

wood is good GROW MORE, USE MORE









Vol. 4, Issue 3, October - December 2023







wood is good

GROW MORE, USE MORE

PATRON

Bharat Jyoti

Director General, Indian Council of Forestry Research and Education

Jagmohan Sharma

Director General, Indian Council of Forestry Research and Education

Kanchan Devi

Director General, Indian Council of Forestry Research and Education

EDITORIAL BOARD

PRESIDENT

Sajjan Bhajanka

President, Federation of Indian Plywood & Panel Industry (FIPPI)

VICE PRESIDENTS

R.V. Rao

President, Indian Academy of Wood Science (IAWS)

Dwara Ramakrishna

Federation of All India Timber Merchants, Saw Millers & Allied Industries

Jikesh Thakkar

Executive Director, Association of Indian Panelboard Manufacturers (AIPM)

Rahul Mehta

COO, Furniture & Fittings Skill Council

Naresh Tiwari

Chairman, All India Plywood Manufacturers Association (AIPMA)

Subhash Chandra Jolly

President, Wood Technologist Association (WTA)

M.M.Mujeeb Rahman

President, Sawmill Owners and Plywood Manufactures Association

Amrik Singh Anand

Senior Technocrat & Progressive Farmer

Navnit Gajjar

President, Kandla Timber Association

EDITOR-IN-CHIEF

M.P. Singh

Director, ICFRE - Institute of Wood Science & Technology

EDITORS

N. Palanikanth

Head, Extension Division, ICFRE - Institute of Wood Science & Technology

Shakti Singh Chauhan

Head, WPP Division, ICFRE - Institute of Wood Science & Technology

D. Sujatha

PPPT Division, ICFRE - Institute of Wood Science and Technology

Rajesh S. Kallaje

Head SFM Division, ICFRE - Institute of Wood Science & Technology

C.M. Shivakumar

Group Co-ordinator (Res.) ICFRE - Institute of Wood Science & Technology



BLUEPRINTS OF OUR GREEN FOOTPRINTS

Our manufacturing unit in Visakhapatnam has been awarded the IGBC Green Building certification.



Certification Milestone

MDF Board unit in Visakhapatnam to receive Green Building Certification

Green Landscaping

32% plant site covered with vegetation 50% are drought-tolerant species

Cost Savings

64.58% of energy cost savings

Energy Efficiency

40% reduction in energy consumption 30% reduction in water consumption

Government Support

50% reimbursement for green measures

Wastewater Excellence

100% wastewater treatment at plant.



Toll Free No.: 1800 233 7952 www.vir-mdf.com | info@rushil.com

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION

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

VISION

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



MISSION

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



CYCUS v. 1.0

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

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

ZiBOC

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



Varieties/ Clones developed

- 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.



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 coloures, 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

Assistant Director General, Media & Extension Division, Indian Council of Forestry Research and Education, Dehradun - 248 006 Phone:- +91-135-222 4814, +91-135-2755221,











DR. M.P. SINGH, IFS

DIRECTOR
INSTITUTE OF WOOD SCIENCE
AND TECHNOLOGY,
P.O. MALLESHWARAM,
BENGALURU - 560003

Preface

ICFRE-Institute of Wood Science and Technology (IWST), Bengaluru is bringing out this issue of Wood is Good magazine which is in continuation to Vol.4, Issue. 2 July to September 2023 edition of Wood is Good including important articles related to wood technologies developed by ICFRE-IWST and articles related to functioning of Forest Development Corporations of different states. ICFRE-IWST through Wood is Good magazine is creating awareness among wood industries, Forest Departments, other stakeholders regarding the technologies developed in the field of wood science. This issue also includes the proceedings of the Institute-Industry Interactive meet held at Perumbavoor, Kerala on 14th December, 2023 with the objective to understand the ground level related problems faced by wood industries and also to bring awareness about research of wood based panel products of the Institute to the industries.

In this issue few of the wood technologies developed by ICFRE-IWST viz. "Cement Bonded Bamboo Board", "Development of Medium Density Particle Board from Lantana camara", "Wooden Core plugs from paper mill waste" and "Electrical Resistance Tomograph (ERT): A Novel Technology in Forestry" etc. are presented which will immensely help the stakeholders especially entrepreneurs and wood based industries to take up these technologies in consultation with ICFRE-IWST for greater cause.

Articles on functioning of Forest Development Corporations of Madhya Pradesh, Gujarat, Odisha, Kerala, Chattisgarh, Goa, Rajasthan and Karnataka have also been covered in this issue to showcase the production aspect and activities which are being carried out by them to various stakeholders so that they can interact with Forest Development Corporations as per their needs and requirement.

This issue also covers highlights of the salient features of the draft report of Joint Working Committee of Ministry of Environment, Forest and Climate Change (MoEF&CC) for promotion and expansion of Tree outside Forests and recommendations of Task Force of MoEF&CC to develop synergies between National Forest Policy, Forest Conservation Act 1980 and National Agro Forestry Policy 2014. Further a draft Agroforestry Act is also presented in this issue, which was prepared by ICFRE-IWST to give effect to National Agroforestry Policy 2014 and submitted to the Ministry of Agriculture and Farmers' Welfare for due consideration.

I am sure this edition in continuation to earlier edition will create interest and motivation to various stakeholders in subjects related to wood technologies of ICFRE and functioning of different Forest Development Corporations.

Dated: 15th January 2024

(M.P. Singh)









THE LEADER OF SURFACE SOLUTIONS

When it comes to plywood, real wood floors, premium veneers, decorative laminates, exterior cladding, or even doors and frames, one name will leave you spailt for choice - Greenlam.

Greenlam is a name of trust and reliability. It is tridia's Nis. 1, Asia's largest, and among the top three home surfacing solution brands in the world. With its presence in over 100 countries, Greenlam caters to all the possible attributes of a home and transforms it into a personalised space, unique and exclusive just for you.

For any query, please contact at our To8-Free Nos.: 1800-833-0004

www.greenlamindustries.com













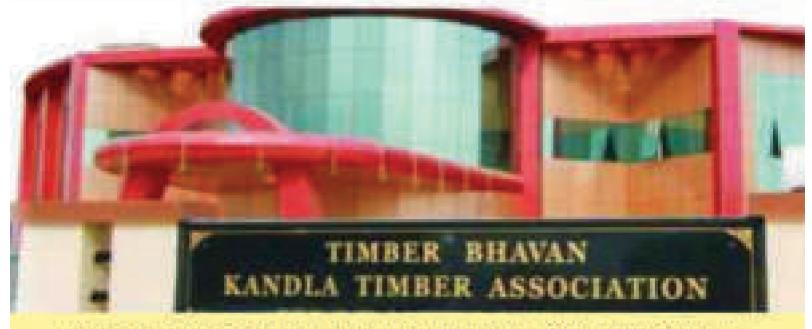


Duroply Industries Limited

BLOCK BOARD - PLYWOOD - VENEERS - DOORS

Toll Free: 1800-345-3876 (DURO) | Website: www.duroply.in E-Mail: corp@duroply.com | Find us on: 1 in 2 2





Association of Timber Imorters, Traders, Saw Mill Owners, Plywood & Veneer Manufacturers

MANAGING COMMITTEE

Shri NAVNIT R GALLAR

President.

