna and folk designs, the pompous royal appearance makes it a higher-end product in both the domestic and international market.

Wooden Street firm in Rajasthan has emerged as one of the most successful E-commerce platform in India with its provision of online customization of furniture. The large scale manufacturing and integration of local artisans have made the cost competitive and have been supporting village economies.

Market Overview

The Indian furniture industry is revolutionizing and is re-establishing the domain of traditional wooden furniture. The change in lifestyle, better standard of

living, real estate growth, rise in hospitality industries, are changing the scenario of the furniture industry in India.



Opportunities in wooden furniture industry of India

1. Focus on Ethnic and Traditional Designs

India is globally recognized for its durable and different and unique styles of wooden furniture. Traditional and cultural furniture art is the niche in which India could thrive and lead the market. Hence, the focus should be on designing furnishing collections that can be produced on large scale, without depriving them of the deep essence of 'Made in India' design culture whose tradition is based on essential pillars such as beauty, elegance, balance, and research. In present times, it has become easier to market the products online and reach the international market with proper marketing and funding from MSME sector. 'Vocal for Local' should be the theme that we should focus on the short as well as long term and also promote village economies.

2. Branding of Traditional Furniture

Indian furniture style is recognized for its unmistakable touch of nature, royalty and class, factors that, combined, connote the mastery of the

craftsmanship and quality of the items produced in India. Indian furniture uses rich hardwood species that ensure durability and class along with seamless modelling of upholstering on top of wooden furniture to make it comfortable and elegant. Hence, there should be branding and marketing of regional Indian furniture art which would enable India to establish itself as luxurious furniture.

3. Clustered or Integrated Infrastructure for Furniture Industry

India has abundant raw material, manpower and skilled craftsmen and with government support in this competitive sector could excel. The strength of Indian wooden furniture lies in its diverse and influential styles and designs. However, many micro and small units are not equipped in terms of technological know-how, capital access, design innovation, control quality and market their products on a larger scale. Therefore, cluster-based development would synergize their existing resources and opportune them to acquire

technology, capital and upgrade their skills. This also creates an employment opportunity for a large scale population and satiate demands for value-added products, large volume and low volume goods.

4. *Set up of Export Hubs near port proximity to reduce logistic burden*

India has one of the most suitable geographies for trade and commerce. The maritime trade routes of India have given ease of access of logistics and establish trade relations with other countries. Kandla, today has one of the largest timber import hub in Asia owing to its maritime trade route.

As per FICCI report of 2020, India needs to invest US\$10-12 billion in a phased manner for the establishment of at least three export hubs near port proximity to grow its export. India needs Special Economic Zones (SEZ) for the export of wood and potential port regions could be Kandla, Nhava Sheva, Vizag, Paradip, Haldia ports. The manufacturing units or even the supply chains, if set up near the zones could

largely reduce the logistic costs.

5. *GI Tagging of Furniture*

Geographical Indications of 'GI' tag refers to indications which identify a good as originating in the territory of a country, or a region or locality in that territory, where a given quality, reputation, or other characteristics of the good is essentially attributable to its geographical origin (TPCI). GI tags help consumers in distinguishing goods produced in a particular region from goods produced elsewhere thereby preventing them from being misused.

GI tags safeguard the significance of local culture and tradition in the face of globalization. It can also localize economic control, promote rural socio-economic development and assure higher economic returns. This is crucial for the producers of GI products in developing countries since there is a lot at stake. Presently, Sankheda furniture of Gujarat is the only furniture art that has a GI tag and there should be a push for the GI tagging of other traditional furniture.

Drawbacks of Current Strategies of Wooden Furniture in India

1 *Cost Competitiveness in Raw Materials*

◦Short term: Make imported wood raw material competitiveness

◦Long term: Expansion of certified source of wood plantation in Indian

The prices of the raw materials need to be cost competitive to create large size market for wooden furniture. Also, certification of wood plantations is necessary for unorganized market to be organized.

2 *Diminishing Traditional Furniture*

The government has remained apathetic to the local artisans. The high land ownership, expensive raw materials, exploitation of the skilled workers, fewer apprenticeship institutions are responsible for the

lower growth and shutting down of many smaller units of wooden furniture. This has also led to the diminishing regional furniture arts. It is necessary to revive the traditional furniture through the setup of training and research institutes and focusing on the government design institutes.

3 *Lack of Wood Refurbishing Market*

Wooden furniture is beneficial in terms of durability and finance. It fetches a good amount over the sale. Since wooden furniture is expensive over moulded plastic furniture, it is less in demand among those who are on move or in smaller offices. Now, refurbishing of old wooden furniture would lower the prices of the furniture and create a demand in the larger section.

An outlook of local Indian furniture in global market

The Western European and the USA market are the largest imports of wood for furniture. China and Vietnam are two leading Asian countries that have been catering to the import demand in the West. India barely exports about one percent of wood but has acquired a spot for its traditional and ethnic styles of furniture. The Indian wooden furniture has great finesse, durability and elegance at a lower cost than the Italian furniture which is one of the sought after luxurious style. India could become a competitor to the Italian furniture style with the setup of



proper manufacturing units and export hubs, the creation of organized sector, timber certification and political reforms.

Conclusion

Indian wooden furniture has been influenced by numerous cultures and traditions from historic times and it has emerged as one of the finest artistic forms in the world. Wooden furniture continues to be the most preferred choice among the consumer but a lack in political reforms and investments in the sector has slowed down the pace of development. Despite, the technological advances and highly skilled craftsmanship, India has failed to grow internationally to its full potential. The expansion of manufacturing centres, set up of research institutes and organizing the scattered furniture industry are long term development plan but the immediate focus should be on the promotion of traditional and cultural

wooden furniture and revival of diminishing traditional furniture through set up of government-sponsored training centres and investment opportunities from MSME sector. Also, GI tagging of this traditional and regional furniture is important in its preservation.

Godrej Interio, Fabfurnish, Usha Lexus, Zuari, Durian are some of the leading Indian brands in wooden furniture and there needs to be a consumer sensitization towards these brands. Also, international brands stepping into the Indian market should adopt the furniture styles and design as per the cultural lifestyle of India and not replicate the designs from the West. Realizing its strength in ethnic style, India needs to create a niche market for itself and start exporting. It might be a slow pace development but with the exhibition of its traditional products internationally it would attract huge investments and could grow as a global export leader of wooden furniture.

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Association of India Panel Board Manufacturers (AIPM), is non-profit organisation consisting of members who are manufacturers of MDF, HDF, particle boards with and without pre-lamination, laminated flooring etc. With different grades and international-national norms like E0, E1, E2 and other standards.

AIPM seek to balance protection of forest resources, the exploitation of the ecosystem services that trees can contribute to agriculture and the role of Agroforestry in diversifying the range of agricultural products and markets. AIPM's main object is to develop & promote the MDF industry by upgrading the industry's manufacturing technology base & supply of raw materials while promoting Agroforestry.

All members encourage Agroforestry farmers as a key raw material to create more diverse, productive, profitable, healthy, and sustainable land-use systems. Collective power and years of experience of AIPM members have enabled a strong network with the market to revolutionise the furniture industry by replacing plywood.

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Wood based industry synopsis

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Wood is a renewable natural resource and humanity has a very long association with it. It provides one of the very basic of life for rural areas and urban/semi-urban households in India as in other countries, particularly the developing countries, often referred to as the third world. After economic reforms, India has made impressive economic growth in recent times, as evident from the rise in income of people. This growth is leading to increase in consumption of wood and wood products such as furniture, construction timber, paper etc.

The Indian wood panel industry is estimated to be around INR 28,000 crore and is growing at the rate of 10-12% annually. Wood Based Panel Market size is anticipated to witness significant growth during 2020 to 2026. Rapid expansion of the construction industry in recent years has positively influenced global market trends, owing to economic improvement in both developed and emerging economies. The need for improved residential and commercial infrastructure has fostered the demand for robust construction materials and furniture.

India's per capita income has been witnessing steady growth and has almost doubled in the last few years. This trend is likely to continue in the near future as the economy continues to grow. The trend in aggregate consumer spending also corroborates the consumption boom in the economy. The rate of growth of spending on discretionary items has been growing and resulting in Indian manufacturer's strength of 70 Particle Board (PB) plants & 17 Medium Density Fibreboard (MDF) organised plants.

STATES	Installed Capacity of MDF	Installed Capacity of Particle Board
Punjab	600	NIL
Andhra Pradesh	2450	NIL
Himachal Pradesh	300	NIL
Haryana	400	NIL
Uttarakhand	2100	NIL
Karnataka	300	1100
Orissa	200	NIL
Gujarat	NIL	4500
North India	NIL	3000
Kerala	NIL	400
Tamil Nadu	NIL	200
TOTAL	6350	9200

*MDF & PB Tentative Data for the states

Regulations

During the year 2005-2006, the wood based industry licences approval given by the central empowerment committee of Hon'ble Supreme court through applications received from applicant. Besides Sawmill, In 2015 the Hon'ble supreme court had given various orders regarding the wood based industries including that the MoEF&CC is authorised to issue appropriate guidelines in conformation with the orders & directions issued by the Hon'ble supreme court and guidelines to the SLCs like (DOF, PCCF, DOI) Relating to assessments of quantity of timber and other raw materials for wood-based industries and permission of licences/permission to wood based industries granted by officers authorised by the state Government (DCF/DFO or Equivalent). The Wood based industries like MDF/Particleboard can be established in any industrial estate or else 10kms away from the Natural reserve Forests. Besides, Industries also need to follow the state forest rules.

The Government has been under active consideration on regulating the wood-based industry which will have a bearing on the activities of investors and Carpenters engaged in this sector. The policy decisions are held on the issues related to Forests, afforestation and Environment protection by representing various activities in the sector. The budget of the environment and forest department has been increased from Rs. 50 Crore in 2005-06 to Rs. 911 crore in the 2019-20 financial year.

Raw material availability

The plywood & panel industry is another major sector of the wood based industry which is heavily dependent on wood extracted from plantations grown under farm-forestry and agroforestry, e.g. Poplar and Eucalyptus. With dwindling wood resources on one hand and increasing demand for the wood based panel products on the other, attention is gaining momentum on the utilization of agro-residues and also recycling of wood waste for manufacture of panel products. Unlike plywood, Particle Board (PB) and Medium Density Fibre Board (MDF) provide enough scope for the substitution of wood by non-wood fibre resources.

While India's forests continue to provide timber and fuel wood to its people, farm forestry and agroforestry have grown in importance over recent decades in India in providing the industrial wood for its economy, as well as in reducing pressure on available natural forests. The forests of India are under severe anthropogenic pressure due to

growing demands for forest products. National Forest Policy, 1988, brought in policy shift towards using forests for conservation, which included preservation, maintenance, sustainable utilisation, restoration and enhancement of forest cover. This policy shift caused enhanced focus on 'Trees Outside Forests' (ToF) to reduce pressure on forests & to make the farm forestry plantations (part of ToF) productive as well as viable.

Cotton stalk-A raw material option

Raw materials availability is quite vulnerable day by day for panel board and plywood industries. Infrastructure development and furniture industries growth encouraged panel board industries to establish more units in last few years but same time very less raw material resources developed and simultaneously lack of processing equipments developed so far. Major raw materials for panel industries are mainly wood and bagasse with processing equipment available in Indian markets. There is acute need of research for the development of different options for raw material by industry players as well as academic institutions and industry association.

According to NPC (1990) study, at least 1.1 million tonnes of cotton stalk is available for industrial exploitation. Presently, very little quantity is, however, used. Its potential received much attention when the first MDF plant in the world based on this non wood source was established with an installed capacity of 39,000 TPA. The success of this venture would have ensured emergence of proven technology for utilizing this material.

Further the cotton stalk has no commercial use at present as it is treated as an agriculture waste and, therefore, cotton stalks are easily available at economical price. As the fibre contents of cotton stalks are not inferior to the Bagasse, the boards manufactured from cotton stalks would be easily marketable. To verify the suitability of cotton stalks for MDF/HDF manufacture, support would be required from Government bodies, R& D Institutes and skilled research teams. Scarcity of raw materials for manufacturing MDF & PB has been faced abundantly in

India and exploring how options of raw materials could be put to manufacture such as cotton stalk which is abundantly available but in order to process further as one of the Raw material option.

Agro waste utilisation is new opportunities as huge amount of agro-waste (including post-harvest biomass) is generated worldwide. A country like India alone generates nearly 5 million tons of agro-waste (plant residues) per year. On the other hand large quantities of such agro wastes are burnt harming the environment and damaging the soils. Cotton Stalks, which is presently burnt as wastage and in the process create's pollution and smoke, would be fruitfully utilized and in fact it would be conversion of agro waste into wealth and, therefore, the unit would be the finest example of eco-friendly project. The rural community including farmers, farm labours and self-employed women would also be benefited as the sale of cotton stalk would generate additional income to them.

Agriculture of the Future- Agro-Forestry & Agro-Residue (waste)



Indian Panel Industry is growing tremendously, scattered all over India. Yet, the ultimate source of Raw materials is still dependent on the Agri-produce of indigenous farmers. Due to market condition, there is a wide fluctuation in availability of quality raw material.

India is a wood-fibre deficient country. Inadequate raw material availability is a major constraint for sectors that depend on wood as their principal raw material, affecting their competitiveness. Over the last two decades, State Forest Development Corporations worked with farmers to create a sustained wood resource base of more than three million hectares of plantations under agroforestry. About 70% of these plantations comprise eucalyptus.

The supply chain of wood based industry begins with farmers and ends with homes & offices employing more than 2 million farmers throughout the country in Agro-Forestry. Agro-Forestry & Farm Forestry has taken deeper Roots in the country. These trees outside forest (TOF) are contributing to the increase in country's trees cover & are enhancing ecosystem services.

Agroforestry approach augments sustainable



livelihood for small and marginal farmers and resource self-sufficiency for the Industry, a win-win proposition. The Agro forestry programme is expected to increase farmer incomes, reduce the inward resource logistical costs and enhance assuredness of resource supply. The win-win arrangement – across farmers, company and the environment – makes responsible Agro forestry critical to the Company's long-term sustainability. The larger the quantum generated by farmers, the more sustainable the business model of the industry, reducing its dependence on the need to buy from the open market.

The wood-based industry only use leftover agro-residue from farms which otherwise is burnt in open fields causing enormous pollution. In year 2019-20, over 3 million Agro-fibres are converted into 1.2 million cubic meter of usable furniture in rural India. Therefore this Industry plays a major role in boosting the economy of farmers and reviving the employment generation in rural areas.

Climate change in Wood based industry

The challenge of global warming and climate change are burning issues and require a collective effort for a situation turn-around. The statistics suggest that there's going to be a stark rise in the growth of furniture industry of about 10% to 12% in the near future. And with that, will come a surge in the demand of wood. In such times agro-grown wood comes to us as a saving grace. Agroforestry plays a key role in not just climate change mitigation but also climate adaptation. Agroforestry essentially can mitigate climate change and possesses the potential to reduce global warming by absorbing greenhouse gases (CO₂) through the process of carbon-sequestration. There are several studies that suggest that Agro-forestry plantations sequester more carbon per unit area and time (more than 2 -3 times).