Mon: +91 98252 25163

E-mail: supreyenterprise1717@gmail.com

Shiri, DHARMESH C. JOSHI

Hon. Secretory

Main: +91 99137 77768

E-mail: dharmeshinshif-Bornal.com

SHH. BHARATH H. PATEL

Hon Treasurer

Mai: +91 98250 20825

E-mail: ravikiras825@gmail.com

Shi HEMCHANDRA B. YADAY

Vice President

Mate: +91 98262 25515

E-mail hemackendrayadav@gmail.com

Shirl SANJEEV GUPTHA

Jt. Becretory

Mab: +91 99252 25067

E-mail sarge-reguetha timber@gmail.com

SHIL PRAVEEN BANSAL

J. Treasurer

Mob. +91 99099 48025

E-mail: gdm8025@gmail.com

Timber Shanan: Plot Na.-47, Sector-9, Gandhidham - Kotch - Gajarot 370 201

Phone: 02836-236676, 232613

Telefus, 02836-222337, E-mail: kata.admsi/amail.com

With: www.kandlatimbes.org

CONTENT

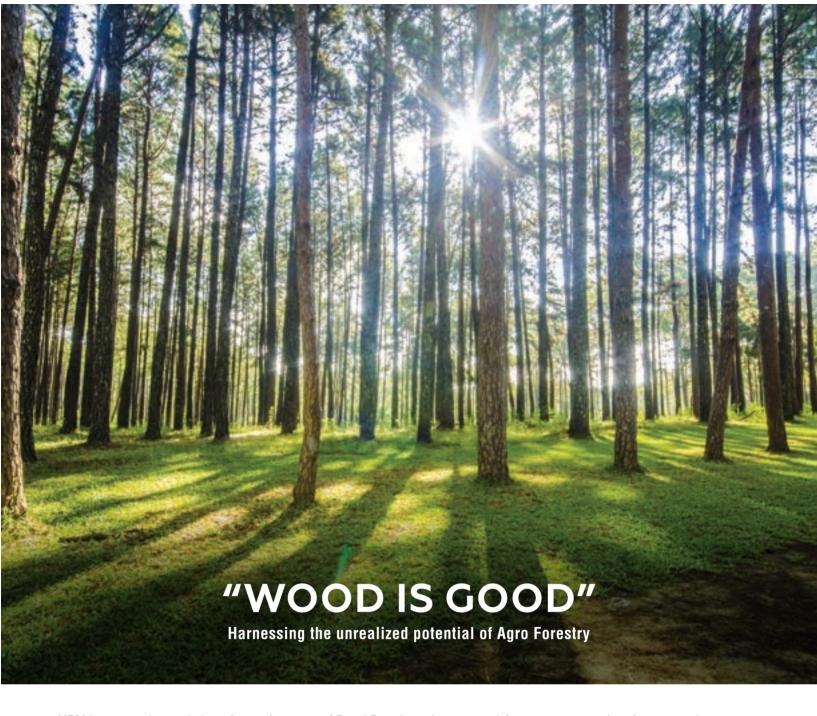
IWST Activities during October - December 2023 Proceedings of the Institute-Industry Interactive meet held at Perumbayoor, Kerala on 14th December, 2023 Agroforestry (Promotion and Facilitation) Draft Act, 2023 (A Draft Act submitted by ICFRE-IWST to MoA&FW, GOI) Brief on Draft Report of Joint Working Group for Promotion 18 and Expansion of the Tree outside Forest (ToF) Brief on Draft Report of Task force for Developing Synergies between the National Forest Policy, FCA, 1980 and National Agroforestry Policy, 2014 Tapesh Kumar Jha Manoj Kumar Dubey Activities of Chhattisgarh Rajya Van Vikas Nigam-Improvement in Colour Uniformity and Furthering the Cause of Timber Production in Dimensional Stability of Wood through Central India Oil Heat-Treatment Nandakumar E. Parab A Muthu Kumar Activities of Goa Forest Development Microbes Build Wood (Microbe Wood) Corporation Ltd. (Government of Goa Undertaking) Mamatha.B. S Wooden Core Plugs from Paper Mill Waste Ram Ratan Nala Activities of Gujarat State Forest Development **Amitava Sil** Corporation Ltd. (Govt. of Gujarat undertaking) Use of Bamboo Composites as Components of Disaster Resistant Houses Activities of Karnataka Forest Development Baragur Neelappa Divakara Electrical Resistance Tomograph (ERT): Corporation Limited A Novel Technology in Forestry Georgi P. Mathachan Activities of Kerala Forest Development S.C.Sahoo Incorporating Jute Felt:- A Novel Approach to Corporation Enhance Plywood Manufacturing. **Abhay Kumar Patil** Narasimhamurthy, Pradeep Kushwaha, Activities of Madhya Pradesh State Forest **Development Corporation Limited** Rashmi Ramesh Shanbhag, Mamatha B. S., Mahesh K. Protocol for the Protection and Preservation Suresh Pant of Wooden Artefact in Outdoor Conditions Activities of Odisha Forest Development Corporation- A Journey from Forest Contractor Mamatha B.S., Sujatha D., and M.P. Singh to Green Developer Harmonization of Medium Density Fiber Board Standards: A need for Product Application **Uday Shankar** Revision of IS 303 standards Activities of Rajasthan State Forest Development (Comparison between old and new IS 303 standards) Corporation Limited Revision of IS 710 standards Manish Ranjan (Comparison between old and new IS 710 standards) Cement Bonded Bamboo Board Revision of IS 4990 standards V R Ramkumar, K Thanigai, M C Kiran, (Comparison between old and new IS 4990 standards) V Prakash, and Manoj Kumar Dubey

DATA POINT: Timber Import Statistics in India:

V.K. Upadhyay

Development of Medium Density Particle Board

from Lantana camara



AIPM is a trusted association of manufacturers of Panel Board gearing up stead-fast to encourage Agroforestry and aggressively creating strategies to harness the unrealized potential of Agro-Forestry and form a sustainable product through Agroforestry.

The Member companies in association with Govt. bodies like IWST, IPIRTI & other influential entities are continuously investing efforts & augmenting innovative skills & efficient options on agroforestry for sourcing raw materials from Farmers leading to sustainable livelihood & creating symbiotic mutual beneficial relationship.

AIPM is developing its capacity and strengthening the research in agroforestry and expanding the plantation in an integrated manner to improve productivity, employment, income and livelihoods as a dedicated adage.

COST EFFECTIVE | DESIGNER | SUSTAINABLE

DURABLE & ENVIRONMENT FRIENDLY | MOULDED INTO SHAPES

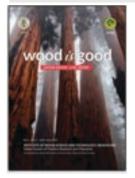
Address: 2nd floor, Rushil House, Near Neelkanth Green Bunglow, Off. Sindhu bhavan Road, Shilaj, Ahmedabad - 380058, Gujarat, INDIA.

Tele. No.: +91-79-61400400 | FAX No.: +91-79-61400401

E-mail: jt@aipm.in | Website: www.aipm.in



Wood is Good Vol. 1 Issue 1 April-June 2020





Wood is Good Vol. 1 Issue 2 July-September 2020





Wood is Good Vol. 1 Issue 3 October-December 2020





Wood is Good Vol. 1 Issue 4 January-March 2021





Wood is Good Vol. 2 Issue 1 April-June 2021





Wood is Good Vol. 2 Issue 2 July-September 2021



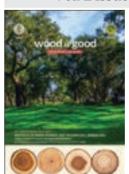


Wood is Good Vol. 2 Issue 3 October-December 2021





Wood is Good Vol. 2 Issue 4 January-March 2022



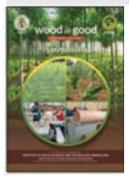


Wood is Good Vol. 3 Issue 1 April-June 2022





Wood is Good Vol. 3 Issue 2 April-June 2022





Wood is Good Vol. 3 Issue 3 October - December 2022





Wood is Good Vol. 1 Issue 1 April-June 2020





Wood is Good Vol. 4 Issue 1 April - June 2023





Wood is Good Vol. 4 Issue 2 July - September 2023





IWST activities during October-December, 2023

Gandhi Jayanthi

ICFRE-IWST celebrated 154th Gandhi Jayanthi on 2 October 2023. Dr.M.P.Singh, Director, IWST and staff members paid homage to Mahatma Gandhi. On this occasion, Dr. Ashwath Narayana, Professor (Retd), Bangalore University delivered a talk on "Gandhian thoughts-Historical perspective". Also, Dr. G.S Purushothama, Lecturer, Department of Pre University Education Government of Karnataka delivered a talk lecture on "Gandhian Thoughts and its relevance in contemporary scenario"



One month Training course on "Plywood Manufacturing Technology"

In recent years HR Planning has assumed great significance in manufacturing sector which includes wood based panel industry and this Institute caters to HRD needs of the wood based panel industries through several training programmes. In this endeavor, IWST Field Station Kolkata has excellent infrastructural facilities for



classroom teaching, laboratory and factory simulated facilities for "hands on" training in Plywood, Resin Manufacture and Testing etc and successfully completed one month certified training course on "Plywood Manufacturing Technology" from 4th-6th Oct 2023 at the campus. Timber and defects, resin manufacturing, plywood manufacturing, testing of plywood, blockboard, flush door, retention of preservative chemical, power requirement in industries were the key focus of training. Classroom & practical sessions, demonstration at industry were organized. Seven students were benefitted by this

training program. Seven trainees from after obtaining their graduation were benefitted from this training course.

Training on Bamboo Cultivation, Management, Seasoning, Preservation and Utilization

Under the AICRP Bamboo project, ICFRE-IWST, Bangalore in association with Goa State Forest Research & Training Institute (GSFRTI), Valpoi, Goa conducted a training on Bamboo cultivation, management,

seasoning, preservation & utilization on 6 October 2023. The training program was inaugurated through lighting of the lamp by Mr. Vishwanath G Pingulkar. Principal, and officials of IWST. About 50 farmers participated in the program. The participants were given a brief of the research activities, extension activities and trainings imparted at IWST. They were also sensitized about Mission LiFE initiative and pledge was administered. This was followed by a lecture on cultivation and management of bamboo, utilization of bamboo and on bamboo seasoning and preservation. The presentation on bamboo seasoning and preservation was followed by



demonstration on bamboo preservative treatment with special emphasis on usage of eco-friendly preservatives like Neem oil and Cashew nut shell liquid using simple treatment technique like brush coating and dipping methods of treatment for dry bamboo. During the interaction session, farmers raised many questions on various aspects of nursery techniques, utilization, harvesting, marketing, bamboo processing techniques and shared their expericence on different types of simple seasoning and preservation techniques followed by them to improve the service life of bamboo.

ICFRE-IWST, Bangalore organized a lecture on "Community Awareness on Basic Life Support Training Program" by Dr Gopinath, Emergency Physician and Life Skill Trainer on 13th October 2023 as part of Mission Life activity. All officers/Staff/Students attended the said program.



Training for IFS officers on Advances in Wood Production and Utilization

ICFRE-IWST organized, MoEF & CC sponsored one week compulsory training (through physical mode) for IFS officers on "Advances in Wood Production and Utilization". A total of 13 IFS officers nominated by MoEF & CC from different states attended the training from 16th - 20th October 2023. Dr. Jagmohan Sharma, IFS, Director General, EMPRI delivered the inaugural address. He emphasized on the importance of wood production and enhancing capacity for utilization of wood. He encouraged participants to focus more on production forestry as per the principles of Sustainable Forest Management and uses of wood products in building constructions since wood which is a renewable and carbon neutral material helps in carbon storage. Dr. M.P. Singh,



IFS, Director, ICFRE-IWST emphasized the importance of using wood as sustainable building material and highlighted the salient features of NWPC - 2023 and Indian Forest Management Standards.



The training was broadly classified into five sessions namely overview & industrial wood production; wood science & technology; wood production of high value species; wood based panels & sandalwood products and woodworking machinery & design. The course curriculum included field trip to Karnataka, Soaps and Detergents Ltd. (KSDL), Bengaluru, National Institute of Design, Bengaluru, Wood Working & Machinery at M/s Tischlers India Pvt. Ltd., Bangalore, M/s Pyramid Timber Associates Pvt Ltd, M/s Hunsur Plywood Works Ltd. and Chennapatna Craft Park. The officers also visited IWST laboratories, xylarium, wood museum and wood working centre to get an understanding of the research activities being carried out at the institute. Experts from Federation of Indian Plywood & Panel Industry, wood based industry representatives, timber trade consultants, retd. forests officials and researchers and experts in the field of design and wooden building technology delivered presentations and interacted with the participants.

Visit of IFS Probationary Officers

Dr. M. P. Singh, IFS, Director ICFRE-IWST addressed about 52 Indian Forest Service (IFS) Probationers of 2022 -24 batch from Indira Gandhi National Forest Academy, Dehradun during their visit to the institute on 21st October 2023. The officers were given an overview about the research activities of the institute. They interacted with Director and his team of scientists. This was followed by visit to laboratories, xylarium, Wood workshop and Advance Woodworking Training Centre of the institute.



Meeting of Technical Committee



Dr .M.P. Singh Director, IWST convened 4th Meeting of Technical Committee II under "National Bamboo Mission" with participation of bamboo related industries, entrepreneurs, NGOs and institutes such as Mutha Industries, Bio Craft innovations, ITC, Uravu, Bamboo Pecker, NID Bengaluru, BCDI Agartalaetc.was held on 26th October 2023. The main focus of the meeting was to discuss the ways and means to rejuvenate the bamboo sector in India, benefitting both small enterprises as well as larger commercial units in order to empower the sector's role in both domestic market and for export.

Vigilance Awareness Week

Vigilance Awareness Week was observed by ICFRE-IWST, Bangalore and Kolkata Fieldstation from 30th October 2023. Dr. M. P. Singh IFS, Director ICFRE-IWST led the officers, scientists, staff and students in taking Integrity pledge to commence the Vigilance Awareness Week 2023. Poster and elocution completions on the theme "Say No to Corruption; Commit to the Nation" were organized for staff and students. The institute concluded Vigilance Awareness Week 2023 on 10 November 2023. The Chief Guest of the occasion, Shri. Ramesh. G, IRS, Chief Vigilance officer, Karnataka



Antibiotics & Pharmaceuticals Ltd., (KAPL) addressed the gathering and distributed prizes to winners of competitions.



Rashtriya Ekta Diwas

Rashtriya Ekta Diwas / National Unity Day the birth anniversary of our great leader Sardar Vallabhbhai was observed on 31st October 2023. Dr. M. P. Singh, IFS, Director IWST administered the oath. Officers, scientists, staff and students of the institute took the oath to make India united and secular.

Kannada Rajyotsava

IWST, Bangalore on 1 Nov 2022 celebrated State Formation Day - Kannada Rajyotsava with great enthusiasm. M. P. Singh, Director ICFRE-IWST hoisted the Karnataka flag and wished the employees on the occasion. During the preceding week various sports completions were held for the staff and students. Dr. Shripad S.B., KAS, PS to Deputy Speaker, Vidhana Soudha, Bangalore and Dr. Nagendra F.Honnalli, KAS, Director, Commissionerate of



Industrial Training & Employment, Koushalya Bhavan, Bangalore delivered the inaugural address on occasion of Kannada Rajyotsava. The program ended with distribution of prizes to winners of various cultural & sports competitions and cultural extravaganza by staff &students of the institute.



Specialized training module on Wood Technology

ICFRE-IWST conducted two days specialized training module on "Wood Technology" for 55 State Forest Service Officer trainees of CASFOS, Coimbatore during 1 – 2 November 2023. Shri Anisha Kalkoor, IFS, Lecturer, CASFOS, Coimbatore accompanied the trainees during their visit. The two days training covered wood identification, structure and properties of wood, bio deterioration of wood and its control, wood seasoning and its importance. They were also introduced to emerging trends in wood technology, wood and

bamboo based products, saw milling and saw doctoring. They visited Tissue culture lab, wood anatomy lab, wood workshops and plants at both campus of the institute, wood museum & Advance Woodworking Training Centre. Dr. M. P. Singh, IFS, Director, ICFRE-IWST addressed and interacted with the trainees. He discussed about the National Working Plan Code 2023 and the importance of Indian Forest Management Standards.

Forestry Training and Capacity Building: Training of Other Stakeholders on Bamboo Processing and Utilization

ICFRE-IWST, Bangalore organized three days training program on Bamboo Processing and Utilization from 6th - 8th November 2023 sponsored by Ministry of Environment, Forest, and Climate Change, New Delhi. The program witnessed participation of 32 trainees representing IT sector, architecture, bamboo plantation, handicrafts, and engineering from states across India. A total of twelve lectures were scheduled over three days covering bamboo propagation techniques, carbon capture, themo plastics, lumbar technology, industrial production, bamboo composite housing technology, seasoning & preservation, application and architectural potential, value addition and innovative designs in bamboo furniture. Four external resource persons were invited for the training.



The training program was initiated on 6thNovember 2023. Chief Guest of the occasion, Shri. Rajkumar Srivastava (IFS), PCCF (Development), Karnataka Forest Department delivered the Key Note Address on "Govt. of India Scheme: National Bamboo Mission (NBM) & its application in Karnataka". In his address, he emphasized on the key elements of NBM namely research and development, establishment of new nurseries, raising high yielding bamboo plantations, pest and disease management, sharing best agronomic practices, capacity building, marketing etc. Dr. M. P. Singh, IFS, Director, IWST in his address to the participants, quantified the role of IWST in providing training to various stakeholders and expressed his happiness in the successful participation of stakeholders to the training program. Classroom sessions were supplemented with visit to National Institute of Design (NID) to view the product range developed at the Bamboo Design Lab of NID and to various laboratories and workshops at IWST. The IWST-IPIRTI campus visit provided insight on processing machinery, operations, maintenance practices, and bamboo product development at a lab scale. Demonstrations on bamboo preservation techniques further enriched the hands-on experience, providing valuable insights and potential avenues for entrepreneurial ventures.

KrishiMela 2023

ICFRE-IWST put up a display stall and participated in KrishiMela 2023 organized by University of Agricultural Sciences at GKVK Campus Bangalore during 17th- 20th November 2023. The visitors mostly farmers showed keen interest in cultivating sandalwood, bamboo, teak and other important tree

species in their farmlands either as agroforestry or as plantations. They were briefed on the cultivation, management and protection aspects of these species. Seasoning, preservation of bamboo and wood & wood products were also explained to the visitors. End users also enquired about the short term training programs conducted on various topics by the institute.





Short Term Training on Wood Seasoning and Preservation

IWST, Bangalore organized a Short Term Training on "Wood Seasoning and Preservation" from 20th to 24th November 2023 at IWST through physical mode. 22 Foresters and Range Forest Officers of Tamilnadu Forest Department attended the training. The technical session covered by subject expects working on wood science and technology included topics likewood structure with relevance to seasoning and preservation, properties and utilization of wood, new developments in wood drying techniques, basics of wood seasoning, seasoning kilns, kiln schedules. seasoning defects, wood deteriorating insects and their management, fungal degradation of wood, wood preservation, preservative treatment methods. The participants were also introduced to wood modification aspects namely thermal modification of wood and surface treatment of wood in terms of coatings and colour. Preservative treatment methods using Bucherie/ Sap displacement/ Pressure method was demonstrated during the training. Visits to Seasoning and Preservation Plant at Karnataka State Forest Industries Corporation, Bangalore; Chennapatna Craft Park; Wood workshop (seasoning kilns), Xylarium and plywood plant at both campus of IWST were also part of the program.





Capsule course on plywood, block boards, resin and flush door

ICFRE-IWST Field Station Kolkata and Bureau of Indian Standards, Eastern Region Kolkata organized one day capsule course on plywood, block boards, resin and flush door as per relevant Indian Standards in at its campus on 24th November, 2023. The program's goal was to teach the Quality Control personnel how to test and inspect wood based panel products that meet the Indian standards. From the course the personnel from different industries understood about quality control and assessment and solution to the problem addressed. In this capsule course, short lecture along with a practical demonstration of testing, including a brief on testing procedures were given. Total 15 personnel from Quality control of wood based panel product industries benefited from the programme.



Meeting with Andhra Pradesh Forest Department

Group of scientists and officers from ICFRE-IWST led by Director, ICFRE-IWST visited AranyaBhavan, Andhra Pradesh had discussion with senior officers of APFD led by Shri. Y. Madhusudhan Reddy, IFS, PCCF (HoFF) on 28th November 2023 at Vijayawada, Andhra Pradesh to discuss on the possible research proposals from ICFRE-IWST and also to review the proposed methodology of evaluation of CAMPA works. Some of the important aspects discussed during the meeting was,



research related to identifying suitable Agroforestry species for Rayalaseema region, propagation techniques for RET species of Eastern Ghats of Andhra Pradesh, Red Sanders, Protocols of Bamboo tissue culture etc.

Convocation Ceremony -33rd batch of PGDC course in WPPT

Convocation Ceremony of 33rd batch of PGDC course in Wood and Panel Products Technology (WPPT) consisting of 40 students was held on 1 December 2023. Dr. SurabhiRai DIG (RT) MOEF & CC addressed the gathering as Chief Guest. The syllabus for this course is mainly focused on manufacture of plywood and panel products from wood and other ligno cellulosic materials. Or the first time, students also got industrial exposure through Internship in different wood-based industries for 3 months. The Institute also facilitates recruitment of trainees by wood based industries in various parts of the country through placement process for which campus interview was arranged towards the end of the course.



Specialized training module on Wood Science and Technology



ICFRE-IWST, Bangalore conducted four days Specialized training module on "Wood Science and Technology" from 5th to 8th December 2023 for 11 Forest Officials from Tamil Nadu Forest Academy, Coimbatore. The training included topics of need and interest to the department officials like wood as a sustainable material,

physical and mechanical properties of timber, wood degradation by insect pests, wood decay and its impact on wood properties. They were taught in detail about internal structure of wood and identification of important timber species. Basics of wood drying, drying schedules, seasoning methods, preservative treatment methods were highlighted and a demonstration was conducted on seasoning, preservation and nondestructive testing method. Advanced wood processing technologies, termal modification of wood, wood briquetting, wood polymer composite were few to aspects that were introduced to the trainees. The trainees were interested to learn about tissue culture and identification of heartwood in high value tree species through Electric Resistance Tomograph (ERT). ERT which is a non destructive technique to evaluate standing trees was also demonstrated. They visited the various facilities of the institute like Tissue culture lab, wood anatomy lab, wood workshops and plants at both campus of the institute, wood museum & Advance Woodworking Training Centre. During the concluding session, Dr. M. P. Singh, IFS, Director, ICFRE-IWST addressed and interacted with the trainees. He discussed about the National Working Plan Code 2023 and the importance of Indian Forest Management Standards.

Mahapari Nirvan Diwas

ICFRE-IWST observed Mahapari Nirvan Diwas on 6th December 2023. Dr. M. P. Singh, Director, IWST lead the staff and celebrated by offering floral tribute to Dr. B. R. Ambedkar on his 66th Death Anniversary.