The topic of global warming and climate change crisis is incomplete without the mention of Biomass being the effective most solution to combat it. Wood is the oldest form of energy known to humankind and it is biodegradable which means it is a chief source of renewable energy. Along with that, Agro-forestry or the Agro-grown trees only further significantly add to the process of biomass. The wood processing industries like Panel Board, Medium Density Fibreboard (MDF), particle board, MDF flooring etc. promote, encourage and depend upon Agroforestry. These industries Convert a marginally high amount of wood waste into energy generation-Wood which in turn due to its natural components can be optimally utilized as renewable resources and that's the

Import restrictions

Imported panel products are available at cheaper price than locally manufactured PB & MDF. Therefore, India being a net importer of wood and wood based panel products, imports around 7-8 billion USD worth of wood and wood products each year causing huge fiscal deficit. The import of wood and wood products is virtually unregulated and customs duty from this has been substantially reduced. While import of wood-based raw material has been liberalized and duties have been kept at the lowest level possible. There has been a growing demand for fiberboards (particle board and Medium Density Fiberboard (MDF) in India, as growth of organized/mechanized furniture manufacturing and consumption has peaked up in last decade.

With increase thrust on Agro-forestry & wood availability for manufacturers within the country. Wood-based Industry is providing a good scope of substituting imports into the country. The industry association is making representation of Anti-dumping & Anti-Subsidy cases at various Governmental levels for restrictions on imports on wood-based panel products and promote the Agro-forestry, farmer's Incomes and increase productions with a healthy Market.

beauty of wood; a gift to us mankind from our very own Mother Nature.

Standards and up-gradation

Industry association officials are suggesting necessary changes in existing investment promotion 2016 policy through technology up-gradation, waste reduction, value addition, storage, skill up-gradation and export promotions for better output that can increase interest of investors thereby generating higher income returns to entrepreneurs & farmers creating employment opportunities.

Wood science and technology has not yet been explored efficiently in India. There are no industry standards for wood-based manufacturing at the moment. Lack of parameters and certifying agencies are resulting into low standards in manufacturing, wage rates, working environment etc. Very few educational institutes have dedicated courses for the wood-based industry. No standards or benchmarks have been identified for quality checks by the government or woodworking fraternity.

Hence, with help from Local & Central Govt. &

certified research institutes & Industry Associations, industry is making efforts to identify & upgrade the Industry and amend compulsory standards for quality checks which all the manufacturers will have to abide by in order to manufacture standard/good quality products and create healthy competition in the Market.

Shortage of Skilled manpower & Enhancement

The Shortage of skilled manpower has raised concerns and the industry has taken steps to enhance and educate the people with the mind-sets.

Industry is associating and collaborating with different organisations/associations like IPIRTI, IWST, FFSC in which the talents are trained and shaped to encourage the usage of MDF and shifting their mind-set to adapt more modernistic approach & supporting them through the training cycle and giving them opportunities to strengthen their learning, Decision Making and Accountability aspects.

The Govt. bodies and Industry Associations, Institutional research centres are encouraging and training carpenters by organizing the Carpenter meets which are frequently taking across the country to educate carpenters/Architects/Interior designers on the benefits of MDF and the tools required to work with it to enhance their skills and improve their livelihood opportunities by bringing professionalism in the field.

Role of MoEF&CC (Ministry of Environment, Forests & Climate Change)

MoEF&CC (Ministry of Environment, Forest & Climate Change) plays a major role in the wood based industries by framing guidelines and policies to boost the wood-based industries and protect the Environment and Natural Forests. MoEF&CC has passed on the major decisions to state forest authorities. Any Fresh applications for the establishment of new wood based industry can approach STATE LEVEL COMMITTEE (SLC) headed by Principal Chief Conservator of Forest (PCCF) & Head of the Forest Force (HOFF). If WBI Applicant has any dispute or inconvenience at State Level Committee (SLC) can approach any SLC.

Stakeholders & Investments

Wood-Based Industry is making all efforts to encourage the entire chain of stakeholders of Medium Density Fibreboard (MDF) & Particle Board (PB) –Farmers involved in Agro-forestry, workers involved in Manufacturing units, common man who is the end

consumer, Governments who can earn higher revenues on increased production, Save foreign exchange due to restrictions on imports & earn foreign exchange due to increase in exports.

The industry is working to improve and promote the wood-based like MDF & PB industry by taking necessary actions and prepare specific policies to promote & encourage stakeholders.

A favourable policy regime and sound business environment have facilitated increase in FDI flows into the country. With a view to liberalising and simplifying the FDI policy to provide ease of doing business climate in the country that will also lead to larger FDI in-flows; the government has undertaken various reforms currently.

Community based Joint forest Management (CBJFM)

The efforts of Community based Joint forest Management (CBJFM) have been working with the local



village/ self-help group communities of the village to promote forest management in different region of different villages of the rural areas. JFMC plays a major role in community's control over & access to waste lands and private cultivation on forest lands. JFMC has undertaken the distribution of the saplings and provide employment to the village women to cultivate the Non-Productive/waste land of the village.

Self-Help groups indirectly encourage farming leading to employment wages to women of the villages. Such an initiative for this activity was carried out by a Self-Help group from one of the villages from Patan District of Gujarat which has empowered and encouraged the unemployed and helped save Natural reserve forests adding up to environment sustainability

Sawmill vs. Wood-based Industries

Sawmill wood and WBI has always been a part of the agroforestry wood of which Sawmill wood falls under the

expensive side and requires minimum girth of 10 inches and above whereas manufacturing of Particle Board & MDF uses the non-expensive agro-wood size between minimum Girth of 2 inches to 8 inches.

The wood waste/residue of sawmill is the raw material for the Particle Board (PB) and Medium Density Fibre Board (MDF). Sawmills can be operated mostly from sunrise to sunset whereas Particle Board & MDF is a continuous Process. Both need to maintain the wood records for the audit purpose of the Forest Department. Both sector need to require forest licence from the forest Department but as per the new guidelines, Nov 2017; WBI such as PB & MDF need a registrations at the Forest Department.

Lesson-Learnt

As India's wood-based market continues to grow rapidly, the country needs to introduce a better regulatory framework which includes stringent measures to control illegalities in its wood imports. Despite a quarter of the country's geographical area being under forests, wood availability from them is extremely low. Most of the domestic wood production in the country is from resources outside forests. Therefore, it is important to realize the potential of TOF and promote it. Substantial improvement in productivity of forest resources on sustainable basis and large scale expansion of industrial linked agroforestry plantations are critically important for meeting the

industrial raw material requirements besides achieving the national goal of 33 per cent forest cover. Diversification of agriculture should receive high priority as water resources are depleting.

However, tangible results can be achieved only if the farmers are offered practical, viable and economically attractive alternative land use options. Technology based farm forestry plantation with genetically improved, high yielding and fast growing clonal planting stock has tremendous potential for diversification and meeting growing shortages of industrial wood on sustainable basis. However, meticulous planning and integrated development of farm forestry and wood based industries are required to ensure regular demand and remunerative prices to the growers.

Farmers, particularly small and marginal farmers, would be encouraged to grow, on marginal, degraded lands available with them, wood species required for industries. These may also be grown along with fuel and fodder species on community lands not required for pasture purposes and by Forest Department/Corporations on degraded forests, not earmarked for natural regeneration.

Better administration & Govt. policies, subsidies will bring investors on-board and manufacturers will be able to fight the challenges. Upgrading Techniques and forming a standard to certify the Product will definitely create a healthy market regionally & locally.

Company Background:

KumarEngineeringCo. is a pioneer in India for making indigenous global standard machines being used in the wood working industries as Plywood, Laminate & Furniture, Founded in 1990 by Mr. Sunil Srivastava (M.D.) on Engineering graduate with breakthrough experience in advance automation with strong focus on research and development, our organization is recognized worldwide for technical excellence and development of innovative products. The numerous industry milestones, new products, technical upgradations and patents that have resulted from our work continue to provide long-term benefits to our clients.

We are ISO: 9001 2015 certified company located in NCR District Rohtak, Haryana, approximately 40 miles from the capital city of New Delhi and easily accessible from the airports.

Core Competencies:

- ♦ Double Head Wide Belt Top Sanding Machine
- ♦ Double Head Wide Belt Bottom Sanding Machine
- ♦ Heavy Duty Both Side Sanding Machine
- ♦ Triple Head Calibrating and Sanding Machine
- ♦ Heavy Duty Laminate Sanding Machine
- ♦ Heavy Duty Both Side Calibrating Machine
- ♦ Super Heavy Duty Both Side Calibrating Machine
- ♦ Single Combi Head Sanding Machine
- ♦ Single Head Calibrating Machine
- ♦ Double Head Both Side Brushing Machine
- ♦ Triple Head Both Side Brushing Machine
- ♦ Automatic Edge Cutting Machine (ServoControlled)
- ♦ Hardwood Calibrating & Sanding Machine.
- ♦ Sanding Machine with Cross Belt for UV/Lacquer.

Our Clients:

We have a diversified client base & enjoy strong patronage of 500+ national & international clients including leading Plywood, MDF, Laminate and other wood-based product manufacturers, research organizations and government agencies. Apart from pan-India presence our machines are being increasingly exported to Nepal and preparing for other neighboring countries.

We look forward to receiving your esteemed order and forging a strong relationship with you. Please feel free to contact us for more information



Need of furniture testing and certification facilities in India

S.R. Shukla and T.K. Dhamodaran

Institute of Wood Science and Technology,
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Introduction

Furniture manufacturing in India is mostly driven by the designs chosen; the inputs come from in-house designers and market feedback. Manufacturers consider several aspects related to the customer (such as demography, lifestyle, motivation and aspiration, needs and preferences, etc.), raw material (type, quantity and availability) and internal capability (expertise, quantity and availability of labour, production process complexity and delivery time) for developing different designs, which in turn, determine the functionality of furniture, look, feel and value. Depending on the end user requirements, the furniture produced in India falls into two broad categories: domestic furniture meant for home use and commercial furniture meant for the office and hospitality sectors. Domestic furniture represents almost two-thirds of the total output. Manufacturers in the domestic sector typically try to differentiate on the basis of design variety and price; while in the commercial space, having a strong and reliable brand is important.

In present global scenario, there is great opportunity for the furniture sector of the country to grow and grab the domestic as well as export markets. For this to happen, innovative designs, quality assurance and certification of the furniture are very important aspects with which this sector has to deal with. At the same time, the furniture sector of the country is facing many challenges which are to be addressed for desired growth of industry. India competitiveness in furniture sector is mainly because of following few reasons:

Raw material competitiveness:

- (I) Huge gap between demand and supply of good quality timber due to less supply of local woods.
- (ii) Suitable timbers are imported from different countries to meet the requirement of furniture industry.

Scale of operation:

- (I) Only small percentage of industry operates at larger scale.
- (ii) Most of the furniture manufacturing units belong to unorganized sector and operate at very low scale.

Making logistics efficient:

- (I) Furniture hubs or furniture parks are required to be developed in different parts of the country.
- (ii) Skilled labour force is to be generated by creating more numbers of training centers.
- (iii) Supply chain of raw materials as well as finished products need to be strengthened.
- (iv) Policy support—Government intervention is needed to make or improve the existing laws and procedures to ease of doing business, required to liberalize export policies.
- *Quality control through testing and certification:*
- (I) Testing and certification facilities are to be established in public sector in all the major furniture hubs for better quality control.
- (ii) More emphasis to be given for research and development including designing and supporting the skilled force of master trainers.
- (iii) CARB testing facilities need to be developed especially for the panel product industry of the country.

Roadmap Ahead for Furniture Sector of the Country (Anon. 2020a, Jha 2020)

- Defining the financing model (public/ private/ partnership) for the exports hub basis evaluation of special economic zone (SEZ) model and acquiring the land by expediting the regulatory clearances.
- Identifying the land from available land bank across states, basis proximity to port and existing logistics (rail/road) connectivity.
- Developing the investment policy on the basis of SEZ financial model to attract the potential players of the sector.
- Identifying and prioritizing the potential target companies (from both India/Globally).
- Developing the inbound and outbound logistics capabilities for raw material and finished products.
- Reviewing and reducing the import duty on wood logs, sawn wood and FSC/CARB certified panel products being used in the furniture sector.
- Identifying and finalizing local Indian tree species that could serve as the quality furniture raw material.
- Developing a long term forest policy for the identified

tree species and implementing a holistic FSC certified plantation program.

- Creating a long-term plantation target policy and certification program & initiate implementation of the same.
- Introduce new design and skill development courses which are priority for the industry.
- Introducing new courses in relevant Institutes/ Universities with industry participation.
- Create plan to set-up Training Centers in the furniture hub, based on defined modalities of joint funding by Government and industry.

Need for Furniture Testing and Certification

Furniture has evolved in parallel to the needs, comfort, tastes and status of civilized cultures around the world. As opposed to construction elements (doors, windows), furniture is not subject of certification when it is produced solely for national market. Export products, on the other side, are often required to pass a series of tests and to fulfill requirements prescribed by directives, especially when they are placed on overseas markets. However, furniture for special purposes, such as furniture for healthcare service institutions, is required to pass much stricter requirements. Modern global markets brought additional demand in front of furniture manufacturers in terms of low price, high quality and unfair competition. Indian wooden furniture industry is more or less a low-tech, labour intensive and supplier-dominated one; its pattern of innovation is business driven. The dynamics of innovation in wooden furniture industry is characterized as collective innovation without much emphasis on design aspects, quality assurance and certification. Today's consumers expect quality furniture and furnishings with durability and safe from harmful substances. These requirements defined by customer specifications, industrial requirements or legal norms and standards, need to be tested by a reliable and independent third party. IWST is in process of developing a facility to provide furniture testing services of international standards to ensure compliance of products and facilitate access to and competitiveness in demanding markets.

Current Status of Standard and Certification

No adequate industry standards are in place in this sector against which furniture manufacturing, quality

assurance and working environment can be benchmarked. A Standard Authority (Certifying Agency) is therefore required to be formulated to issue performance quality certificates for Indian furniture industry. Sector's skill councils are to be more efficient and training standards are also required to be developed. Furniture R&D has to be a focus area; sector-academia collaboration is to be developed and strengthened. These aspects have to be taken care of, if furniture sector is to gain patronage by potential workforce and increase the export potential of the country.

Furniture Testing

Testing of furniture and its components is a very essential service. Customer could use it and try out any offered product before it is delivered. Furniture is tested in accredited laboratory which operates in accordance with International/National Standards. Structural integrity, safety and durability of the furniture are very important quality parameters. Combination of cyclic and static tests used in performance testing simulate stresses that would be placed on the furniture in a normal-use environment should also be evaluated.

Various tests that need to be conducted on furniture are listed below:

- Strength, durability, shock resistance, structural stability tests
- Mechanical and electrical safety test
- Material and surface testing
- Flammability testing
- Life cycle tests and ageing tests
- Ergonomic and functional testing and evaluation
- Fitness for usage tests
- Inspection of assembly instructions user manuals, product information
- Testing and analysis for contaminants and harmful substances
- Hygiene tests, assessments for kitchen and bathroom furnishings
- Life cycle tests and ageing tests
- Microbiological tests and assessments- resistance to bacteria and fungi
- VOC and formaldehyde emission testing
- Sustainability assessment

Following are the important furniture testing categories (Anon. 2020b):

I. Performance testing

This type of testing is used to evaluate the structural integrity and safety of the furniture. Combination of cyclic and static tests used in performance testing simulate stresses that would be placed on the furniture in a normal-use environment.

II. Safety testing

Safety testing is used to evaluate the product's electrical, mechanical, and design safety in a normal-use environment.



Fig.1 Furniture universal test machines
(Source: <https://www.haidatestequipment.com>)

chemical transparency. Formaldehyde is the well-known example of a potentially dangerous substance that can be released from wood-based panel products such as



Universal table and chair testing machine



Chair backrest durability test machine



Chair seat impact testing machine



Seating durability testing machine



Drawer durability testing machine



Bursting strength tester

Fig.2 Different types of furniture testing equipments (Source: <https://www.stc.group>)

environment. Primary safety standards writing bodies in domestic scenario as well as North America are Underwriter Laboratories and CSA International.

III. Flammability testing

Flammability testing ensures that product does not ignite and pose risk to lives/property in its normal-use environment. Flammability testing has become an important issue as the usage and concerns of flame retardant chemicals in products continue to rise.

IV. Environmental testing

It is used to evaluate the environmental, health, and sustainable attributes of a product. The demand for VOC emission testing is increasing as product manufacturers, architects, designers, and end users are requesting

particleboards, fiberboards, plywood etc. and should be quantified as per standard procedures.



Fig.3 Flammability testing of furniture
(Sources: <https://www.stc.group>; <https://www.rst-labs.com>)



Fig.4 Test chambers for (a) environmental and (b) VOC & formaldehyde emission testing (Sources: <https://www.camal.ncsu.edu>; <https://www.tuv.com>)

Some furniture testing standards

A variety of standards are applied in furniture industry, which requires manufacturer's understanding and compliance in order to sell into the market (domestic or importing country). Some of them are mentioned below (Anon. 2000c, Anon. 2000d, Benson and Reczek 2016, Prekrat et al. 2011):

- ANSI/BIFMA (Business and Institutional Furniture Manufacturer's Association) Standards develops, maintains and publishes safety and performance standards for furniture products.
- International Furniture Standards (ISO): ISO TC-136 Furniture; ISO 7170: 2005 Furniture: Storage units– Determination of strength and durability: International Standards
- European standards (EN): EN 14749:2016- Domestic and kitchen storage units and worktops – Safety requirements and test methods; EN 581(1 to 5):2017 Outdoor furniture – Seating and tables for camping, domestic and contract use.
- American Standards for Testing Materials (ASTM): ASTM F2057, ASTM F1912, ASTM F1821, ASTM F2613
- German standards (DIN): RAL-GZ 430 (General quality assurance and test criteria for furniture)
- British standards (BS): BS 4875 Part 7 & 8, BS 7176, BS EN 12520:2015
- Netherlands Standards: NEN ISO 19833: 2018 (Test methods for the determination of stability, strength and durability)
- Australia/New Zealand (AUS/NZ): AS/NZS 4688.3:2000 (ISO 7174-1:1988)
- Japan (JIS): JIS S 1017:1994: General rule for test method of furniture

Indian standards on furniture

Bureau of Indian Standards (BIS) is the government body responsible for preparation and implementation of standards in the country. CED 35 of BIS is related with furniture made of wood, metal, plastic etc. It lists about 63 different Indian Standards for furniture in the category of 'Methods of Tests' and 'Product Specifications' (Anon. 1993, Anon. 2018).

Performance and quality assurance testing

Countries like Sweden, Norway, Denmark, and Netherlands have developed a unified system of

performance tests and common quality assurance labelling system. Although, some differences do exist from country to country, all of these countries make use of a symbol 'MÖBELFAKTA' (Facts about Furniture) quality label system. In this system of quality assurance, functionality, durability and surface resistance of the furniture along with workmanship are evaluated. Three levels of performance: Basic, High and Extra High are identified. Results of the tests are summarized on a small tag attached onto each and every furniture items. This helps the consumers to make quick decision about the furniture before purchase (Eckelman 1999, Eckelman and Lee 1981, Prekrat et al. 2011).



Fig. 5 Furniture quality control symbols used by different European countries: (a) Sweden, (b) Norway (NFC), (c) Germany, (d) The Netherlands

Current Industry Scenario - capacity building of ecosystem for global opportunities

Furniture industry ecosystem of the country is generally consists of designers, OEMs, material suppliers, distributors, retailers, contractors, carpenters, polishers, painters, glaziers, upholsterers, influencers and customers. OEMs being the key operator in the furniture ecosystem, they are the natural contenders to take the lead in venturing global markets.

A brief SWOT (strength, weakness, opportunities and threats) Analysis is given below:

1. Strength
 - Possessing major share of infrastructure required for manufacturing global products
 - Experienced by catering to domestic demands
2. Weakness
 - Lack of sufficient furniture testing facilities in the public sector
 - Lack of exposure to global markets & standards
 - No product base product manufacturing ideology
3. Opportunities
 - Receptive Indian markets for trial run of products

- Global markets for India make furniture

4. Threats

- Being competitive
- Product failure due to sub-standard key raw materials
- Innovative designs

Global export opportunity in next decade

The global and domestic trade environment, coupled with government intent for the growing indigenous capability in the furniture sector will provide a window of opportunity to exporters in India to harness the latent potential (Anon. 2020e). Exporters have been interested in enhancing their production capabilities by opening up manufacturing bases in identified regions.

India has a great opportunity and potential to be among top global manufacturers and exporters like China and Vietnam due to the following attributes:

- Significantly lower labour cost compared to other countries, may result in significant unit cost reduction
- Cost competitive in raw materials (wood, panel products), cotton fabric (textiles), etc. - most competitive when using locally sourced wood and other materials.
- Differentiated furniture design capabilities-traditional (antique), modular and modern design furniture
- Preferred location by top global furniture buyers (for certified & cost competitive products)

The furniture industry in India is dominated by micro and small units. Manufacturing units are not well-equipped in terms of technological know-how, access to capital, ability to design and innovate, control quality and market their products in international market. To achieve the production levels, quality and design standards set by the international markets is the key for these micro and small players to maximize their potential and contribute towards the growth of the sector. Cluster based development would help to synergize their existing resources and provide an opportunity for these players to acquire technology, access capital, upgrade skills, encourage indigenous design and help MSME units to handle large orders or cater to the need of the international buyers.

Thus, there is a need to establish a “Furniture Testing and Incubation Centre” which would benefit the entire furniture industry, especially the MSME segment.

Establishing a Furniture Testing and Certification Centre at IWST

There is a need to establish a Furniture Testing and Incubation Centre (FT&IC) having all the furniture and material testing and training facilities. The centre would support to organise and convince the Indian furniture industry ecosystem through least risk case examples to prove the viability and scope of the idea of evaluation of wooden furniture items with a mark of quality in the domestic market first, thereafter upgrade to cover the global markets. The centre will also facilitate the Indian furniture industry with a state-of-art furniture testing and certification, for design and other hand-holding services, at one place under a common umbrella. The centre will be equipped with various testing facilities including performance tests with the scope of covering strength, durability, stability, safety, flammability, emissions etc. The centre will certainly support the locally produced furniture in capturing larger business share in various domestic and international markets. It is also proposed that this testing and certification facility will be accredited by the well accepted accreditation bodies of this sector such as Furniture Industry Research Association (FIRA) of the UK or Business and Industry Furniture Manufacturing Association (BIFMA) of the USA, which will enhance its testing scopes in line with the latest quality assurance requirements for the local products in domestic and global markets.

The key objectives of FT&IC are:

- ♦ Establishing furniture testing facilities for quality assurance and certification.
- ♦ Ensuring global performance standards through testing and certification.
- ♦ Capacity building of OEMs to participate in global trade and competition.
- ♦ Comprehensive and continuous development of innovative designs.
- ♦ Selecting and prototyping a product from the products pool.
- ♦ Strategic domestic trial marketing for facilitating global trade.
- ♦ Hand-holding of existing OEMs and encouragement for start-ups in furniture industry.
- ♦ Suggestions and overhauling the merchandise of key material providers.
- ♦ Fetching local industry players in a holistic commercial frame work.

Deliverables of FT&IC @ IWST

- Established state-of-art furniture testing capabilities of international standards within the country for the benefit of the furniture sector
- Offer testing and certification services to help local furniture manufacturers in improving the quality of their furniture for local as well as overseas markets
- Offer novel designs and codes which will be developed for the benefit of furniture sector
- Creation of skilled manpower for manufacturing quality wooden furniture products for exports (Capacity building)
- Utilization of fast-grown agroforestry timber resources for high value furniture products thereby increasing the income of farmers
- Entrepreneurship opportunities created in manufacturing furniture for domestic and export markets - Make in India! Atmanirbhar Bharat! Vocal for Local!

Some of the major R&D areas related with furniture sector which will be in the focus of the proposed centre are as follows:

- Designing and rapid prototyping blending the international trends, usability and transport-friendliness.
- Integration of advanced raw materials and fixtures, inputs of traditional Indian hand skills, keeping the identity.
- Utilising maximum material efficiency, constant study of advanced raw materials for better product performance, competitiveness and eco-friendliness.
- Efficient cabinetry and joinery, surface finishing and easy of packing and transport.

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Deendayal port- furniture park

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Deendayal port is located in Kandla, Gujarat and is one of the leading ports in the country in terms of cargo throughput. Due to its strategic location, it is able to cater to the vast part of the northern and central hinterland. The port also has two satellite ports in Vadinar, Jamnagar and Tuna. While Vadinar caters to POL and has SPMs of IOCL and Nayara Energy, Tuna has a bulk Terminal operated by Adani Kandla Bulk Terminal Pvt. Ltd.

The port caters to a diverse set of cargo, and has been implementing infrastructure projects which are of economic and strategic importance, not only to the Kutch region but also to India as a whole. One of the major thrust areas of the MoPSW has been port led industrialization, and Deendayal Port has been making active strides to flourish industries in and around the region. As the port has large landholdings around the coast and in the city, it has been the hub for a lot of industries which import or export cargo through the port. The major industries operating in the area are related to fertilizer, timber/wood, POL-Chemical (Tank Terminals), ceramic, salt etc.

The cargo profile of Kandla is diverse and it has been able to handle close to 122.61 MMT of cargo in 2019-20. One of the major imports in Kandla has been timber and it has been importing 2.5-3 MMT of timber every year which caters to the demand of the ply and the wood industries located in an around Kandla/Morbi.

Under the visionary guidance of Gov. of India, Deendayal Port conceptualized a major project for port led industrialization-Smart Industrial Port City (SIPC). SIPC encapsulates 1430-acre land, where 850 acres has been reserved for industries (SIPC Location 2) and 580 acres for township supporting the industrial sector (SIPC Location 1). A dedicated Furniture Park consisting of 100 acres of land has also been planned

SIPC – Location 2- Salient Features

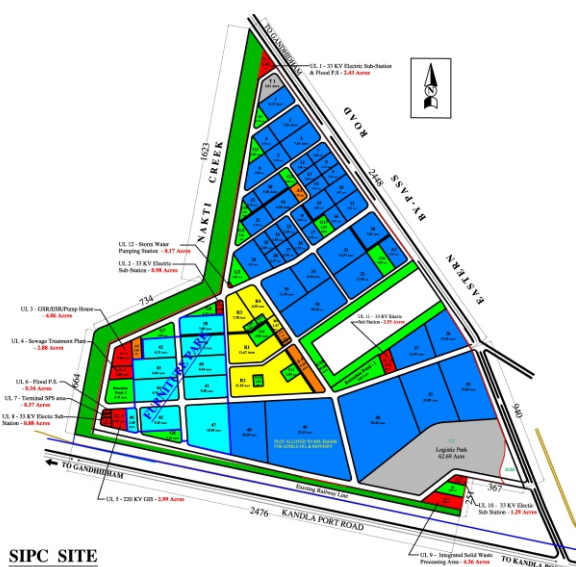
- ♦ Earmarked 850 acres of land near Deendayal Port for SIPC Kandla.
- ♦ SIPC Kandla aims to help industries and economy grow by providing better infrastructure facilities and promote non polluting port led industries such as
- ♦ It is aligned with Sagarmala Programme - an initiative of Hon'ble Prime Minister of India, for promoting development of coastal areas and port based economic zones.
- ♦ Excellent connectivity through Rail, Road and Sea-Adjoining NH 141, Railway siding terminal prooposed, 3Kms from Deendayal Port Trust, 22 Km from Kandla Airport.
- ♦ Infrastructural Facilities: Water Supply, Power Supply, Drainage, Roads etc.
- ♦ Create additional economic activities which will help to generate direct & indirect employment (more than 25000)
- ♦ Expected investment by Industries ~ Rs. 6000 crores
- ♦ Present Status-One plot of 53.13 Acres has been allotted to M/s Emami Agrotech Limited for development of Edible oil processing
- ♦ Approximate investment to be done by DPT on Infrastructure Development ~Rs 676 Crores

in the 850 acres of SIPC.

SIPC also aims to bring in other non-polluting industries viz. engineering based industries, Salt based and edible oil related industries to create an ecosystem of export/import led industrialization. It will have adequate infrastructural facility in synch with port operations along with uninterrupted power supply and water supply, and is aimed as a plug and play infrastructure for the industries.

Salient features

	Port based industrial development		Developed plots with infrastructure like Power supply, Water supply, Roads, etc.		2 to 53 acres Plot Size		60 year Lease Term		Competitive price
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Area Statement

Type of Landuse	Area in Acres	% Landuse	
Green Area / Open Spaces	86.36	10.16	
Industries	371.40	43.69	
Furniture Park	100.00	11.78	
Utilities	23.29	2.74	
Amenities	14.76	1.74	
Residential Area	48.16	5.67	
Transport & Logistics & Track Parking	66.60	7.84	
Roads + Embankments	139.26	16.39	
Total Area	849.84	100.00	

Total Area 850 acres

Saleable Area 586 acres 69%

The plot sizes are of 2 acres to 55 acres on 60 years lease base with a rent of Rs 3500 to 4100 per square meter per annum. The 100 acres assigned for The Furniture Park make perfect sense for Deendayal Port and the adjoining area as it has a central role for timber-based imports in India.

- Kutch region has been identified as an Imported Timber Conversion Zone with >2000 players already undertaking wood product related manufacturing activities. (90 plus plywood, particle board and veneer plants, 2000 + saw mills)
- ~70% of timber imported by volume in India is through Deendayal Port. (~2.5 Million cu m/year).
- Kutch district contributes to ~15% of the wood & wood product manufacturing factories in Gujarat (little value addition on final product).
- Furniture Park is aligned with “Make in India” campaign of Hon'ble Prime Minister of India. Hence, tremendous scope for value addition

DPT also organized a seminar on the aforesaid furniture park in October-2019 which was graced by Hon'ble minister of Ports, Shipping and Waterways, Shri Mansukh

Mandaviya and other dignitaries from the govt. and the industry. More than 400 people attended the same and a positive interest has been shown by the timber and allied industry for the furniture park.