Forestry Training and Capacity Building: Training of Other Stakeholders on Sandalwood Cultivation and its Prospects

ICFRE-IWST organized three days training during 6^{th} – 8^{th} December 2023 on "Sandalwood Cultivation and its Prospects" to sensitize and educate stakeholders. The training was well received by 34 participants from various



backgrounds like chartered accountants, lawyers, engineers and professionals, businessmen, bankers, academicians, NGOs, homemakers, social activists, students, farmers, etc. The training was sponsored by Ministry of Environment, Forest and Climate Change under the Umbrella Scheme: Forestry Training and Capacity Building - Training to Other Stakeholders.

The training program was inaugurated on 6th December 2023. About eleven lectures were scheduled over three days covering sandalwood nursery

technology, agroforestry, management of pest & diseases, policy and marketing. The in house resource persons included IFS officers and scientists from IWST who are working in the field of sandalwood research. Two external resource persons were also invited for the training. A half day field exposure visit was to get first-hand field information, directly interact and hear about the experience on growing sandalwood along with various combinations of trees and plants. They visited Thapovan located in Baradhi village, Nelamangala, Rural Bangalore. On field, they learnt about various hosts, growing of sandalwood in trenches as a measure to save the root stock from theft. They also visited the Karnataka Soaps and Detergents Limited and got firsthand information related to the process of making world famous Mysore Sandal Soap.

Institute Industry Interactive Meet

The ICFRE- IWST Industry Interactive Meet was successfully organized under the leadership of Dr. M. P. Singh, IFS, Director, ICFRE-IWST at VMJ Auditorium, Perumbavoor, Kochi, Kerala on 14th December 2023. Sawmill Owners and plywood Manufacturing Association (SOPMA) supported in organizing this meet. About 350 participants from 291 different industries benefitted from the program. The detailed proceedings are published in this issue.



Memorandum of Understanding Signed

- Memorandum of Understanding has been signed between Dr. M. P. Singh, Director, ICFRE- Institute of Wood Science and Technology, Bangalore and Prof. L. S. Shashidhara, Director, National Centre for Biological Sciences – Tata Institute of Fundamental Research, Bangalore (NCBS-TIFR), Bengaluru on 5th October 2023 to collaborate in research on forest management, biodiversity conservation & value addition of wood and wood products.
- Memorandum of Understanding has been signed between Dr. M. P. Singh, Director, ICFRE- Institute of Wood Science and Technology, Bangalore and Dr. M. K. Gupta, Director, Central Pulp and Paper Research institute, Saharanpur on 21st November 2023 for academic and research collaborations
- Memorandum of Understanding has been signed between ICFRE- Institute of Wood Science and Technology, Bangalore and Chem Process Systems Pvt Ltd, Gujarat on 11th December 2023 for development of adhesives using lignin as a biomaterial for plywood.

Visit of Delegates

- Shri. Bharat Jyoti IFS, Director, IGNFA / DG-ICFRE visited ICFRE-IWST, Bangalore on 4th October 2023. During the visit he had fruitful interaction with scientists and officers of IWST regarding various research projects and their progress.
- Dr. M. P. Singh IFS, Director, ICFRE-IWST welcomed Dr. SurabhiRai IFS, DIG (R&T), MoEF&CC during her visit to ICFRE-IWST on 1st November 2023. Dr. Surabhi Rai interacted with officers and scientists regarding research activities, capacity building programs and policy support of IWST to the wood sector. She visited Advanced wood working Training Centre and IPIRTI campus of IWST.





VVK - KVK trainings

Under VanaVigyan Kendra trainings funded by CAMPA, ICFRE-IWST, Bangalore conducted a one day training program on "Bamboo cultivation, seasoning, preservation and utilization" under CAMPA extension funding. The training program was conducted through KrishiVigyan Kendra, Margoa, South Goa on 4th October 2023. Sri. Shivaram B. N. Goankar, Program Coordinator, KVK initiated the program by lighting the lamp. About 50 farmers participated. and enhanced their knowledge.

The participants were given a brief of the research activities, extension activities and training imparted at IWST. They were also sensitized about Mission LiFE initiative and pledge was administered. This was followed by a lecture on cultivation and management of bamboo, utilization of bamboo and on bamboo seasoning and preservation. The presentation on bamboo seasoning and preservation was followed by demonstration on bamboo preservative treatment with special emphasis on usage of eco-friendly preservatives like Neem oil and Cashew nut shell liquid using simple treatment technique like brush coating and dipping methods of treatment for dry bamboo. During the interaction session, the farmers were very enthusiastic and raised many questions on various aspects of nursery techniques, utilization, harvesting, marketing, bamboo processing techniques and different types of seasoning and preservation techniques to improve the service life in simple way. Progressive farmers also shared their experience during the program.

Demonstration of Electrical Resistance Tomograph (ERT) on farmer's field at Epigunta village in Eluru district

As a part of on-farm consultancy, Dr. BN Divakara, Scientist F, IWST and Mr. M Prashanth, Technician successfully demonstrated ERT heartwood estimation in standing trees of sandalwood and redsanders to 35 Farmers, Divisional Forest Officer of Eluru with his staff, faculty members from AP Forest Academy, Team leaders of Trees Outside Forest in India (TOFI) in the farm of Shree T. Murali Krishna Tummala at Epigunta village, Eluru district, Andhra Pradesh on 29th Nov, 2023. Dr. BN Divakara explained about



the objective of testingand process involved in heartwood estimation using ERT machine. During this interaction, DFO, Eluru showed keen interest in getting some trees of Eluru diviiosntested by using this method.



The Executive Director
International Tropical Timber Organization (ITTO)
International Organizations Center, 5th Floor,
Pacifico-Yokohama, 1-1-1, Minato-Mirai, Nishi-ku
Yokohama 220-0012, Japan

Excellency,

I have the honour to inform you that the delegation consisting of the following officers will represent India in the 59th Session of the International Tropical Timber Council (ITTC) and the Associated Sessions of the four Committees are scheduled to be convened from 13-17 November, 2023 in Pattaya, Thailand.

- Mr. Madan Prasad Singh
 Director
 Institute of Wood Science & Technology
 Bangalore
- 200.110

Leader of Delegation

Mr. Raghu Prasad R
 Inspector General of Forests
 Ministry of Environment, Forest & Climate Change

Delegate

Mr. Sanjay Kumar Chauhan
 Assistant Inspector General of Folests
 Ministry of Environment, Forest & Climate Change

Delegate

The delegation has full powers to carry out all functions in accordance with the rules and procedures of the International Tropical Timber Council (ITTC) and to participate in the deliberations of the Session.

Please accept, Excellency, the assurances of my highest consideration.

New Delhi Dated: @ November, 2023 (Dr. S. Jaishankar) Minister of External Affairs Government of the Republic of India

Indian Delegation at ITTO







Proceedings of the Institute-Industry Interactive meet held at Perumbavoor, Kerala on 14th December, 2023

he interactive meet started at 9:30 AM with the registration of industries. About 290 wood-based industries related to plywood, sawmills and other timber related manufactures participated in the meet. Products developed by ICFRE-IWST were also displayed.

For the inaugural programme, Dr. Mamatha B.S. invited Dr. M. P. Singh, IFS, Director, ICFRE-IWST, Mr. Mujeeb Rehman, President, SOPMA (Sawmill Owners and Plywood Manufactures Association), Mr. Riyas, General Secretary, SOPMA; Mr. Babu S., Treasurer, SOPMA, Ms. Sujatha D., Head PPPT Division and Mr. Uday D N, Scientist-F and organising Secretory, ICFRE-IWST Bangalore to the daiz. The meeting started with a formal welcome to the dignitaries by presenting flower bouquet followed by lighting of lamp. The documentary video on ICFRE-IWST was played to show case the research activity of the Institute.

Dr. M.P. Singh, IFS, Director, ICFRE-IWST delivered welcome and inaugural address to the gathering. He stressed that the purpose of the meeting was to understand the ground level reality of problems faced by industries and also to bring awareness to the industries about the research on wood based panel products of Institute to the Industries. He asked the industries to share their problems with Institute. He also explained about the regulations and guidelines pertaining to the woodbased industry and sourcing of raw material. The importance of BIS in product manufacturing was also highlighted. He assured that if industry develops any specific products, then the Institute can help them in developing specific standard for the products in collaboration with BIS. All the industries were also briefed about WINCOIN and the benefits to the members associated with WINCOIN.

Mr. MujeebRehman, President, SOPMA addressed the gathering and spoke about the

problems faced by the industries. He informed that there is approximately 1500 timber related industries in that area and most of them have 2-3 common problems. The first and foremost problem is that they cannot use species other than Rubberwood as state government has put restriction on utilising other species. Hence, there should be change in policies to allow the use of other wood species grown in farm land by the industries. Second problem faced by industries was related to the disposal of boiler ash. Institute was requested to provide suitable solution for handling the boiler ash. The third issue was related to the non-availability of BIS standard for certain materials produced by some of the industries.

Mr. Riyas, General Secretary, SOPMA, addressed the gathering and stressed about the importance of BIS certification and how it will help the industries to grow more.

The inaugural programme was concluded by a vote of thanks by Ms. Sujatha D.

In the technical session there were presentations on different topics by the Scientists of ICFRE-IWST.Mr. Uday D N Scientist, ICFRE-IWST, talked about "Veneer processing issues and remedies". He discussed about the importance of lathe settings and veneer drying in obtaining quality veneers. He deliberated upon various causes of veneer defects and its control measures in peeling with different lathes viz., 4 feet p,8 feet, Spindle less peeling lathe. He gave general guidelines to be followed for Drying of veneer without much drying defects. Dr. Mamatha B.S. Scientist, made a presentation on "Adhesives for panel products" and briefed different types of adhesives present in the market, their merits and demerits. Problem of formaldehyde emission and its control, use of alternate adhesives including biobased adhesives, partial replacement of phenol with biobased materials were also explained.

Dr. Narsimhamurthy, discussed about

preservative treatments in wood protection and highlighted its importance in the protection of rubber wood-based products. A brief account on the preservative types, treatment methods and preservatives developed by ICFRE-IWST was presented. Mr. Anand Nandanwar, Scientist, made a presentation on "Standardization for Panel Products". He briefed about various standards related to wood based composites and highlighted the importance of complying to Indian Standard. Dr. Anil Kumar Sethy Scientist, briefed about wood seasoning and wood Modification". He discussed about the advantages of seasoning and how to follow seasoning to achieve the desired moisture content. He also briefed about the recent seasoning methods. Some commonly used wood modification techniques such as acetylation, furfurylation, thermal modification their advantages were also explained.