Furniture Manufacturing in India has good future potential. The furniture industry in India comprises primary of hotel, household (bedroom, kitchen, living) and office furniture. India's organized furniture industry is expected to grow 20% per annum over next few years and projected to cross Rs. 22.40 Lakhs Crores in the near future. The demand for the furniture industry will get a boost owing to indirect impact due to increase in FDI in realty sector, rising disposable income, PM's vision of Housing for all, 2022 and rapid urbanization.

Also, considering the recent US- China trade war and the associated trade shift from China, India can grab the opportunity with both hands as China is one of the major players in export-based furniture segment Big players like IKEA making a foray in India and recently opening a store in Mumbai, shows that the future of the industry is bright and it is a golden opportunity for the region and Deendayal port to latch on the opportunity.

Fire rated doors: construction, testing and evaluation

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Wood is inflammable material and hence doors made of wood would burn in case of fire. Use of wooden door in building, specially, in high rise building poses danger in case of fire. Model building codes require passive fire protection and active fire protection system to minimize damage resulting from fire. The most common form of active fire protection is fire sprinkler. To maximize passive fire protection of buildings, building materials and furnishings in most developed countries are tested for fire resistance, combustibility and flammability.

A fire **RATED** door is a door with a fire-resistance rating (sometimes referred to as a fire protection rating for closures) used as part of a passive fire protection system to reduce the spread of fire or smoke between compartments and to enable safe egress from a building or structure. With the increasing building activities and stringent building regulations the behaviour of building components from various panel products or in combination with other materials against fire and to ensure occupants safety is the need of the hour. There is an increasing demand for fire retardant wooden doors in housing applications and there are huge opportunities for door manufacturers to produce/start producing fire rated doors. Fire rating has to be specified prior to the installation of a timber door in any high-rise buildings, shopping complexes, hotels and condominiums. Fire doors are “rated” by time (in minutes or hours) that a door can withstand when exposed to fire test conditions. Fire ratings include 30, 60, 90, 120 minutes etc., with the maximum rating required of any swinging type fire door being 180 minutes.

Construction of fire rated doors

- a. **Materials:** Fire doors may be made of a combination of materials, such as:
 - Wood veneer / MDF board / Particle board etc.
 - Insulation board made of Magnesium oxide, asbestos, ceramic wool etc.
 - Timber
 - Intumescent strip

Both the door leaf (the swinging panel of the door) and the door frame are required to meet the guidelines of the testing agency which provides the product listing. The door frame



includes the fire or smoke seals, door hardware, and the structure that holds the fire door assembly in place. Together, these components form an assembly, typically called a "door-set" which holds a numerical rating, quantified in hours of resistance to a test fire.

b. Door hardware

Door hardware generally includes:

- Automatic closing devices.
- Ball bearing hinges.
- Positive latching mechanism.

c. Seals

Edges of a fire door usually need to have fire rated seals which can be composed of:

- An intumescent strip, which expands when exposed to heat
- Neoprene weather stripping
- Gaskets to prevent the passage of smoke

When intumescent seals are used in the door design, use of the correct seal is crucial in the fire rating performance the door assembly. Seals may vary in chemical composition, expansion rate, expansion volume, and/or charring characteristics.

Standards and requirements

The aim for Passive Fire Protection systems is typically demonstrated in fire testing the ability to maintain the item or the side to be protected at or below either 140 °C (for walls, floors and electrical circuits required to have a fire-resistance rating) or ca. 550 °C, which is considered the critical temperature for structural steel, above which it is in jeopardy of losing its strength, leading to collapse. This is based, in most countries, on the basic test standards for walls and floors, such as BS 476: Part 22: 1987, BS EN 1364-1: 1999 & BS EN 1364-2: 1999 or ASTM E119. Smaller components, such as fire dampers, fire doors, etc., follow suit in the main intentions of the basic standard for walls and floors.

Passive Fire Protection means do not typically require electric or electronic activation or a degree of motion. Exceptions to that particular rule of thumb are fire dampers (fire-resistive closures within air ducts, excluding grease ducts) and fire door closers, which must move, open and shut in order to work, as well as all intumescent products, which swell, thus move, in order to function.

National Building Code for residential apartment in India under Fire Safety or Fire Protection says “In the case of apartment building exceeding three stories above ground level a certificate of approval from the Director of Fire Force or an Officer authorised by him should be obtained before use of the building permit”. National Building Code India Fire Protection Part IV (CED 46 of BIS) states fire prevention pertaining to design and construction of buildings on passive fire protection measures and also describes the various types of building materials and their fire rating.

Regulations

All components are required to adhere to product certification requirements that are acceptable to the local Authority Having Jurisdiction by meeting the requirements of the local building code and fire code. The regulatory requirement can change from country to country.

For example in the United Kingdom a fire resisting doorset should be subjected to either a British Standard Fire Test BS 476 Part 22 1987, or a BS/EN 1634-1 2000 test. In India fire door is tested as per IS: 3614 – 1992, “Metallic and Non-metallic Fire Check Door – Resistance Test and Performance Criteria”.

The results are recorded by the test agency and provided in a report which provides detail of such things as constructional details, test conditions, distortion data, observations, temperature and pressure readings etc.

Evaluation of performance of fire rated doors

a. Specimen Installation

The specimen is mounted in an associated construction of a wall or partition of the type to be used in practice or if the type is not known, the specimen is mounted in a construction with fire resistance greater than the specimen being tested. The construction is of sufficient strength to resist the thermally induced stresses that may develop during the test and shall also be capable of providing adequate fixing as well as ensuring the door is hung properly and squarely. It is also very important that when a fire door is installed, any gaps left in the opening between the wall and the door frame must be properly filled with fire resisting material. Fire doors are normally installed by experienced carpenter.

The performance of timber doors is judged by subjecting them to the standard test procedure specified

Criteria of Fire Rated Doors

a. Combustibility

Fire doors are not necessarily noncombustible. It is acceptable for portions of the door to be destroyed by combustion during exposure to a fire as long as the door assembly meets the fire test criteria of limiting temperature limits on the non-fire side of the assembly. This is in accordance with the overall performance goal of a fire rated door to slow fire propagation from one fire rated compartment to another for only a limited amount of time, during which automatic or manual fire-fighting may be employed to limit fire spread, or occupants can exit the building.

b. Fire door failure

Fire doors are sometimes rendered unable to provide its listed fire resistance by ignorance of the intended use and associated restrictions and requirements, or by inappropriate use. For example, fire doors are sometimes blocked open, or carpets are run through them, which would allow the fire to travel past the fire barrier in which the door is placed. The door's certification markings are displayed both on the door leaves and the fire door frames, and should not be removed or painted over during the life of the building. Sometimes fire doors have apparently very large gaps at the foot of them, an inch or two even, allowing air movement, such as in dormitory facilities. This can lead the occupants of a building to question their status as 'real' fire doors.

c. Normal operation

Most fire doors are designed to be kept closed at all times. Some doors are designed to stay open under normal circumstances and close automatically in the event of a fire. Whichever method is used the door's movement should never be impaired by a doorstop or other obstacle. The intumescent and smoke-seal bounding of fire doors should be routinely checked as should the action of the door closer and latch.

Some fire doors are held open with an electro magnet, which may be wired to a fire alarm system. If the power fails or the fire alarm is activated, the coil is de-energized and the door closes on its own. Wireless battery operated fire door retainers can also be used to safely and legally hold fire doors open. Rated fire doors are tested to withstand a fire for a specified period. There are 20, 30, 45, 60 and 90-minute-rated fire doors that are certified by an approved laboratory (e.g. Underwriters Laboratories). The certification only applies if all parts of the installation are correctly specified and installed. For example, fitting the wrong kind of glazing may severely reduce the door's fire resistance period.

in BS 476 Part 22 (1987), BS EN 1634-1 (2000), IS 3614 (1992), ISO 3008 (2007) etc. Tests are performed on complete door assemblies i.e., the fire door and frame with all the necessary hardware. It is then fixed in a wall representing its use in practice. The test procedure is fully described in the Standard and consists of exposing one face of the door to heat condition expected in a fire whilst observing the door for stability and integrity. The Standard requires the tests to be carried out with the upper part of the door under a small positive pressure, to simulate the conditions likely to occur in a fire. It also provides an objective method of establishing the loss of integrity of a fire door by the use of a combustible fibrous pad on the un-exposed side of the door and see when it ignites. A fire door should be tested from each side to establish its performance with either faces exposed to fire conditions, consequently requires two specimens. It is reasonable to assume that all fire doors and frames manufactured to the same specification as the two specimen doors and frames will achieve the same fire resisting properties.

Keeping future requirements of building bye-laws in our country and to facilitate testing of fire check doors, the facility has been established at IPIRTI for testing fire performance of full size door/shutters as per national/international standards such as BS 476 (part 20 and 22), IS 3614 (part 2), ISO 3008:2007 and BS EN 1634-1:2000 using latest technologies and instrumentation comparable with best in the world.

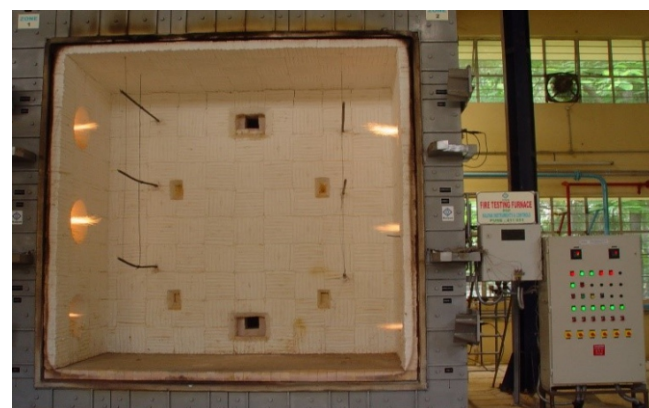
The salient features of the fire door testing setup installed at IPIRTI are:-

- o Vertical front open furnace structure with refractory bricks & ceramic wool blanket for best heat insulation
- o Computer programmable Automated LPG burners with computer controlled LPG flow
- o Hot gas exhaust system with automated dumper system
- o Pillar mounted I beam jib crane with electric hoist
- o Test frame to hold door under test with trolley and roller skid
- o Thermocouple assembly with good measurement accuracy
- o PC based multi-channel data logger, etc.
- o The system is equipped with fire-fighting and safety equipments.

Panel based industries and door manufacturers are welcome to avail the testing facilities and get their products evaluated at IPIRTI and gain customer's confidence.

Indian scenario

The primary goal of fire safety efforts is to protect building occupants from injury and to prevent loss of life and prevent property damage. According to Indian law, minimal fire safety equipment is mandatory for any developed property.



These laws are given by the National Building Code, which is a document containing standardized requirement for the design & construction of most types of building in the country. The National Building Code (NBC) is a national instrument that guides the regulations for construction activity. It contains all the important aspects relevant for safe and orderly building development. However, it is mandatory to use fire rated door for high rise commercial buildings, but in general it is seen that hardly any fire rated doors are rarely used even in the places where they are mandatory as per National building code. Knowingly, without any doubt, fire can cause a lot of damage, not only financial loss, but casualties as well. Fire rated Doors are quite in demand these days. After all, they provide assurance about protection from fire. But the scenario is rapidly changing and steep increase in demand as well as production of fire rated Doors are observed in India during last few years and new many old as well as new industries have started its production.



6TH INTERNATIONAL CONFERENCE ON LAMINATES

Strength of Unity

Indian Laminate Manufacturers Association (ILMA) is nonprofit making organization of manufacturers of Decorative and Compact laminates or high pressure laminates, Particle Boards, Plywood and Pre-lam (Short Cycle Laminates). It is the only registered association of the laminate industry at national level and we are proud to complete 20 years since 1998. More than 140 manufacturers of Laminates of India are the registered members of ILMA.

ILMA is a place where companies collaborate to get more opportunities to grow their business. ILMA is a symbol of Indian Laminate Manufacturer's unified commitment to provide seamless & world-class decorative surfaces. ILMA assembles its manufacturers on a unified platform & voices out its fair opinions. It unanimously provides a healthy competition, creating great opportunities by using different strategies and combining the views of the manufacturers.

Key Achievements

1. Organized six International Conference on Laminates between 2010 to 2018
2. ILMA Institute of Technology to enhance production capabilities of members employees
3. Restrict import of low quality laminate
4. Study on Cleaner Production
5. Launch of Technical book on laminate
6. Catalogue shows at National and International Level
7. Launch of awareness video on Laminate application
8. Networking with members for raw materials, production, market and government policy related issues
9. Export incentive benefits to laminate exporters
10. Support to PM Cares fund during pandemic

Upcoming Events

1. 7th International Conference on Laminates during Delhi wood March 2021
2. Catalogue show at Interzum, Germany 2021
3. Online technical workshop on production and environment aspects during October 2020.
4. Environment clinic with Pollution control board (December 2020)

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Desirable wood properties for application in furniture

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Introduction

The story of wooden furniture in the country may start from primitive unfinished wooden coat – cum – chair to the princely peacock thorn to the modern-day's elegant cushioned design furniture. Different wooden furniture items are available with different designs for the homes, offices, service sectors such as hospitals, airports, railway stations, etc. in the Indian furniture market. Apart from indigenous timbers available in India, wherever domestic supply is inadequate, import of wood is also practiced. Major common species of wood used for furniture making in India includes teak, sheesham, rosewood, deodar, sal, redwood, red cedar, mahogany and walnut. Sandalwood and ebony are also used very rarely due to cost and availability factors. Teak accounts for almost 50% of the total wooden furniture produced, sal and deodar account for about 20% and the balance includes mahogany, cedar and other tree species. India has an abundant resource of rubber wood supply. The southern state of Kerala produces 95% of the total supply of rubber wood in India, and a major quantity of this perishable timber is made used for furniture making after value-addition by preservative treatment for enhanced durability. Although furniture making from the various wood species available has spread across the country, a few centers have become famous for their exquisite carving, inlaying, turning and lacquering. Indian states well known for woodwork include Gujarat, Jammu and Kashmir, Punjab, Uttar Pradesh and Kerala. India is one of the largest consumers of wood in South East Asia. The country has sufficient availability of tropical wood; however, in recent years, growing concerns about the environment and the need for conservation of forests have led to reduction in the supply of wood.