An open house session chaired by The Director, ICFRE-IWST, Dr M P Singh was followed the technical presentation and the industries were asked to raise their issues. Industries raised their concerns about the difficulties in establishing laboratories. In response, Mr. Anand Nandanwar informed that this problem can be solved by establishing a common lab by a cluster of industries as per BIS terms, if establishing lab by individual industry is difficult.

Some of the industries expressed their concern on the restriction of use on other species except rubber wood. In response, The Director, ICFRE-IWST assured that the Institute will pursue this issue with Kerala Government and will make effort to allow the use of Tree outside forest species and requested President to put up these issues from SOPMA to the Director, IWST for taking up with Kerala Forest Department.

Many manufactures pointed that they are making packaging grade plywood for which BIS standard is not available. In response, the Director ICFRE-IWST urged that the concerned industries should write to the BIS and with a copy marked to ICFRE-IWST. The Institute will pursue the matter with BIS to develop a relevant standard for packaging grade plywood.

There was concern about the sustainable supply of Rubber wood in the state as most of the industries depend on this particular species. In response, the Director informed the Institute will be happy to take up the study if any financial support is provided either from the state government or industries.

At the end of the open session, the industry representatives were requested to fill a questionnaire prepared by ICFRE-IWST to understand the constraint faced by different industry.



Glimpses of the event















Agroforestry (Promotion and Facilitation) Draft Act, 2023

(A Draft Act submitted by ICFRE-IWST to MoA&FW, GOI)

An Act to implement the objectives and provisions of National Agroforestry Policy; to encourage and expand tree plantation in a complementary and integrated manner with crops and livestock; to improve productivity and livelihood of farmers while also meeting raw material requirements of wood based industries and to reduce reliance on imports from foreign countries;

WHEREAS the policy document identifies various factors such as restrictive legal provisions for harvesting and transportation of trees planted on farm lands, inadequate attempts at liberalization of restrictive regulations, near non-existent extension mechanisms, lack of institutional support mechanisms, lack of quality planting materials, inadequate research on agroforestry models and species suitable across various ecological regions, inadequate marketing infrastructure and price discovery mechanisms, lack of post-harvesting processing technologies and industry operating at a sub-optimal level etc. for agroforestry not gaining the desired importance as a development tool;

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 (Atmanir bharta), 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 framework for electronic Certificate of Origin and Ownership and establish a standard for the legality and chain of custody of farm wood that is accepted worldwide (Vocal for Local) to promote efficient, transparent, and barrier-free inter-state and intra-state trade and commerce of farm wood;

AND, it is necessary to promote and facilitate certification of nurseries, seeds and other planting materials through institutional mechanism for registration of nurseries and their accreditation to farmers;

AND, it is necessary to establish institutional mechanism investing in research, extension and capacity building and related services;

AND, it is necessary to establish a national guidance framework on agreements for farm wood to facilitate establishment and promotion of farm wood-based enterprises and matters related to providing institutional credit and insurance cover to agroforestry or incidental thereto.

NOW, THEREFORE, it is expedient to enact a legal framework for hassle-free transportation, marketing and utilization of wood grown on nonforest 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 Agroforestry (Promotion and Facilitation) Act, 2023.
 - (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) "AgriWood-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" meantrees 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 forestswhen 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;
 - (b) Shall not be understood as "Scheduled Farmers'Produce" under any State APMC Actor Regulation;
 - (c) Shall not be understood as 'Biological Resources' within the meaning of the provisions of the Biological Diversity Act,

2002.

- (iv) "Imported wood"meansall 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, woodbased industries, companies, partnership firms, limited liability partnerships, cooperative 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, enduse, 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" meansany State legislation in force in India, by whatever name called, which regulates markets for agricultural produce in that State.
- (xii) "Farmingagreement" 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.
- (xiii) "Sponsor" means a person, trader or agent who has entered into a farming agreement with the tree grower for growing trees.
- (xiv) "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, any officer or group of officers authorised by the state government.

"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.

CHAPTER 2 GENERAL

- 3. Power to make rules for standards with regard to planting stock— The Central Government shall have the power to make standards or delegate such powers to any other institution or state bodies to establish systems for the followings:
- (i) Release new clones or cultivars for timber species;
- (ii) Wood productivity claims by any entity;
- (iii) Accreditation of nurseries and certification of seeds and quality planting stock; and
- 4. Power to make rules or standards regarding the legality of farm wood.— The Central Government shall have the power to make standards or delegate such powers to any other institution or state bodies:
- (i) to make rules or delegate its function for the establishment Information Technology-based systems(also through mobile apps) 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 include following information and documents needed to fulfil the requirement of due diligence system:
- (a) Description, including trade name and type of relevant commodities and products as well as, where applicable the common name of the species and its full scientific name
- (b) Quantity of the relevant products (No./mass/volume)
- (t) Identification of the area (district, state) of production
- (d) Geo-coordinates of all the plots of land where relevant products produced with date
- (e) Names and address of the businesses/persons

- from whom they have been supplied relevant products and to whom the products have been supplied
- (iii) to authorise 'local bodies' to besecond-party certifiers for the issuance of COOto the first party (tree growers) in the IT based system mentioned in (i) and risk assessment mechanism verifiable through remote controls for due diligence;
- (iv) to authorize traders, agents or industries as third-party certifier through Information Technology-based systems(also through mobile apps) for issuance of Certificate of Origin and Ownership ("COO") and to mark and grade farm wood according to the AgiWood-India Standards;
- (v) to prescribe a system in India for electronic registration of a trader or agent to "Electronic trading and transaction platform" 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 for IT based online registration of such Wood-based industries and enterprises conforming to above provisions of legality of farm wood so as to promote demand for such farm wood and help farmers increase their income;
- 5. Inter-state or intra-state trade and commerce.—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.
- 6. Power to make rules for national framework on farming agreements. The Central Government or institution authorised by 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 protect and empower 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 or delegate such powers to state bodies for a particular state.

CHAPTER 3 AGROFORESTRY BOARDS

7. Constitution of Agroforestry Board of India. —

- (1) The Central Government shall prescribe for constitution of an Agroforestry Board of India to provide for improved linkages between tree growers, traders or agents, farm wood-based industries or enterprises, research institutes and related government representatives including the states.
- (2) The Agroforestry Board of India shall be under the Chairmanship of the Minister-in-charge, Ministry of Agriculture or any eminent personality from the agroforestry sector nominated by the Minister-in-charge.
- (3) The Agroforestry Board of India shall function at New Delhi under the ministry of agriculture investing in research, extension and capacity building, coordination and related services;
- 8. Constitution of Agroforestry Board at the State level and the regional level. —
- (1) Agroforestry Boards shall be constituted at the State level as well as the regional or district level by resolutions of respective State Government. The Chairmanship of such council shall be the Chief Minister of the respective State or an eminent personality from agroforestry sector nominated by the Chief Minister of the respective State.
- (2) The State and regional or district-level **Agroforestry Boards** shall function under the overall guidance of the **Agroforestry Board** of India.
- (3) The regional or district-level **Agroforestry Boards** shall function under the overall guidance of their respective State-level **Agroforestry Board**, and the decisions of their respective State-level **Agroforestry Board** shall be binding on them.
- 9. Functions of State-level and regional-level Agroforestry Boards. — 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 their 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 their area following the chain of custody regime electronically.
- 10. Powers of State-level Agroforestry Board. -
- (1) The State-level **Agroforestry Board** shall be the final authority on the establishment and promotion of farm wood-based industries to encourage all farm wood industries, especially new establishments, to promote farm forestry plantations and monitor progress of the same to ensure sustainable farm wood supply to all wood-based industries in the State.
- (2) The State-level **Agroforestry Board** shall be the final authority on demarcation and designation of any catchment area for trader, agent and sponsor so as to encourage tree growers (farmers) to grow trees on their lands.
- (3) It shall decide on incentive programme, if any for the farmers who grow trees, depending upon the succession rate after one year of plantation for continuing the plantation for longer time.
- (4) The State-level **Agroforestry Board** 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, not withstanding 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 **Agroforestry Board** or the **Agroforestry Board** 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 **Agroforestry Board** shall lie only to State-level **Agroforestry Board**.
- (2) Appeal against the decision of the State-level **Agroforestry Board** shall only lie to **Agroforestry Board** of India.
- 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.

Brief on Draft Report of Joint Working Group for Promotion and Expansion of the Tree outside Forest (ToF)

1. Introduction:

- 1.1. Trees outside Forests (TOF) play a significant role in resource provision and environmental services. Globally TOFs defined as the trees found in agricultural lands, agro-forestry systems, home gardens, orchards, urbanscapes - including along roads - and scattered throughout the landscape that are not designated as forest or other wooded land and cover an area of less than 0.5 ha (Kleinn, 2000, FAO, 2014). But in India, TOFs are defined as all tress growing outside of Recorded Forest Area (RFA) irrespective of patch side which could also be larger than 1 ha and includes trees growing on community land, roadsides, farms, private land, and revenue land (FSI, 2021) TOF can be natural, planted, or coppiced, and it can grow in blocks or linear formations, or it can be scattered. They may be found in both rural and urban areas, and depending on land settlement and ownership rights, they may be owned by individuals, communities, or the government. During recent years, there has been a growing recognition of the importance of the trees outside forests being a major source of forest produce in the country and timber, firewood and small wood supply coming from outside the forest areas is significant. They are one of the important renewable resources that contribute to climate change mitigation, as every patch of forest around the world is absorbing carbon.
- 1.2. Currently, the timber from forest areas are very minimal and ToF is the main source of wood produced in the country, particularly from the agroforestry sector. As per an FAO report, about 1.6 billion people or 25% of the global population worldwide depend directly or indirectly on forests for food, shelter, energy, medicines, income and from the perspective of their ecological, socio-economic and cultural significance. As per the current estimation of

- forest survey of India published in ISFR-2021 report, the extent of ToF has been found to be 29.29 million hectares which is about 36.18% of the total forest and tree cover of the country.
- 1.3. The National Forest Policy 1988, envisages onethird of the total land area of the country to be under forest or tree cover. To achieve this national goal, there is a requirement of tree plantation on private/non forest land on a much larger scale. The National Agroforestry Policy, 2014 mentioned that agroforestry is practiced in both irrigated and rainfed conditions and trees on farmland or agroforestry are uniquely placed for achieving multiple objectives, especially food, timber, nutrition employment, health and environmental security. The Ministry has released an Expert Committee Report in 2018 as Strategy for Increasing Green Cover Outside Recorded Forest Areas. A Guidelines for liberalizing felling and transit regime for tree species grown on non-forest/ private land was also issued in 2014 suggesting list of preferred agroforestry species for relaxation by State Governments
- 1.4. Considering the importance of Trees outside Forests (ToF), the Ministry of Environment, Forests& Climate change constituted two joint working groups on 7th march 2022 for promotion and expansion of Tree outside Forests (ToF). The composition and ToR/deliverables of the joint working groups are as follows:

1.4.1 The 1st Joint Working Group (JWG) was constituted with following composition:-

- (i) Sh. S. P. Yadav, ADG, MOEF&CC-Chairman
- (ii) Dr.SuneeshBuxy, Ex-IGF(SU), MoEF&CC
- (iii) Shri Ritwick Dutta, Environmental Lawyer, Delhi
- (iv) Shri AmanJha, Environmental Lawyer, Delhi

- (v) Shri Sanjay Upadhyay, Environmental Lawyer, Delhi
- (vi) Shri Maneesh Kumar, AIGF(FP), MoEFCC-Member Secretary

1.4.2 The ToR /deliverables of the first Joint Working Group is as under:-

- to review of existing laws for facilitation of growing of timber outside forest,
- (ii) to address the issues growing of timber outside forest holistically,
- (iii) to prepare a draft policy and legal framework document which may be either new or based on specific changes in the current regulatory regime, with justification,

1.4.3 The 2nd Joint Working Group is constituted with following composition: -

- (i) Shri BivashRanjan, ADG(WL), MoEF&CC-Chairman
- (ii) Shri R K Sapra-Retd. PCCF, Haryana
- (iii) Dr. J. V. Sharma-Director, TERI
- (iv) Ms. SunitaNarain-Director General, CSE.
- (v) Shri Vijay Dhasmana-Eco-restoration practitioner
- (vi) Shri Maneesh Kumar- AIGF (FP), MoEFCC and Member Secretary

1.4.4 The ToR/deliverables of second joint working group is as under:-

- (i) to develop a step wise five-year action plan for doubling of the area under tree plantations in private/non forest lands with specific interventions depending on site and tree species, wood based products of desired quality, standards and cost, which can meet growing domestic demand and gradually replace import of similar wood/wood based items in near future.
- (ii) to prepare the action plan document with justification and identification of concerned agencies for implementation

The present article highlights the salient points of the joint working groups draft reports with respect to suggestions in research and development, Identifying constraints in growth of agroforestry, Strategies and recommendations for faster development of agroforestry sector,

recommendations for tapping funds for agroforestry, conclusion and way forward.

2. Suggestions for Research and Development to strengthen the Agroforestry sector:

- 2.1 A comprehensive documentation of the various region-wise Agroforestry models and record on economic returns from these agroforestry models should be developed. Research on various agroforestry models region-wise should be attempted and best models should be published for the use of various stakeholders.
- 2.2 Developing innovative models in agroforestry towards timber production and wider range of end products, and for various agro climatic zones for supporting tribal livelihood.
- 2.3 Investment is needed in the field of research and extension to develop region-specific agroforestry models and suitable tree species that farmers can directly adopt to provide better sustainable return from their land. This can be done in collaboration with Forest Research Institutes, Centers and Agriculture Universities spread across the country.
- 2.4 With the settlement of individual rights, there is urgent need to popularize various tree-based farming models with the potential to generate better livelihood for tribal and forest-dependent communities, so that the lands with reference to which rights are settled, are put to use in harmony with abutting forests.
- 2.5 Site-specific agroforestry systems for wetlands, and dry lands systems aiming at productivity enhancement and sustainable income generation should be developed.
- 2.6 Conducting comprehensive research on treecrop interactions in agroforestry systems with special reference to root architecture. Identification of fast-growing species for integration in agroforestry is needed.
- 2.7 Lack of high-yielding quality planting material is a major constraint for agroforestry so more research should be focused on the availability of quality planting materials. Protocols for Quality Planting material of prominent climateresilient varieties should be developed and transferred to State Forest Departments (SFD's) along with departments for dissemination.

- 2.8 Advanced technologies to produce Quality planting material (QPM) for agroforestry species need to be made available to the forest department for mass multiplication and further distribution to farmers and other stakeholders.
- 2.9 Research should continue focus on the development, testing and deployment of new superior and resistant clones of ecologically and economically important tree species like Poplar, Salix, Eucalyptus, Teak, Bamboos, Shisham, Meliadubiaand Neem, red sanders, agarwood, sandalwood etc. and other potential native species.
- 2.10 Research work should be continued to provide techniques for improved nursery propagation, cultivation and harvesting emphasizing the region-specific native species. Lesser-known agroforestry species should also be evaluated by the research institutes for the development of new models.
- 2.11 Research should be focused on sustainable integrated farming systems with indigenous tree species.
- 2.12 Clonal technology for area-specific species should be developed with focus on reducing the rotation period which should be cost-effective.
- 2.13 There is an urgent need of identification of suitable species and their improved varieties for cultivation in TOF (Tree outside Forests) in order to reduce the dependency of forest fringe communities on natural forests. Agroforestry
- 2.14 Research should go beyond the traditional areas (ToF, Carbon storage, Wood) such as Climate change resilience, livelihoods, more per acre, tourism etc. Research outputs should be attempted to notify sustainable Agri-Silvicultural, Agri-Silvipastoral, Agri-Silvi-Horticulture systems etc.
- 2.15 The research should also include germplasm propagation (Tissue culture), nursery development (clonal propagation) and plantation monitoring (GIS/drones/remote sensing).
- 2.16 At present no reliable data and database system of Agroforestry exists at national/state and district level, hence it is essential to establish a sound database platform and management

- system, to upscale the adoption of agroforestry. A database on research should be developed and made available to all forest departments to update them on the continuous ongoing research on agroforestry. Similarly, database and mapping of the statewise and district-wise area under agroforestry should be created for the easy use of the stakeholders. Geo-spatial techniques should be used for estimation of agroforestry area and agroforestry suitability mapping, estimated annual production etc.
- 2.17 Research need to be taken up on Agroforestry with special reference to climate change resilience. Quantification of carbon sequestration in agroforestry systems including assessment of soil health and soil carbon in agroforestry systems.
- 2.18 Research should further improve the low productive teak plantations (lower site quality) to better agroforestry models for improved economical returns in southern states of India.
- 2.19 Traditionally, in North East many bamboo and tree species are used in the farms and private lands since generations as shade crop, boundary crop, nurse crop etc., the best combinations should be recorded and such a database of species for agroforestry modules is paramount to take the research in the right direction.
- 2.20 Intensive screening of suitable bamboo species over diverse areas along with work on breeding high yielding clones and clump management directed towards productivity improvement should be done. So that bamboos can be used as a promising crop in Agroforestry systems.
- 2.21 ThornlessKhejri variety (TharShobha and TharAmruta) should be encouraged and used in development of agroforestry models already known to be effective with normal thornedKhejri varieties.
- 2.22 As rubber is one of the trees crops popular among the tribes and other indigenous tribes of Tripura, Assam etc., suitable agroforestry models integrating rubber as cash crop may be studied.
- 2.23 Shifting (Jhum) cultivation is rampant in north

east. Wherever such cultivation is practiced on private or community land relevant agroforestry models may be tested and proposed for recovery of the land with financial outturn using the primary vegetation forest trees.

- 2.24 Farmers/community-oriented research should focus on sustainable harvesting of forest produce to enhance the income of the tribal community. Conducting studies on socioeconomic impact of technologies and products disseminated to farming communities.
- 2.25 The best and promising practices are not widely followed due to lack of Benefit- Cost analysis. The best performing models should have benefit-cost analysis under different conditions viz., Hills, plains and valleys etc. and popularized among the masses. Agroforestry models should clearly indicate their economic potential.
- 2.26 Research work on organic farming and value addition to the natural product should be conducted to improve the income generation avenues for agroforestry farmers.
- 2.27 Eco-friendly technologies and protocols need to be developed to contain the insect pest outbreaks especially in the fragile ecosystem of cold deserts.
- 2.28 Sufficient data on demand and supply of softwood are available from paper and pulp industries, but the same is not the case with hardwood. There is an urgent need to quantify the demand and supply of both hardwood and softwoods to identify the gap for better planning in the forest sector.
- 2.29 More policy research at the local level implementation of Agroforestry is needed to provide policy support by removing various bottlenecks
- 2.30 Collaborative research among research organizations like ICFRE, ICAR, SFD's, MOTA, SAU's etc. and the experts, should be encouraged with sharing the information and best practices to give speedy recommendations for agroforestry to the various stakeholders.
- 3. Constraints in Growth of Agroforestry:

The constraints in the development of agroforestry are either related to farmers or related to wood-based industries as both are mutually dependent upon each other.

3.1 Issues of Farmers

The farmers suffer mainly in cultivation of tree crops due to following constraints.

- Availability of Certified quality planting material
- 2) Poor Extension Programme
- 3) Marketing of Agroforestry Produce
- 4) Legal Restrictions
- 5) Flow of Institutional Finance
- 6) Absence of Market Support System and Insurance for Tree Crops
- 7) No Incentive for Carbon Sequestration
- 8) Lack of Incentives for Protecting Native Trees

3.2 Issues of Wood-based Industries

The efficient processing of wood is not so prevalent in our country as majority of wood-based industries are in the Micro, Small and Medium Enterprises (MSME) sector. The factors contributing to the inadequate performance of wood-based industries include technological obsolescence, cheaper machinery which affects the quality of wood products and their cost effectiveness, lack of spare parts, low productivity of labour, lack of trained manpower, over-capacity and over capitalization. The wood-based industries mainly suffer due to following constraints.