India imports wood from various countries like Malaysia, Indonesia, Myanmar, and Ivory Coast, etc. MDF boards are imported from Europe; soft and hard wood are imported from Russia and other South East Asian countries. Veneered panels are becoming increasingly popular in India and are imported from the European Union and USA. This situation called for rigorous awareness on the quality of furniture wood. The Indian and imported timber species mostly used for furniture

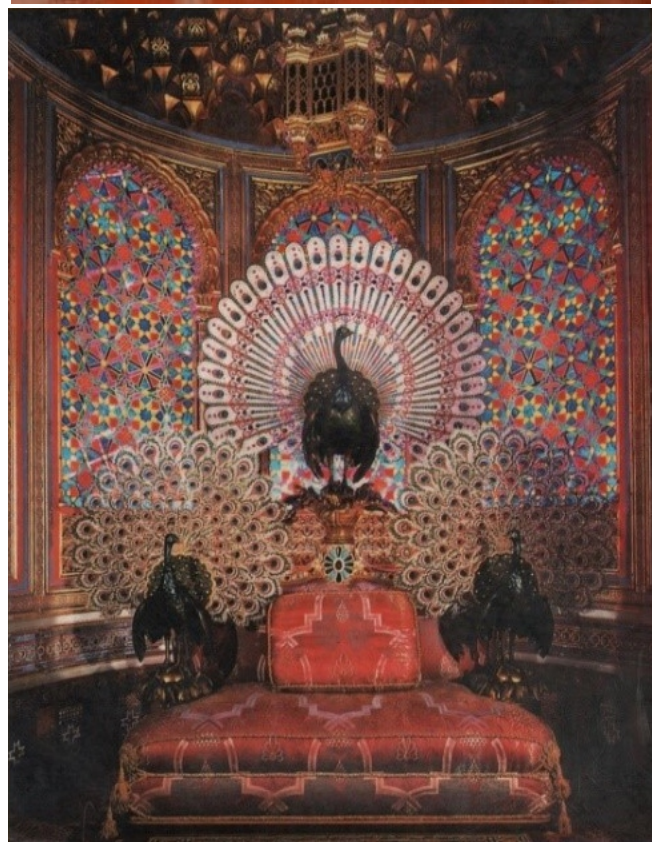


Table 1. Indian and imported timber species mostly used for furniture works

Indian Wood		Imported Wood	
Teak (<i>Tectona grandis</i>)		Walnut (<i>Juglans nigra</i>)	
Rose wood (<i>Dalbergia latifolia</i>)		Maple (<i>Acer saccharum</i>)	
Sheesham (<i>Dalbergia sissoo</i>)		Mahogany (<i>Swietenia mahagoni</i>)	
Satin wood (<i>Chloroxylon swietenia</i>)		Birch (<i>Betula alleghaniensis</i>)	
Mahogany (<i>Swietenia macrophylla</i>)		Oak (<i>Quercus</i> spp.)	
Sal wood (<i>Shorea robusta</i>)		Cherry (<i>Prunus</i> spp.)	
Deodar (<i>Cedrus deodara</i>)		Pine (<i>Pinus</i> spp.)	
Jack fruit (<i>Artocarpus heterophyllus</i>)		Chestnut (<i>Castanea</i> spp.)	
Marandi wood (<i>Melia azederach</i>)		Black locust (<i>Robinia pseudoacacia</i>)	
Mulberry wood (<i>Morus alba</i>)		Cedars (<i>Thuja</i> spp.)	

Desirable wood quality parameters for furniture and fixtures

Wood to be used for furniture and fixtures should be strong and hard, it should be durable (resistant to rot/fungi, borer etc.), dimensionally stable (low in shrinkage and swelling, water resistant) and aesthetically appealing. For decorative and ornamental furniture, grain orientation, texture, colour and figure are important requirements. Requirements of timber for different types of furniture and cabinets are different. The following basic wood physical and mechanical properties are required to be evaluated using standard procedures as laid down in Indian standards (BIS, 1986) to compute the strength coefficients and other parameters.

Physical and mechanical properties

Wood properties vary with respect to species. Timber may be put to a number of applications depending upon the properties it possesses. Because of inherent variations in the various properties of different species, not all timber species are found to be suitable for all purposes. The choice of appropriate wood species for different applications is the first step towards rational utilization of timber. Considerable amount of studies have been carried out for evaluation of different anatomical, physical, mechanical and chemical properties of various wood species (Anon. 1970, Rajput et al. 1996).

Physical properties

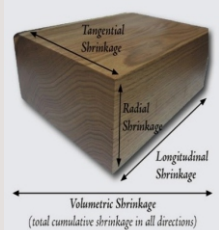
The term "physical properties of wood" is generally ascribed to denote such inherent qualities as the wood moisture content, density, shrinkage and swelling characteristics (dimensional stability), appearance, colour, etc. (Anon. 1970, Rajput et al. 1996, Tsoumis 1991). These physical properties are very important for proper characterization of wood material and have great influence on the furniture aesthetics and performance (Anon. 1970, Shmulsky and Jones 2011). Reactions of wood to different forms of energy such as sound, heat, light, electricity, etc. also broadly classified under physical properties. These properties have sometimes been predominantly responsible for the numerous uses of wood such as for decorative surfaces, insulating media, etc. Study of these aspects has been found to be of great value in the techno-economic utilization of various species. Testing and evaluation of the physical properties of wood specimens is generally carried out according to the procedure laid down in Indian Standards (BIS 1986). Fig. 1 shows the measurement of physical properties such as moisture content (MC) and density of wood. Table 2 presents different directions and range of values of radial (SR), tangential (ST) and volumetric (SV) shrinkage in wood sample:

- ♦ Wood moisture content
- ♦ Wood density (specific gravity)
- ♦ Shrinkages:
 - ♦ Radial shrinkage
 - ♦ Tangential shrinkage
 - ♦ Volumetric shrinkage



Fig. 1 Measurement of physical properties of wood

Table 2. Range of shrinkage values of wood from green to oven-dry conditions (Anon. 1970, Rajput et al. 1996)

Directions in wood sample	Shrinkage	Range of values
	Radial (S_R)	2 – 6%
	Tangential (S_T)	5 – 10%
	Volumetric (S_V)	8 – 18%

Mechanical or strength properties

Mechanical properties of a material generally relate the resistance it applies to counter the imposed external forces. The mechanical properties include the elastic properties which measures of resistance to deformations and distortions and strength properties which relates the failure aspects of the material. Both of these parameters finally provide the indications of performance and other related issues. The strength properties are closely related to density which varies widely depending upon the species. While strength varies with species, it also depends upon the shape of a member, the nature of forces applied, and the relative direction in which forces are applied. For example, a lesser force will be required to bend a piece of wood than to crush it, and yet a different degree of force will be required to pull the piece apart. In addition, the magnitude of forces differ depending upon whether forces are applied parallel or perpendicular to the grain. Mechanical properties of wood also vary with the change in its moisture content. Wood is

generally much stronger in dry condition than in green or wet condition. An exception is impact strength; dry wood tends to shatter with high impact loads. For the sake of comparison of two wood species, the wood with higher specific gravity values corresponds to higher strength values. It is also to be noted that the wood is much stronger (7-10 times) when stressed parallel to the grain direction than perpendicular to the grain.

Testing and evaluation of mechanical properties

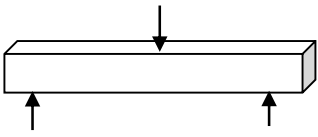

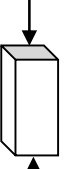


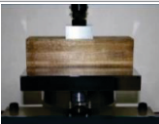
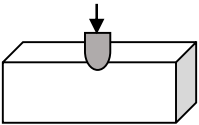

Wide application and usefulness of the testing and evaluation of mechanical properties of different wood species requires that they be obtained in some standardized manner. Testing of most of the mechanical properties is carried out on universal testing machine (UTM). Fig.2 shows the UTM and impact bending test machines for evaluating the mechanical properties of wood. Some basic mechanical test configurations, direction of applied forces and fixtures have been shown in Table 3. Specific Indian standard procedures are followed for determining the mechanical properties of wood (BIS 1986) and evaluate their suitability for furniture.

- ♦ Static bending:
 - ♦ Bending strength (modulus of rupture-MOR)
 - ♦ Bending stiffness (modulus of elasticity-MOE)
 - ♦ Fibre stress at elastic limit (FS at EL)
- ♦ Impact bending:
- ♦ Fibre stress at elastic limit (FS at EL)
- ♦ Compressive strength parallel to grain:
 - ♦ Compressive stress at maximum load (maximum crushing stress- MCS)
 - ♦ Compressive strength perpendicular to grain:
 - ♦ Compressive stress at elastic limit (FS at EL)
- ♦ Surface hardness
 - ♦ Hardness-radial
 - ♦ Hardness-tangential
 - ♦ Hardness -end
- ♦ Tensile strength perpendicular to grain
 - ♦ Tensile stress-radial
 - ♦ Tensile stress-tangential



Fig.2 Timber testing machines for evaluating mechanical properties of wood (a) Universal timber testing machine (UTM, Shimadzu), (b) Impact bending machine

Table 3. Some basic mechanical test and direction of applied forces

Properties	Directions of applied forces	UTM fixtures for test
Static bending (3-point loading)		
Compression parallel to grain		
Compression perpendicular to grain		
Hardness (surface indentation)		

Strength coefficient

Timber species to be used for manufacturing furniture should have adequate physical and mechanical properties such as bending strength, weight (or density at 12% MC), retention of shape (low shrinkage values), etc. For furniture and cabinets applications, timber species are evaluated for the strength coefficient in terms of teak as 100 for strength as a beam (S1), suitability as a post (S2), splitting coefficient (S3) and retention of shape (S4).

General procedure for computing suitability indices

All these suitability indices (S1, S2, S3 and S4) are computed from the basic wood properties which are evaluated in green and air-dry conditions (Sekhar and Gulati 1972). Suitability figures for green and air-dry conditions are calculated separately which are used to compute the composite suitability index. Finally, Comparative Suitability Index is calculated with respect to teak value, using standard formulae. Various principal basic and auxiliary basic wood properties for computation of suitability indices are shown in Table 4.

Table 4. Principal basic and auxiliary basic wood properties for computation of suitability indices (BIS 1993a, Rajput et al. 1996, Sekhar and Gulati 1972)

Suitability index	Principal basic property	Auxiliary basic property
<i>Retention of shape (S1)</i>	<i>Volumetric shrinkage</i>	<i>Radial shrinkage (SR) Tangential shrinkage (ST) Shrinkage ratio (=ST/SR)</i>
<i>Suitability as a post (S2)</i>	<i>Compressive strength parallel to grain (MCS)</i>	<i>Compressive parallel to grain FS at EL Static bending-MOE</i>
<i>Hardness (S3)</i>	<i>Compressive strength perpendicular to grain (FS at EL)</i>	<i>Hardness-radial Hardness-tangential Hardness-end</i>
<i>Splitting coefficient (S4)</i>	<i>Tensile stress (Radial)</i>	<i>Tensile stress (Tangential)</i>
<i>Strength as a beam (S5)</i>	<i>Static bending strength (MOR)</i>	<i>Static bending FS at EL Impact bending FS at EL</i>

Table 5. Classification of timbers based on properties into different groups (BIS 1993a)

Group	Strength coefficient (Teak as 100)	Weight (Teak as 100)	Grain, texture, finish, polish, and appearance	Examples of wood species (as per IS:13622)
<i>Super Group</i>	>75	<i>85-110</i>	<i>Excellent</i>	<i>Rosewood, Sissoo, Padauk, Teak, Kokko (13 species)</i>
<i>Group I</i>	≥ 75	<i>85-110</i>	<i>Very good</i>	<i>Safed Siris, Benteak, Aini, Bijasal, Champ (14 species)</i>
<i>Group II</i>	≥ 65	<i>70-120</i>	<i>Good</i>	<i>Haldu, Kathal, Deodar, Mango, Gamari, Laurel, Rubberwood (42 species)</i>
<i>Group III</i>	≥ 50	<i>60-130</i>	<i>Satisfactory</i>	<i>Fir, Kadam, Neem, Eucalypts, Chir, Bahera (34 species)</i>

Based on above properties and strength coefficients, various Indian timber species have been classified into four different groups for furniture and cabinets as shown in Table 5 (BIS 1993a). It may be noted that the timber species selected for manufacturing furniture and cabinets should have adequate wood working qualities, smooth finish, colour, texture, figure and appearance. Moreover, all timbers should be seasoned to the moisture content of $10 \pm 2\%$ using kiln or natural drying procedures (BIS 1993b). It may be noted that the sapwood of all durable timber species belongs to durability class III must be given proper preservative treatment to avoid fungus and insect attacks (BIS 2001).

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Wood technologist association: 20 years of adding value to the wood-based industry in India

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Wood Technologist Association (WTA) is India's apex non-government organisation of plywood and other wood-based industries, providing a unique platform for all its stakeholders: Government - Research Institutions - Industry - Machine Manufacturers - Technologists - Agroforestry Farmers, to interact and introduce path-breaking measures for progress of the industry. The association is an essential link for co-operation, dialogue and understanding with the Government by representing the views and concerns of its industry members to the relevant authorities.

The Wood Technologist Association (WTA) is a non-profit association that has grown and evolved with the engineered wood industry. Established in 2000 as a private sector body, it is the representative organisation for wood-based industries in India. For more than 20 years, the Wood Technologist Association has focused mainly on the following objectives: (a) Platform for integration of Farmer-Government-Industry, (b) Forest Conservation: Afforestation & Reforestation, (c) Spearheading "Green India Mission", (d) Helping government to give shape to "forest policy" of Govt of India and (e) Research & Development of environment friendly products. The association has been helping the wood-based industry in India to develop the engineered wood products of exceptional strength, versatility and reliability. In pursuit of its core mandate, WTA promotes technology and cultivation and trade in quality wood, upholds standards, encourages the enactment and administration of sound policies that facilitates a competitive business environment, reduce the cost of doing business and seek new market opportunities.

Combining the research efforts of scientists at FRI, IPIRTI and IWST with the knowledge gained from decades of the field work and cooperation with its member manufacturers, WTA promotes new solutions and improved processes that benefit the entire industry. With the range of products manufactured by WTA members and the national and international scope of the Association, it provides an essential link for co-operation, dialogue and understanding with the Government by representing the views and

concerns of its members to the relevant authorities. For example, some of the recent recommendations submitted by WTA to the Ministry Of Environment and Forests & Climate Change (MOEFCC), Govt. of India include: a) Wood-based industries are dependent on raw material from plantation grown tree species/agro-forestry. Therefore, the wood-based industry may kindly be declared as an Agro-Forestry based Industry b) Guidelines may be issued to the industries for mandatorily employing the technologists trained by organizations under the MOEFCC, for maintaining productivity and quality standards c) Incentive to establish tissue culture labs by the industry or farmers d) Scheme to support the development of clones of Poplar and other Indian wood species in order to save the huge amount of foreign exchange spent by the plywood industry for importing face veneers.



On several occasions in the past, WTA submitted the views and concerns of its members as memoranda to the Ministry of Environment and Forests & Climate Change (MOEFCC), Govt. of India

Its members are well-known manufacturers whose mills produce the majority of the structural wood panel products plus a host of engineered wood products, including glued laminated timber (glulam), wood structural panels, wood I-joists and structural composite lumber. WTA has a long and extensive history in standards development activities including the performance standards for building products and tools; creation of product reports to help engineered wood product manufacturers expedite market entry of their goods; provide highly technical educational resources to professionals; free on-site consultancy services on the latest construction techniques and code requirements pertaining to engineered wood. WTA has developed many performance standards over the years; including plywood siding, wood structural panel and sheathing, glulam, wood I-joists, rim board, and cross-laminated timber (CLT). WTA issues WTA Product Reports designed to help manufacturers expedite market entry of their products. Through fact-based policy advocacy, the association has evolved into a dynamic, vibrant, credible and respected business association that unites industrialists, technologists and other stakeholders and also offers a common voice for wood-based businesses.