- 1) Licensing Policy
- 2) Rationalization of GST and IGST.
- 3) Import and Export Policy
- 4) Non-Certified wood
- 4. Highlights of Strategies and recommendations to faster development of agroforestry sector:
- 4.1 Need for efficient Agroforestry Extension Strategycovering the following aspects.
- (i) Development of an agroforestry extension program for SFDs
- (ii) Production of extension materials to educate various users
- (iii) Understanding the markets and marketing systems for wood products

- (iv) Capacity building of SFDs in the analysis and dissemination of market information to farmers.
- (v) Development of institutional mechanism for deployment of extension strategy (Ref: Task Force Report on Greening India, Planning Commission)

4.2 Legal measures

- 4.2.1 Easing out of felling and transit restrictions on trees and its products helps to realize their full potential. Based on the local circumstances, these regulations may be relaxed and rationalized in a gradual manner without jeopardizing the security of the natural forest. The process of relaxing such regulation must be left to the State government. However, a reliable IT based system must be developed, to track, trace and distinguish the timber coming-out from the non-forest areas with those coming from the forests. This will make it easier for the state government to further relaxing the regulation on transit and felling. It is also important to ensure that the product is coming from a legally certified source. The species which are exempt from felling and transit restrictions in source state should be issued a NOC by person authorized by state. An innovative digital certification scheme for certificate of origin andchain of custody should be encouraged for such wood that are sourced from species free from the regulatory regime by respective state governments.
- 4.2.2 Another issue which needs to be emphasized is the movement of timber across the source state. As discussed earlier several states has very liberal transit and felling rules. These are mostly the states where there is less natural forest cover or the species are not found in the forest areas. The movement of such timber outside the source state faces the regulatory regimes prevalent in the transit state. It becomes quite cumbersome for a person who wishes to move its legally procured timber to the destination that passes through a number of state boundaries. To facilitate unhindered movement of such produce a system of PAN India TP may be introduced, so that any

- timber having a valid TP/document from source state will not require any in lieu TP in state outside the source state. This will help in removing the bottlenecks in linking the timber production areas to market or industrial clusters and promoting their growth.
- 4.2.3 RET (Rare, Endangered and Threatened) species as well as those found in forests, need to be promoted for cultivation in farmlands to reduce pressure on forests, and to ensure this Pan-India Transit, as discussed above, of such trees need to be allowed under a benign mechanism. Pan-India Transit Pass (TP) may be issued by authorized DFO for any tree species, based on certificate of source of origin by competent authority with whom farmer's/tree owners will register their plantations (in the form of one-time registration in tree/crop cards). Competent authority to issue such certificate of origin would be-
- 1. Designated Officer of Forest Department, which may be delegated to sarpanch of the concerned village (for Trees outside Forests)
- 2. Designated Officer of Forest Department (for Trees inside Forests)
- 4.2.4 The quality of seedlings and clones should be controlled through suitable Agroforestry Nursery Act & Rules, so that the farmers get quality planting stocks. A system of third party based certified nurseries/planting material for agroforestry needs to be put in place, to incentivize and ensure that agroforestry plantations use only certified plant material.

The States should amend Land Ceiling Act to exempt the farmlands under agroforestry from land ceiling.

4.3 Policy Issues

4.3.1 The next phase of growth of agroforestry should be focused on the states which have been laggard during last two decades. This can happen only when concerned state governments, technical agencies, research agencies, agriculture and forest departments and industries join hands and work in unison

- to develop site specific, disease resistant and productive clones and package of practices and its extension through Van VigyanKendras (VVK)/ KrishiVigyan Kendras (KVK). A focused programme under ICAR may be taken to drive this activity forward. The Central Ago Forestry Research Institute (CAFRI), Jhansi and the 37 Centers of the All India Coordinated Research Project (AICRP) on agroforestry should be strengthened for improved advocacy among farmers by way of agroforestry models, together with agronomics, for the various agro climatic regions of the country.
- 4.3.2 Van Vigyan Kendra should be established at selected locations where demonstration plots of various Agroforestry models should be created at suitable sites. All information pertaining to technical knowledge i.e. cultural practices, source of quality seedlings, disease and insects control, harvesting, processing and marketing etc would be made available to the farmers in their vicinity. A focused programme under ICAR may also be taken to drive this activity forward. The Central Ago Forestry Research Institute (CAFRI), Jhansi and the 37 Centers of the All India Coordinated Research Project (AICRP) on agroforestry should be strengthened for improved advocacy among farmersby way of agroforestry models, together with agronomics, for the various agro climatic regions of the country.
- 4.3.3 The availability of CAMPA fund may be ensured for sustained R&D support in tree improvement and tree breeding program. Improved clones of eucalyptus and poplar have helped to improve productivity and income of the farmers. This genetic improvement needs to be taken up for at least ten indigenous species and five exotic species to give options to farmers of different agroclimatic regions.
- 4.3.4 Setting up of National Agroforestry Board or Wood Council may be considered to plan, boost and tackle the problem of linkage between industries, farmers, financial

- institutions, research, marketing, import and export of wood and wood products.
- 4.3.5 Reviewing export and import policy is required to encourage domestic production of wood and wood products. Credible, country based indigenous forest certification or legality regime should be respected for import of logs and finished products like veneers, plywood/furniture etc. to ensure legality and traceability of the products and to ensure that as a country we support only legal and sustainable global forest trade practices. In absence of such system, digital mechanism for certificate of origin and legality of timber may be encouraged for such countries under bilateral trade agreements.
- 4.3.6 A model collaborative agreement needs to be approved by Government of India to enable raising of plantations under PPP mode by Forest Development Corporations (FDCs) to enable for improving the productivity of plantations of medium to long rotation trees only. FDCs may be given the option of working arrangement, tenure, and species of plantations and rotation (medium/long only) of plantations depending on land sites, market demand and financial viability of FDCs.
- 4.3.7 25% of the CSR funds of PSUs may be set apart for development of agroforestry. Corporate sector may be provided tax concessions to take up R&D in agroforestry, development of clones/varieties, etc. A fixed percentage of project cost may be set aside for development of national highways, expressways and corridors including Railway projects for creation and management of green corridors.
- 4.3.8 Planting of trees under agroforestry be provided medium term credit within priority sector lending norms with provisions of interest subvention. Agroforestry tree crops be covered under agricultural insurance scheme and be eligible for input subsidy in case of disasters as per NDRF norms. Minimum support price (MSP) and insurance like agricultural crops may be extended to tree crops. All incentives like subsidies, loans, grants, and benefits of rural development and

- agricultural development schemes, should flow for farmers adopting agroforestry.
- 4.3.9 Make a budgetary provision to support wood-based industry though NABARD for establishment of industrial cluster plantations in association with farmers to ensure sustainable availability of raw material in future. Primary processing industries should not be treated as industry, so that these do not come under the purview of tax regime, including GST. Common Facilities Centres (CFC) pertaining to wood-based industry may be established at community development blocks. The manufacturing of face veneers from the local species may be promoted to dis-incentivize their import.
- 4.3.10 Extending tax benefits to wood and NWFP based industries under Make in India Program.
- 4.3.11 The policy of complete ban on green felling above 1000-meter MSL needs to be reviewed by MoEFCC for North-Eastern States as well as for other areas and ban on felling needs to be removed for slopes below 30 degrees. The vulnerable areas, if any, may be demarcated and identified separately to continue the ban. This will ensure productive use of community and private lands available in North-East as well as in other states, without compromising on environmental safeguards. The long rotation tree species may be promoted to meet the growing requirements of soft wood as well as for import substitution of products of these species.
- 4.3.12 A protocol may be developed for payment of ecological services to the farmers in case of plantation of RET species on their farms.
- 4.3.13 Facilitating creation of a Carbon Registry to provide a listing, trading and tracking platform for carbon credits to stakeholders including industry with overarching objective of meeting the NDC commitment of the country under Paris Agreement of UNFCCC.
- 4.4 Action Points for various Government agencies State Governments
- 4.4.1 Better state and district level co-

- ordination between F o r e s t and Agriculture departments.
- 4.4.2 The farmers should be given a scientific package of practices for nursery, planting, thinning, felling, transportation, and sale.
- 4.4.3 Easing out restrictions on felling trees and transit of wood, and processing of farm wood.
- 4.4.4 Sawmills may be covered under Single Window Scheme for their registration and trade license.
- 4.4.5 Input subsidies can be made more effective by establishing quality control and standards for planting material and nurseries.
- 4.4.6 The marketing of agroforestry products should be facilitated by electronic digital platform either through MandiParishad Act or the Forest Corporations of the State. A system of digital market, may be devised, including a mechanism of periodic review to protect the interest of both producer and consumer.
- 4.4.7 Private sector may be encouraged to replicate ITC/WIMCO models, establishing value chains, and fostering farm wood entrepreneurs to inspire farmers to take up agroforestry.

4.5 Ease of Doing Business

- 4.5.1 The functioning of State SLCs may be streamlined to encourage the growth of woodbased industry.
- 4.5.2 The upgradation and expansion of wood-based industry may be facilitated to improve the quality of wood products.
- 4.5.3 Encouraging establishment of sawmills/ veneers in rural areas to reduce the transportation and other logistics cost.
- 4.5.4 Rural youth may be imparted green skills like woodwork and carpentry, raising of nursery, organic farming, value addition, wood carving etc.
- 4.5.5 Encouraging the establishment and expansion of wood-based industry which will increase the demand of farm wood continuously in such a manner which will help in keeping it seller's market that will ensure remunerative prices to farmers. This will further encourage

farmers to raise more and more plantations.

4.6 Ministry of Finance

- 4.6.1 Aggressive promotion of plantation companies by providing incentives like discounted loans, capital subsidies and tax concessions
- 4.6.2 Reducing GST on wood and wood products to compensate the industry for costly farm wood and making industry competitive in international market
- 4.6.3 Corporate sector may be provided tax concessions to take up R&D in agroforestry, development of clones/varieties, etc.