“WTA's members benefit from our work in the field as we strengthen the engineered wood market through training and education by conducting industry-relevant trainings, seminars and workshops. When our member firms' products are properly specified and installed, customers are happy with the results” says Shri Subhash Jolly, WTA President. Shri Jolly, well known as the face of the Indian Plywood Industry, has been instrumental in taking forward the GREEN INDIA MISSION joining hands with FRI to conduct farmer meets at Ludhiana, Pantnagar, Yamunanagar and other places across Punjab and Haryana. Recently, under his leadership WTA proactively assisted and advised several business



WTA takes active part in Green India Mission and organizes Technical Seminars and workshops for its industry members



Shri Subhash Jolly, WTA President

delegates from China, Ghana and Malaysia on matters related to plywood industry's best practices and on exploring the potential of joint ventures.

Introduction of *Melia dubia* based agroforestry in Eastern Uttar Pradesh

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Abstract

Agro forestry in the present day is the appropriate land use system in the development of agriculture and forestry sector including the protection of the environment. A research project entitled “Development of *Melia dubia* based agroforestry system for eastern Uttar Pradesh” funded by Uttar Pradesh Council of Agricultural Research, Lucknow, is ongoing at Centre for Social Forestry and Eco-rehabilitation, Allahabad. This study is aimed to introduce a versatile and economically important tree species *Melia dubia* in eastern Uttar Pradesh agroforestry and to study its effect on crop production and soil characteristics. Under the project, quality seeds of *Melia dubia* were procured from Forest Research Institute, Dehradun and quality seedlings were raised. Plantations of *Melia dubia* were established in bund and block agroforestry models with wheat crop. Crop production data and growth data of *Melia dubia* recorded under agroforestry. Crop production without tree plantation was taken as control. Growth performance of *Melia dubia* is observed well in the agroclimatic conditions of eastern Uttar Pradesh. Crop production under *Melia dubia* agroforestry was reported less in comparison to control. In spite of this, in long run, the wood obtained from this multipurpose species offers a good economic return to the farmers. Amelioration of soil quality was also observed under *Melia dubia* agroforestry. These features make this multipurpose tree as a preferred tree species for the farmers for agroforestry.

Introduction

Owing to limited land resources, agro-forestry, in the present scenario, is a sustainable and appropriate land management system which increases the overall yield of the lands; combine the trees and shrubs with agricultural crops and or livestock on the same unit of land, either simultaneously or sequentially. It develops agriculture and forestry sector together with the protection of the environment. It is assessed that the population of India will increase to about 1.44 billion by 2030, necessitating commensurate increase in the production of food grains (United Nations, 2015). Due to increase in population of human and cattle, there is increasing demand of food, fodder as well as fuel wood. India is also under tremendous pressure to meet the growing demand for wood and wood products, such as pulp and paper. The current production of raw materials for pulp and paper is 2.76 million tonnes, against the demand of 5.04 million tonnes, a shortfall of 45 percent. The projected demand by 2020 is 13.2 million tonnes, which is still more staggering (Palsaniya et al., 2009). Today, there are about 594 paper mills in India, and out of these 34 considered as large companies and require huge amount of raw material (Parthiban and GovindaRao, 2008). Moreover, the production potential of trees for wood generation is restricted to about 0.7 cubic meter/hectare/year in the India as compared to the world average of 2.1 cubic meter/hectare/year. This results in a huge gap between demand and supply (Bijalwan and Dobriyal, 2015). To meet these requirements and fill up the gap between demand and supply, adoption of agroforestry is only available viable option (Mutanal et. al., 2009; Dubey, 2010). Agroforestry combines agriculture and forestry technologies and make one of the most viable alternative land use systems for maximum sustainable productivity (fuel, fodder and food) to meet the demand of ever growing human and livestock population, while preserving the environment. Agroforestry is also considered as a powerful solution to the climate crisis by harnessing the immense power of photosynthesis, it can fix atmospheric carbon, a problem, into soil carbon safely in the ground (Center for Food Safety, 2016).

Agroforestry practicing has been increased in India and tree plantation has been started in farmer's fields commercially. Agro forestry system of farming has come up in big way in many part of the country but eastern part of Uttar Pradesh is lagging behind in this regard. Extension of agroforestry in Uttar Pradesh is also the need of the day because this region has only about 9.01% of area under tree cover (Table 1) against the figure of 33% recommended by National Forest Policy (website of ENVIS Centre: Uttar Pradesh).

Table 1: Forest and tree cover of Uttar Pradesh (Area in sq.km)

1	State's geographical area	240 928
2	Recorded forest area	16583
3	Forest cover	14338
4	Out Side Forest Tree cover	7382
5	Forest and tree cover	21720
6	Forest and tree cover against geographical area	9.01%

Source: State forest report 2011, published by forest survey of India

Moreover, income from agriculture is reduced due to increased cost for labourers, increase in cost of cultivation, increase in transportation cost, decrease in agricultural production due to adverse effects of natural calamities like flood, drought, onslaught of Nil Gai on agricultural crop, volatility of market of agricultural produce, conversion of agricultural land for commercial uses etc. Therefore, it is required to develop some farming systems incorporating economically important tree crop which fetch a handsome price in the market, assured buyback, and require low maintenance expenditure. Farmers are already practicing Teak, Eucalyptus, Poplar based agroforestry. Due to long span of time and shade effect, teak is not getting the desired success. Eucalyptus and Poplar are short rotation crops and suitable for agroforestry. Eucalyptus is not favored by the environmentalist, owing to the dangers it posed viz: depletion of water table and irreversible erosion of soil fertility (Ram, 2012). This popular and most preferable species for agroforestry, with high economic value, is being gradually disliked world over. The foremost campaigners Nobel Laureate Wangari Maathai termed these monoculture forests as 'dead forest' as one finds no birds, butterflies, other trees and animals (Ram, 2012). Poplar has its limited zone and confined to a particular geographical location. Moreover no suitable clone is also available for this region, particularly for eastern Uttar Pradesh. Therefore, there is an urgent need to see the alternative of these species, which can overcome these problems. The present study is proposed for introduction of a versatile and economically important multipurpose tree species *Melia dubia* in agroforestry in eastern Uttar Pradesh. In south India, *Melia* is considered as money making tree within the short span of time. Even if planted as a single row along the field bunds, about 60 trees can be planted per acre, which will fetch an income of about Rs.2 lakhs in the sixth year of planting. In block, 400 trees can be planted in an acre that fetch 15-20 lakhs in 6-7 years (farmnest web site). Moreover, *Melia dubia* is an indigenous species to India. It is a fast growing multipurpose tree species, which is in high demand in plywood and veneer industry and high-quality termite and fungal resistant timber and has potential to use in biomass power plants (power generation) due to its fuel value, apart from the urban landscaping and in afforestation. It occurs in tropical forests, grows on variety of soils and requires low supply of water which brings it in advantageous position in comparison to other exotic species. However, deep fertile sandy loam soils show optimum growth. *Melia dubia* tree holds promise of good economic returns. The wood can be sold for plywood, veneer & match industry. According to news published in 'The Hindu', dated May 25, 2011, the tree with the minimum size of 16 inches girth

is saleable at the minimum rate of about Rs 2000 per tonne to match industry, however, for the plywood/veneer industry, the rate is bit higher. Therefore, development of *Melia dubia* agroforestry based farming system will provide additional income to the farmers from their limited land resources.

Melia dubia (Synonym: *Melia composita*) belongs to Meliaceae family and is an indigenous species of tree to India. It is fast-growing, deciduous, multipurpose, indigenous tree species which has been considered as an excellent source of raw material for wood based industries like paper and plywood. It attains a height of 20-25 meters. It has a spreading crown and straight cylindrical bole (trunk) of around nine meters. It is also an important medicinal tree and a good source of bio pesticide. The tree can be cultivated in all types of soil; however, it grows well in deep, fertile and sandy loam soils. It requires a low supply of water on a daily basis. It is naturally distributed in forest of Sikkim Himalayas, North Bengal and upper Assam, Khasi hills of Orissa, North Circars Deccan and Western Ghats at altitudes of 1,500 - 1,800 m. It grows rapidly and is adapted to diverse climatic conditions, so used for large scale afforestation purposes. Noble thing about this species is that it can be grown successfully in most of parts of India in different climatic zones (Kumar et al. 2013) and may start to give economic return even after three years. After 3 years, 30-40 tons of biomass/acre can be harvested upto 10 years. The price of wood per ton is Rs 2000-4000. So one can get minimum revenue of $2000 \times 30 = \text{Rs } 60000 / \text{acre every year}$ (<http://richfarmerpoorfarmer.blogspot.in/>). *Melia dubia* can be grown where there is an annual rainfall of 1,000 milli meters and where minimum temperature ranges from 0-15°C and maximum temperature ranges from 30-43°C. The tree attains a height of about 20 m with a spreading crown and a cylindrical straight bole up to 9 m in length and 1.5 m in girth (Troup, 1981; Krishna et al., 2011; Swaminathan et al., 2012; Saravanan et al., 2013). On productivity ground, *Melia dubia* perform well and can grow at the rate of 41.54 cubic meter/ha/yr (Saravanan et al., 2013), which is higher than Eucalyptus and Poplar (Bijalwan and Dobriyal, 2015). These characteristics make this species suitable for Agroforestry. *Melia dubia* has been identified by Kumar et al. (2013) as an indigenous fast growing trees species and performed well in Uttar Pradesh also. *Melia dubia* is a potential species for bio-energy applications especially for biomass gasification to generate producer gas and use in Lime Kiln to replace fuel oil and also for other wood product applications (Chinnaraj et al., 2011). Parthiban et al. (2009) recommended *Melia dubia* as promising pulpwood species with increased pulp recovery, exceptional strength and excellent bleach ability qualities. *Melia dubia* is

valued for its high-quality termite and fungus resistant timber (Ram, 2012). Warriar et. al. (2012) studied on *Melia dubia* Cav. as a potential indigenous fast growing species for farmlands. *Melia dubia* has been established as popular species in agroforestry in Haryana, Karnataka, Tamilnadu, Andhra Pradesh etc. An all India coordinated project is also going on *Melia dubia* in Indian Council of Forestry Research and Education, Dehradun under which ICFRE Institutes in all over India are participating and trials of different progenies are going on in all over India and selection of suitable progeny for different agro-climatic zone. The Forest Research Centre for Eco-Rehabilitation, Prayagraj (Formerly known as Centre for Social Forestry and Eco rehabilitation, Allahabad) is also the part of this All India Coordinated Project (AICP). Plantation trials of *Melia dubia* were successfully established in different agroclimatic zones of eastern Uttar Pradesh under AICP. However, it has not been introduced in and practiced in agroforestry in eastern Uttar Pradesh. Therefore, this study has been proposed to introduce this multipurpose fast growing and economically important tree species in agroforestry, so that farmers of this region may get good additional return from their limited land resources.

Material and Methods

Quality seeds of *Melia dubia* were procured from The Genetics and Plant Breeding Division of Forest Research Institute, Dehradun for nursery raising. Seeds were sown in plastic tray having 4-6 holes at the bottom in the month of February/ March. Trays to be filled upto 5 cm with rooting media prepared by mixing of sand, soil and farm yard manure (FYM) in the ratios of 1:1:1. Watering was done regularly. The germination started after about 20-25 days. Once the seedling grew to four leaves (2 cotyledonary & 2 juvenile foliage), it was transferred to black polybags filled with rooting media consisting of FYM: Sand: Soil (1:1:1). After two days of transplanting in the polybags, transplanted seedlings to be weaned out to partial shady conditions (but not to extremely high intensity of light) and then to fully opened conditions and watered appropriately to maintain good moisture. Maintenance and management of nursery was done regularly. Agroforestry trials were established in bund and block models in Allahabad. Six to nine months old seedlings was planted at an escapement of 2m X 2m in case of bund agroforestry model and 2m X 3m in case of block agroforestry model in three replications. Wheat was cultivated as agricultural crop. Pruning was done to get the straight cylindrical boles. Growth data (height and girth) of the forestry species (*Melia dubia*) recorded. Soil samples were collected randomly from three places from agroforestry and control plots and mixed thoroughly for

analysis. Wheat crop production data was recorded. The crop productions data in 1m X 1m quadrat (grain and Straw weight / m²) of wheat crop was recorded at distance of 1m, 5m, 10m from the tree line in case of bund agroforestry and within the rows in case of block agroforestry, each in three replications. Wheat crop production in adjacent field without tree planting was recorded as control.

Results and Discussion

Nursery of quality seedlings were raised from the seeds of *Melia dubia* procured from FRI, Dehradun and agroforestry trials were established (Fig. 1 and 2). Growth data of *Melia dubia* for bund agroforestry and block agroforestry were depicted in figure 3. Growth in case of block agroforestry was observed more than in case of bund agroforestry, which may be due to the more moisture conservation in case of block agroforestry. Annual increment was also observed more in case of block agroforestry



Fig.1: Seeds and Nursery of *Melia dubia*



Fig 2: Agroforestry of *Melia dubia*

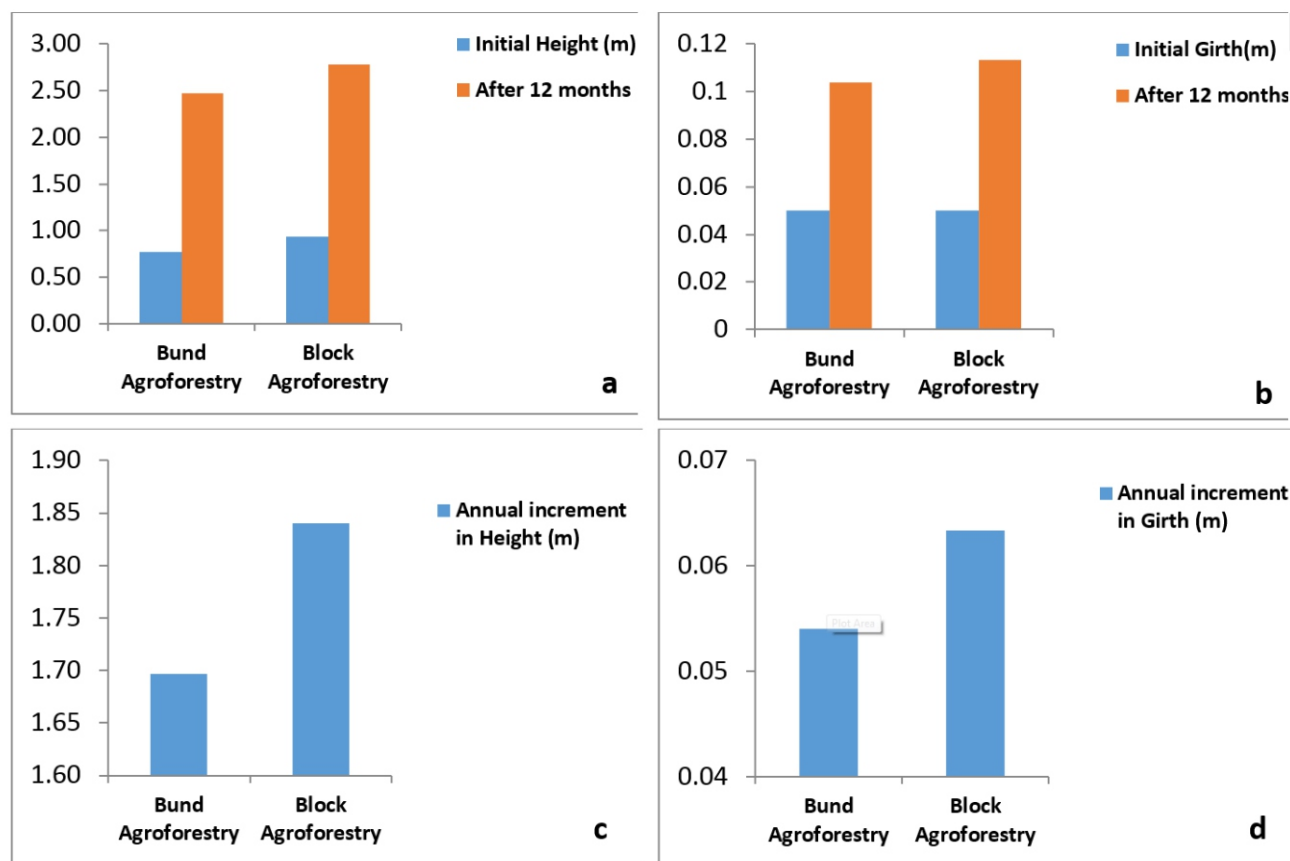
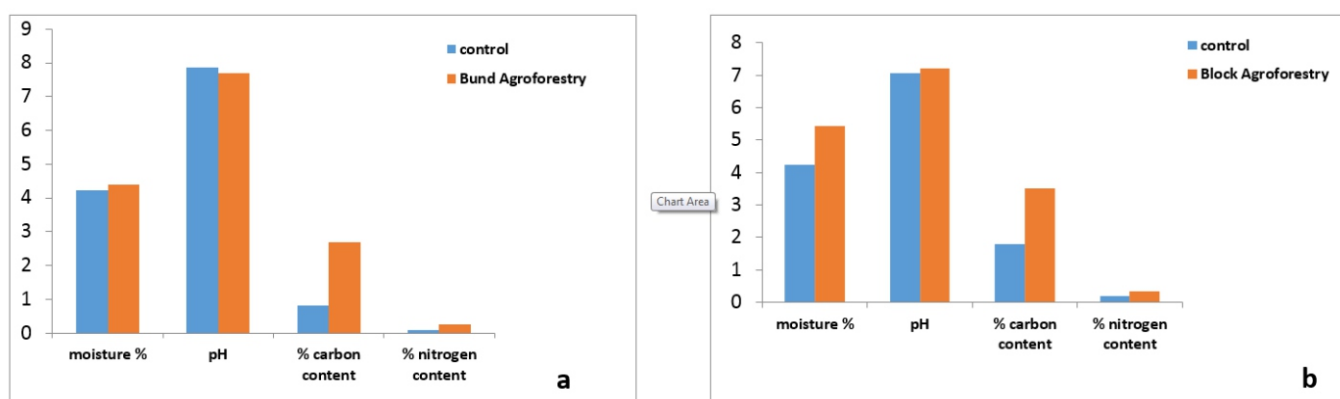


Fig. 3: Growth of *Melia dubia* in agroforestry (a) Height (b) Girth (c) Increment in Height (d) Increment in Girth

Agricultural crop (grain and straw) production data was recorded in case of bund agroforestry and block agroforestry and depicted in figure 4. In case of bund agroforestry, it was observed that crop production was increased with increase in distance from the tree line; however the impact was more in case of grain production in comparison to straw production. The production at the distance of 10m is almost at par with the control. The similar findings were also reported by several researchers (Nekar et. al. 2007; Dubey, 2010). The yields gradually ameliorated with increase in distance from tree row and the tree effect got almost nullified after 12 meter. The crop productions data (grain and straw), in case of block

agroforestry, was reduced in comparison to control. Soil parameter analysis for bund agroforestry and block agroforestry were depicted in figure 5. It was found that moisture content was more under block agroforestry in comparison to bund agroforestry and control. It may be due to shade effect which is more pronounced in block plantation. However, the pH was not affected significantly, in both cases, bund agroforestry and block agroforestry. Soil nutrient condition was improved under agroforestry. Organic carbon and nitrogen were more under agroforestry in comparison to control, in both cases. This may be due to low leaf litter from *Melia dubia*.



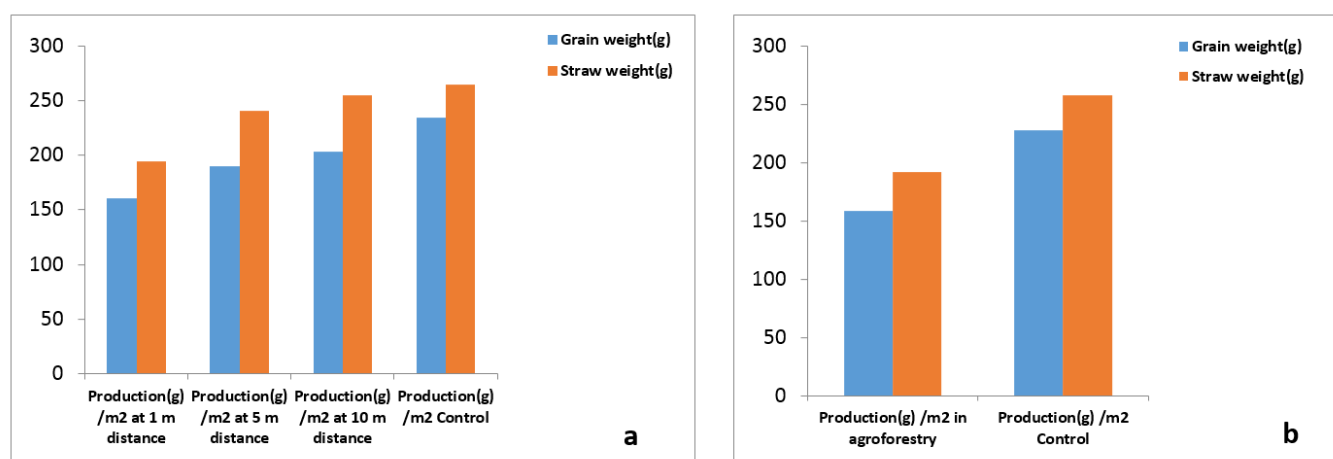


Fig. 5: Soil parameters under *Melia* Agroforestry (a) Bund (b) Block

Agroforestry has the advantage over single crop system. It has potential to significantly improve the livelihoods, economic viability, and agricultural production of traditionally managed areas. In addition, agroforestry can be used as a tool for changing attitudes towards natural resource management. Agroforestry accrue the additional advantages of tree produce, environmental benefits and biodiversity conservation. Crop production was reported less under *Melia dubia* agroforestry, which was mainly due to the shade effect. Effect of shade on wheat crop production was also reported by Singh et. al. (2005). They reported wheat crop production was reduced under Eucalyptus plantation. Reduction in crop production in different agroforestry systems in eastern Uttar Pradesh due to the shade effects was also reported by Dubey, 2010. A scientific branch pruning agro-technique may be opted to minimize this shade effect. This pruning may improve the crop productivity, on the other hand, due to high calorific value of *Melia dubia*, these pruned branches may be utilized as source of fuel. *Melia dubia* leaves are also very good fodder for livestock. Effect of trees in agroforestry system on soil organic carbon was ameliorative. Soil under agroforestry had higher soil organic carbon in comparison to control. Similar finding was also reported by several workers (Soni et. al. 2008; Gupta and Sharma 2009; Gupta and Pandey 2009; Dubey 2010). Therefore, in long run, *Melia dubia* agroforestry is beneficial in both ways economically and ecologically.

The agricultural practicing is becoming costlier day by day from the limited available land resources. Efficiency has also been reduced due to natural calamities such as floods and droughts and Nil Gai attacks. Farmers are facing difficulties to survive solely on agriculture for their livelihoods. Planting fast-growing trees under farm forestry and agroforestry is a reasonable and realistic

alternative to enhance their income and the efficiency of limited available land resources. Agroforestry as alternative land management system addresses many of the global challenges and can be applied for poverty alleviation and mitigating declining agricultural productivity and natural resources. Planting of multipurpose trees in agroforestry with high economic returns are preferred by the people (Dubey, 2010). In the present study, *Melia dubia*, a species with multipurpose use, has been introduced in agroforestry of eastern Uttar Pradesh. High economic importance of the *Melia dubia* makes it a suitable species for agroforestry. The wood quality of *Melia dubia* makes it suitable raw material for manufacturing plywood, match sticks and for use in the paper industry. Being termite resistant, *Melia* wood can also be used for making furniture, musical instruments, packing cases and agricultural implements. In such a scenario, farm-forestry or agroforestry using *Melia dubia* can be the best alternative of sole agricultural land use system. Though, the agricultural crop production was reduced under *Melia* agroforestry, in long run, it is beneficial, if managed scientifically. Agroforestry of this miracle tree may provide a viable option to gain good economic return through high-density plantations 2,500-3,000 trees/ha for paper and pulp wood (on a two-to-three year rotation basis), yielding approximately 100 to 125 tonnes of pulpwood at a market rate of Rs 3,500-4,000 per tonne (Bijalwan and Dobriyal, 2015). Various extension programmes have also been organized by the centre to popularize this species and to educate farmers for its cultivation, harvesting and commercial uses.

Agro-forestry, in true sense, has been realized as a need of the day without confining it to the regional, geographical or agro-climatic boundaries. Agro-forestry concept is a universal application and improves the socio-economic conditions of farmers. *Melia dubia* can be grown under

different agroforestry systems and plantations with different spacing depending on the objective of plantation and on-site conditions for high yield and monetary returns.

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Some unusual observations on the root system of clonal eucalypts

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Eucalypts is one of the main tree species planted on large scale in India for meeting the bulk of wood based raw material needs of the wood based industry. The tree is now life line for at least, paper and pulp, particle board, MDF and few other industries those get its wood from farmers growing it on their farms at short rotations. Eucalyptus clonal culture has picked up during the last three decades and now is the major tree species in the Indian clonal forestry scenerio.

Nearly, 237 million eucalypts clonal plants were produced by various private sector and government sector nurseries and around 200 million were field planted during 2013 (Dhiman and Gandhi, 2014). Though the production of clonal plant number wise and clone wise differs from year to year depending upon demand and market conditions but its number, by far, is maximum than any other tree species clonally planted in the country. Special infrastructure has been developed for its vegetative production by cuttings (including hedge gardens and mini cutting production systems) and propagation infrastructure (low cost poly tunnels to high tech mist chambers for rooting of cuttings). These facilities largely in private sector are operated by skilled professional manpower who record many a times some unusual but useful observations.

The two such unusual observations on root system of clonal plants were recorded from different rooting trials by the first author during the last few years and are presented here. Another observation recorded by him was from felling thousands of old and large sized eucalypts trees of seedling origin planted long back on road side and being felled for widening the roads in Uttar Pradesh, Uttarakhand, Punjab and Haryana states.

This observation even in seedling origin old eucalyptus trees has shown the lack of long tap root system as was perceived, in general, which has been held responsible for tapping the underground water causing land degradation. While debating these observations with professional engaged in eucalyptus culture, some more information is collected from the field by the associate authors,

compared with other tap root forming tree such- chir pine which is corroborated with the existing and published information. The evidences and explanations further help in understanding the controversy of eucalypts for and against tapping the underground water by its root system.

1. Unusual aerial root formation on the stem of cuttings

The normal nodal cuttings of around 10 cm length with half cut leaves are generally planted for rooting in operational propagation facilities. Such cuttings are collected from 45 days old shoots from hedge gardens. It takes around a month for rooting and another month for development of its root system to take them out of mist chambers for hardening and growth of the shoot to obtain plantable size. Such a stock is available for dispatch for field planting in a minimum of three-four months' time as it takes around a month extra for the shoot to grow to desirable and plantable size. An experiment was planned with longer shoot cuttings as how to get a desirable size of the clonal plants for meeting the sudden increased demand and reduce the operational cost of the mist chamber. Multi-nodal long cuttings of varying size up to 25 cm length were made from shoots collected from hedge gardens, treated with 2000 ppm IBA in talcum powder and planted in a mist chamber with a view to get plantable size of clonal plants as quickly as possible. All leaves were half cut similar to nodal cuttings and planted in vermiculite for rooting. Rooting of longer cuttings was faster by around a week, plug formation quicker and better. Plantable size was obtained around a month early than the traditional method of nodal cuttings. In this process it was observed that two cuttings developed unusual aerial roots on their stem (Fig.1).



Fig.1. Multiple aerial root formation on the main stem of 25 cm long two cuttings

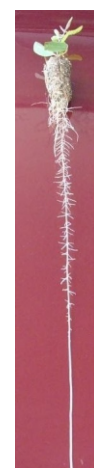


Fig. 2. Excessively long root in two months old planted cutting

Root system in trees helps in their adaptability, stability and productivity under different soil-site types. Root emerging out from radicle of germinating seed is technically referred as tap root/main root and those from rooted cuttings as adventitious roots. No report could be found in literature on such type of aerial root formation on eucalypts cutting/stem. What triggered the formation of aerial root therefore requires systematic and detailed study under controlled conditions.

In operational eucalypts clonal production facilities, its nodal cuttings are retained with half cut leaves to reduce transpiration loss of water and also encourage photosynthetic activity to regulate biochemical and physiological processes. It is also well documented that root forming hormones are produced in leaves and are trans-located through shoots to promote root development (Hartmann and Kester 1986). In the present case, 25 cm long cuttings had longer shoot and additional leaf surface than normal cuttings. It is, therefore, inferred that retaining additional leaf area in long cuttings encouraged more synthesis of root promoting hormones and that additional concentration in a couple of cuttings enabled multiple aerial root formation on their stem. Leafless stem cuttings of eucalypts do not produce copious roots and seldom failed to root in spite of external application of IBA root hormone. This new knowledge on aerial root formation on long eucalypts cuttings with additional leaf area could form the base for multiple experiments under controlled conditions to study the chemical and physiological processes to understand their role in rooting processes. It also opens up an opportunity to use longer juvenile cuttings for having fast production of suitable planting stock (subject to adequate area under hedge gardens) and efficient use of the costly mist chamber space.

2. Excessively long roots in eucalypts cuttings

On setting the juvenile cuttings for rooting, multiple roots are induced towards the distal end of their shoot. These roots grow in size and start protruding from the bottom of root trainers which are mounted above ground to facilitate their aerial pruning and development of more fibrous roots inside rooting media to make a compact plug before being shifted outside chambers for hardening and growth. An interesting but unusual observation of long roots in rooted cuttings was recorded for which it is important to mention the environment in which these developed. The surrounding walls of the beds are of brick work duly plastered and a wire-mesh placed on top of it to support root trainers. Normal nodal cuttings were treated with 2000 ppm IBA powder formulation in talcum powder and planted in vermiculite (A Grade). Keeping root trainers on wire mesh for rooting the cuttings created almost dark conditions having 10-20 percent light



Fig. 3. Cuttings produced elongated root



Fig.4. Inside view of chamber with closed wall beds, root trainers placed on the wire mesh creating darkness like conditions

intensity compared to open conditions. This was a mist chamber that was established long back in 1984 at R&D Centre of Wimco Seedlings and was first such chamber in the corporate sector which paved the way for clonal eucalypts culture in the country (Dhiman and Gandhi 2014). The cuttings were kept around three weeks extra than normal retention period inside chamber. It has been observed that one of the roots of the eucalyptus cuttings with small shoot of around 12 cm length grew multiple time longer of its shoot with morphological structure similar to tap roots (Fig.2). This is not an isolated case but the entire stock of rooted cuttings developed similar root structure (Fig.3).

This observation on formation of excessively long root needs explanation as to what lead to such phenomenon. Roots are geotropic (move with gravity) in nature and are also highly photosensitive and thus need dark conditions without or with reduced light (except aerial roots in some species) for their proper growth and development. Growing millions of plants of different species from seed and cuttings in root trainers, get their root system self-pruned on coming in contact with light on mounted beds, supports this hypothesis. In contrast to this, in a large number of root suckering species their roots on exposure to sunlight start transforming root buds to vegetative buds and produce shoots from light exposed root positions. In the present case, the ecosystem for growth of roots on protruding from root trainers was dark and moist air (Fig.4). It provided a resistant free medium to allow the roots to grow to their natural form and spread despite being adventitious roots formed in cuttings. Such a root system also develops in cuttings grown in hydroponics and aeroponic culture where least resistant media expands root system to its natural form and, horizontal and vertical spread occurs if such stock is retained for longer time for mini cutting production or otherwise (Fig.5). Eucalyptus root system grown in Aeroponic conditions for mini cutting production indicates a well-balanced fibrous root system around laterals from the base of cuttings to their bottom. The white perforated pipe sprays nutrient composition.



Fig. 5. *Eucalyptus* root system in aeroponic condition.

The major root system is near the base of cuttings and above the pipe. When the root system touches the plate at the bottom portion of the chamber, it bends and grows in different directions which seldom happens when the plant is out planted in the field.

This is further validated with a photographic evidence given in Fig. 6(a, b) for chir pine which was grown in low resistant sand medium leading to development of a long tap root, multiple of its shoot length. Seedlings were undercut to study the effect of undercutting/wrenching for bare root planting (Dhiman 1991).

3. Root spread of clonal/seedling origin eucalypts

Observations on a very large number of old eucalypts trees, established with seedling origin planting stock, during their felling and stump uprooting along roadside in North India indicates that they do not develop vertically long root system (Fig.7). In most cases, there were a large number of anchoring roots growing obliquely from near



Fig.7. A classical root system of seedling origin old eucalypts tree uprooted with JCBs on roadside in Haryana

collar portion and descending down the rhizosphere to anchor the above ground tree parts. Even in some rare cases, when the central thick root (appears to be like tap root) was observed, it was having very sharp taper from top to bottom and its vertical length was on an average around 3 m, and there were equally good number of lateral roots anchoring the tree on the ground. The vertical and horizontal root spread of root system of around 40-50 years old trees measuring around 1 m in diameter was also around 3 to 3.5 m.

The root system of four eucalyptus clones in the Bhimarha research plot in Fatehabad District of Haryana were studied where the average annual rainfall is around 600 to 700 mm, temperature from zero to 46 °C, soil sandy loam with pH around 8. It revealed that the vertical root spread of 132 cm, 105 cm, 83 cm and 147 cm for 14 years old clonal trees was recorded for clone No. BCM 304, BCM 290, BCM 306, and BCM 240 respectively. Studies on root system of 1 to 4 year old clonal eucalyptus trees revealed that the root system has a depth of 1.5 to 2.5 m with surface feeder and anchor roots (Kulkarni 2014).

The larger question, in the present context is, does a root system with a mere damage to its tap root originated from the radical of the germinating seedlings, losses its architect, form, spread and functional role of providing stability and support to the above ground parts of the tree when it grows in size and age. The evidences available so far negate such a hypothesis. Root systems in trees are strongly influenced by genetic and environmental factors (Sutton 1969, Eshel and Waisel, 1996). There is a direct correlation between tree size and its root system (Fayle, 1968), and hence the root system grows, complements and supplements above ground parts in a highly complex manner and also meets its functional role to provide the stability and survival of trees.

There is hardly a cavity/container/root trainer used in nurseries, anywhere, to grow planting stock which matches the vertical spread of roots as shown in Fig.2 and Fig.6. The main root, therefore, invariably gets coiled or damaged in traditionally used containers including



Fig. 6a. Long tap root of six months old chir pine seedlings grown in pure sand medium (left)

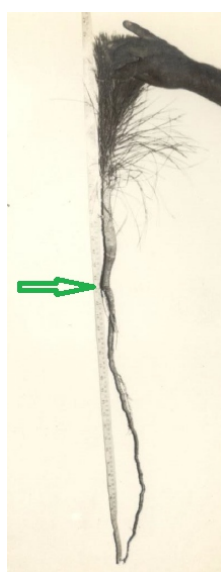


Fig. 6b. A lateral root taking over the undercut tap root and merging with the tap root at arrow point after six months of field planting

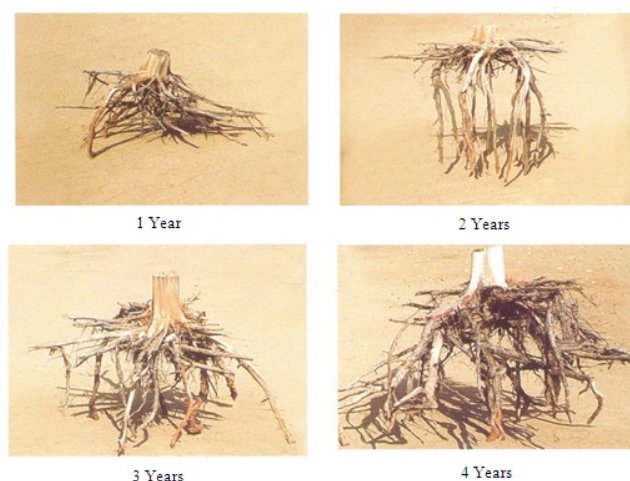


Fig. 8. Root system of 1-4 years old clonal eucalypts.

polybags or air pruned in case of bottomless root trainers. Seedlings grown in nurseries, on getting favourable medium and ecosystem on field planting, start expanding their root system either from damaged tap root or lateral roots emerging out of the plug formed inside cavities/containers during their culture in nurseries. The formation of long tap root may be happening in naturally regenerated trees from seed but hardly a practical reality in plantations established from nursery grown planting stock. According to Riedacker, et. al. (1982), the relative dominance of the tap root in dicots generally wanes with depth and even strongly tap rooted species eventually behave like diffusely rooted species. Klepper (1987) mentioned apical dominance in roots in which case if a tap root is injured or killed, one lateral root grows faster than the others and re-establishes a single dominant root. Such a lateral root taking over the functional role with a dominant vertical growth in absence of tap root is termed as “main lateral root” by Sutton and Tinus (1983). The elongation of one of the adventitious root in eucalypts as shown in Fig.2 and discussed above further gets substantiated by the photographic evidences in case of chir pine (Fig.6) where lateral roots, on cutting the tap root, developed into main lateral roots soon after field planting (Dhiman 1991). Singh (2014) recorded similar observations in vegetative produced sal (*Shorea robusta*) in which thin roots in 7 months old plants have transformed into many elongated roots (looking like tap roots) growing diagonally compared to single tap root of plants grown from seed.

Eucalypts, in India and some other countries, is known for its controversies for tapping ground water table and causing land degradation. Roots especially fibrous roots are responsible for uptake of water and organic nutrients from soil. Fibrous roots grow on lateral and main roots. The vertical spread of main roots provides an indication of the spread of fibrous roots absorbing water from different

depths below ground surface. The field observations on root depth reported here up to 14 years age for clonal origin and around 40 years old seedling origin eucalypts trees confirm that its main root system is restricted to shallow layers below surface. The maximum vertical spread recorded in the present study is upto 3.5 m. Fibrous roots supported by the main root system may further have extension to some more depth but certainly not as deep as the water table that exists in the studied locations. In Haryana, the water table is reported to be 30 to 40 m deep where the present study was made, and there is no reason to believe that main eucalypts roots located around 3 m depth are tapping water from such depths.

This is not an isolated study indicating contrary to the controversy of deep rootedness of eucalypts for tapping water from deep layers. In a study of below-ground biomass of 16 mature *E. grandis* and *Corymbia maculata* trees in open-forest, Australia, about 77 to 90% of total root biomass was found in the upper 0.5 m of soil. The fine root biomass density was approximately constant (0.1 kg m^{-3}) in the top soil (Falkiner et. al., 2006). While, studying 6.5 years old clonal plantation of eucalypts PF1 hybrid on sandy soil in Republic of Congo, Laclau et.al., (2002) found a dense root mat in the forest floor, a high density of fine and medium-sized roots in the first 20 cm of the upper soil, and a marked decrease in root density in deep soil layers. Root density decreased sharply below 50 cm under the stump. In Spain, the tap root length and maximum root length reported was 0.99 m and 1.3 m respectively for planted and 1.05 and 1.15 m respectively for coppice origin *E. Globules* of 9 years age (Herrero, 2014). Saha, et. al., (2020), while studying the root system of 6 genotypes of 2 years old *E. tereticornis* and *E. camaldulensis* reported that a major portion of the root system was confined in the 0 to 0.3 m depth and all the genotypes showed decreasing root length density with increasing depth. The estimated depth at which 50 per cent of the roots were concentrated varied between 10 and 30 cm. Mathur et. al., (1986) reported that the root system of *E. globulus* confines to a depth of 3 m and it does not affect the water table. Kulkarni (2012) reported pizometric studies of bore wells on ground water table for 5 years (2001-2006) in 1000 acre eucalypts grown area. Water level in pre- and post- monsoon period was almost constant and the statistical difference non-significant. Based on these studies, it was inferred that the plantations of 1000 acres did not impact adversely the water table either in summer or in post monsoon period. A recent publication on eucalypts (Outreach, 2019) gave substantial data for and against this controversy and tried to settle this with a dominant view that the tree does not tap ground water as is perceived by some based on rhetoric's and unverified data. This study provides direct evidences

on the root system of the tree which is not so deep (as claimed by some) that is responsible for water absorption around its spread from the upper soil profiles. Thus, it is inferred that most eucalyptus root systems having a vertical spread of around 3 to 3.5 m are more specifically adapted to using soil moisture from upper soil profiles than from the ground water table at considerable depths.

While, there may be a few isolated reports on root systems contrary to ones reported here, as there is a great variability in root form between and within tree species including eucalypts due to strong influence of both genetic and environmental factors. Investigations on root system have inherent difficulty as they are in inaccessible depths underground, and have variable form and extensive branching. In a resistant free soil ecosystem, the roots will grow to their natural form. Such an ideal condition is rarely available in the underground soil profiles where a large

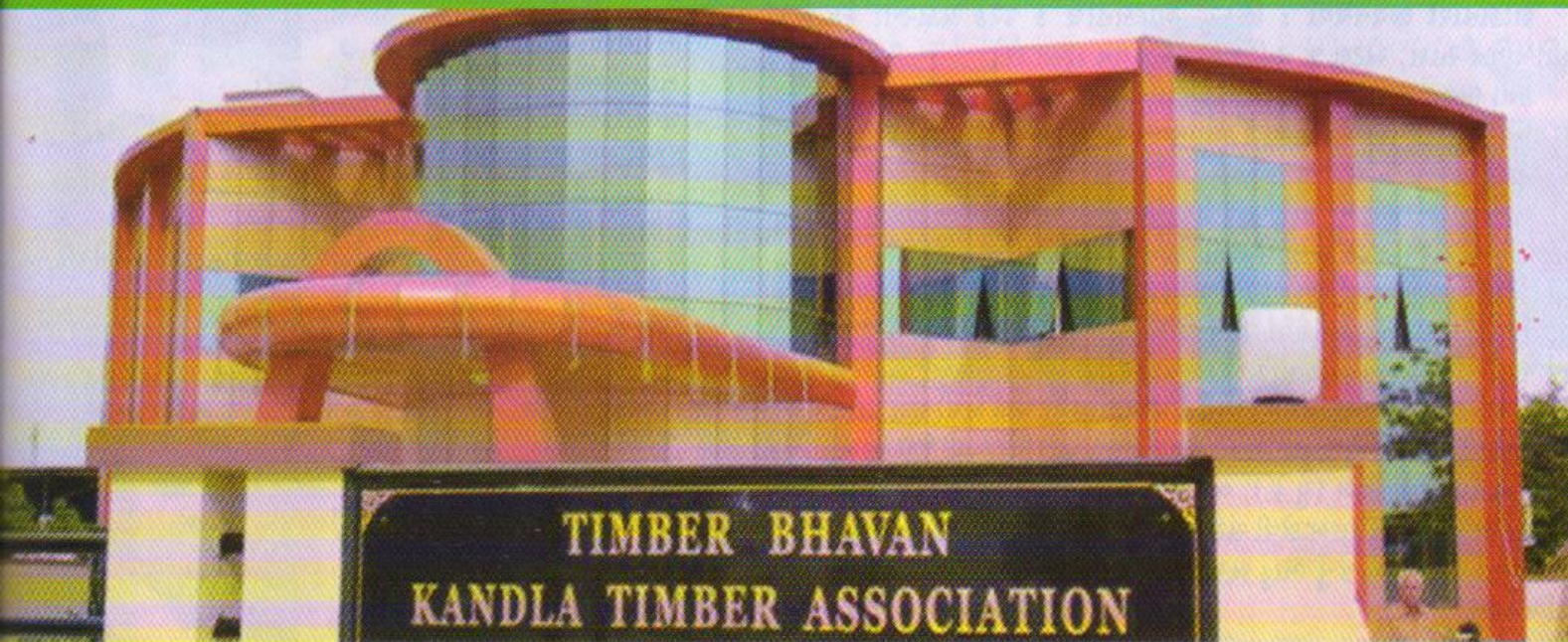
number of abiotic and biotic elements affect the growth and development of roots including their form and spread. However, one thing is sure that a tree root system does not lose its memory in developing the form and spread to support above ground parts irrespective of their origin as tap root from germinating seed or from adventitious roots in clonal origin plants. The observations on eucalypts roots presented here are further validated with photographic evidences from another tree –chir pine supporting this view point. These observations were, however, limited in term of numbers, species and locations. More such studies on eucalypts will add to the existing knowledge on its root systems and further dispel the fear created in the minds of people that eucalyptus draws water from deep underground layers - an unwarranted controversy.

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