4.7 Ministry of Environment, Forest and Climate Change

- 4.7.1 There should be Pan-India amendments to the rules on felling trees and inter-state transportation of wood and developing an online system for registration of plantations, felling of trees, and ensuring seamless movement of wood.
- 4.7.2 Transportation of wood from NE States may be allowed by different means of transport to save precious wood.
- 4.7.3 The licensing requirement for units that use 'farm wood', may be replaced by registration.
- 4.7.4 The production forests specially land with FDCs may be used for raising of plantations of medium and long rotation species to replace imported timber
- 4.7.5 Creation of a Carbon Registry to provide a listing, trading, and tracking platform for carbon credits to stakeholders including industry
- 4.7.6 National Forest Seed Corporation and State Forest Seed Corporations should be established for supplying certified seeds/planting material
- 4.7.7 Continuous funding for Tree Improvement Program through at least 10% amount of CAMPA Fund to supply QPM

4.8 Ministry of Agriculture and Farmer Welfare

4.8.1 The quality of seedlings & clones should be controlled through suitable Agroforestry Nursery Act & Rules, so that the farmers get

- quality planting stocks.
- 4.8.2 Agroforestry may be treated as priority sector, hence the funding pattern in the Sub-Mission on Agroforestry under the umbrella of NMSA may be changed to 90:10 in place of existing ratio of 60:40.
- 4.8.3 Declaring farm wood as agricultural produce.
- 4.8.4 All incentives like subsidies, loans, grants, and benefits of rural development and agricultural development schemes, should flow for farmers adopting agroforestry.
- 4.8.5 The wood markets which are integrated with e NAM, may be established.
- 4.8.6 Make a budgetary provision to support wood-based industry though NABARD for establishment of industrial cluster plantation in association with farmers to ensure sustainable availability of raw material in future.

4.9 Ministry of Surface & Road Transport (NHAI)

- 4.9.1 1% of the project cost of National Highways may be kept for Green Highways Fund for development and management of green corridor.
- 4.9.2 The waterways transport is cheaper than other forms of transport. Inland transport of wood through waterways should be promoted.
- 5) Recommendations for tapping finance for Agroforestry sector:
- 5.1 Financing for promotion of trees outside forests is needed for the following activities:
- (i) High quality planting material production and supply
- (ii) Skill enhancement in nurseries, value addition, wood-based commerce, bio-energy
- (iii) Research & Development
- (iv) Nursery accreditation
- (v) Monetary incentives for maintenance, and protection after planting
- (vi) Price stabilization funds, Minimum support price and insurance
- (vii) Tree based entrepreneurship development
- (viii) Soil and moisture conservation on public wasteland

- (ix) Transport and marketing infrastructure in remote tree production areas
- 5.2 The funding opportunities for promotion of trees outside forests can be broadly divided into (a) government, (b) non-government and (c) public-private partnerships.

5.3 Recommendations:

Funding of trees outside forests is no longer a major impediment in the country as the various schemes and programs of the Central and state governments are ensuring the provision of funds to the farmers and others interested in taking up planting of industrial raw material trees, medicinal trees, fruit trees, fodder trees, cash tree crops like rubber, coconut, spices trees etc. The state governments need to take proactive steps ensuring convergence of state & central schemes for effective promotion of trees outside forests which is the insurance against natural calamities for doubling of income of farmers in the country.

- (i) Existing funds need to be more efficiently tapped and utilized as it has been found in many records that a major issue is non-utilization of funds
- (ii) Implementation and operational guidelines should be issued for the schemes and programs
- (iii) Incentives, subsidies, credit, insurance and similar financial tools must be developed for TOF systems
- (iv) Result based financing should be encouraged for TOF systems
- (v) Roles and Responsibilities of Public, Private and Public-Private fund pools need to be clearly earmarked
- (vi) Private Sector contribution towards TOF funding needs to increase
- (vii) Accountability of government departments towards allocation and utilisation of funds needs to ensure, monitoring and evaluation systems to be in place
- (viii) Public-Private funding collaborations should be promoted more
- (ix) Collaborative Partnership/Forum of various organizations and funding agencies for managing funds for increasing the tree cover

- and TOF in the country can be setup under the government or as an independent setup
- (x) Mechanism should exist to access CAMPA funds for states having a minimum threshold between forest and TOF.
- 6. Conclusion and Way forward
- 6.1 The promotion of tree plantations outside forest will require creation of backward and forward linkages. In addition, structured market for wood obtained from Agroforestry and systemic efforts towards removing the regulatory hassles that discourage the adoption of tree farming in non-forest lands by individuals and organizations will make the tree cultivation a profitable low risk enterprise for the growers. The key suggestions are briefly discussed below.
- 6.2 The institutional mechanism in the form of National Wood Council at the Centre should be established comprising of representatives of wood based industries, tree growers (including forest corporations/ tree cooperatives), concerned government departments/ organizations, Principal Chief Conservator of Forests& Chairman of SLC of selected States by rotation, independent experts on production, utilization and trade of wood and wood products, financial institutions, and R&D institutions dealing with wood. The Ministerin-charge of the Ministry of Environment, Forest & Climate Change shall be the chairperson of the NWC, and the Minister of State in the Ministry shall be the vicechairperson. The NWC shall primarily act as a platform for collaboration amongst all stakeholders of the wood-based industries, including the tree growers, to recommend to the Central Government or through the Central Government to the concerned State Governments the measures that need to be adopted for promotion of wood-based industries while following the basic principle of ensuring conservation and development of forest resources.
- 6.3 Wood obtained from Agroforestry system should be separately defined in the guidelines for Establishment of Wood based Industries as

distinct from forest timber, based on the relaxation of transit and felling regimes for agroforestry tree species by different states. States may be encouraged to further relax these rules for more number of tree species. WBI should be registered online irrespective of wood balance studies so long as they source their raw materials from Agroforestry and maintain a traceability digital records.

- 6.4 A system for PAN India transit permit may be explored for easy movement of legally procured wood and wood products across the state boundaries. This will help in development of markets and clusters of Wood Based Industries based on wood obtained from Agroforestry.
- 6.5 The Wood Based Industries Guidelines should be revised to relax the conditions required for setting up of small processing centers/ Common Facilitation centers in small taluka places. This will reduce the transportation cost and encourage employment. The industry may outsource some of the process to these facilitation centers. This will not only reduce the production cost but also help in development of specialized processing centers.
- 6.6 The risk associated with tree growing must be covered through tree insurance and assured pricing mechanism for the harvested produce. A system of market support on the line of Agricultural produce may be explored. The WBI may enter into buy back agreement with the tree growers. State Forest Development Corporations (FDCs) may be allowed to compete with the industries and participate in the procurement of harvested produce from the farmers. Alternatively, FDC can enter in to agreement with the farmers to purchase the standing crop. The crop can be harvested and sold through e-auction to realize better price. The proceeds from the sales may be returned to the grower after deducting the cost and margins. This will prevent distress sale and will provide safeguard against exploitation of the tree growers.
- 6.7 The certification system of wood and wood products has potential to promote export of the wood products as certified wood has a premium in international markets. However,

- the cost of certification may not be possible to be borne by small tree growers. In order to capture the international market for wood products efforts should be made to develop indigenous system of certification that may find acceptability in overseas market under bilateral or multilateral trade agreement. The quality control of timber and its products is also significant for domestic market. The qualitative certification for domestic market should be promoted through national certification agency like BIS under ISO Certification.
- 6.8 The WBI should be encouraged to source their raw materials either by raising plantation on self-owned or leased land or by entering into buyback agreement with the tree growers.
- 6.9 The Provision for credit and finance be made available to tree cultivators, at par with crops cultivation, through priority lending by Banks and financial institutions. Appropriate insurance packages may be designed for the various agroforestry models and the same should be made available to the tree cultivators at reasonable premiums. Where the cost of insurance premiums is high the government should provide subsidy to the smaller and marginal farmers.
- 6.10 Farmers should be facilitated with credible accreditation of nurseries for quality planting material. Research and development for quality planting materials should be vigorously supported for at least ten indigenous and five exotic species meeting the requirement of different wood sector industries.
- 6.11 Lastly it is important to develop a viable domestic market for wood and wood products, including e-market. This will require encouragement of use wood in daily practices. Wood should be projected as an eco-friendly material having low carbon footprint. For this to happen the research institutes should focus on production of such products which have high utility value in domestic market. The quality parameters for these products must be standardized and made available to public so that a consumer has options to compare, choose and purchase the product from appropriate marketing platform.

Brief on Draft Report of Task force for Developing Synergies between the National Forest Policy, FCA, 1980 and National Agroforestry Policy, 2014

1. Background:

- 1.1 Ministry of Environment, Forest and Climate Change, Government of India is in the process of formulating new National Forest Policy considering the emerging national and international imperatives in the last 3 decades. Goal of achieving forest & tree cover of 33% calls for greater efforts promotion & facilitation of tree plantations on private lands and encouraging demand for wood and other produce from nonforest sources. There has been increased role & responsibility of Gram Sabha, PRIs, Tribal and forest dwelling people in forest management after the enactment of FRA, 2006 and PESA 1996. This needs to be reflected in the policy with enhanced focus on safeguarding their interests and livelihoods.
- 1.2 Further during the intervening period of 40 years since the enactment of the Forest (Conservation) Act, 1980, there has been several issues that has come to the fore leading to ambiguity and causing hindrances in exercising rights of the individual to put to use the land under their ownership. Currently all government forest lands (whether notified or not) and area recorded as forest in any government record come under the ambit of the Forest Conservation Act. Besides, the lands bearing vegetation irrespective of ownership and classification also attract the provision of the Act if it is notified as forest in revenue records. To effectively fit into the present circumstances, particularly for accelerated integration of conservation and development, it has been necessary to make amendment in the Forest (Conservation) Act, 1980.
- 1.3 The National Agroforestry Policy, 2014 has been in force for over five years. The regulatory provisions of Indian Forest Act, 1927 apply to a number of tree species and there is ambiguity on treatment of timber harvested from forest and outside forests, as both comes under the purview of definition of forest produce. There is need to liberalise the production

and movement of such timber coming out of forest without jeopardising the safety of the forests. This is also important to promote and expand tree outside forests and to provide farmers and individuals to grow more woods for their land for increased income and livelihood opportunities. This will also accelerate growth of Wood based Industry in the country thereby contributing to both employment generation and the GDP.

Our National Forest Policy and National Agroforestry Policy should be implemented keeping in mind our international commitments under Climate Change, Sustainable Development Goals and our resolve to make India Global Economic Powerhouse while also serving the primary stakeholders.

Considering the above discussed points, a Task Force was constituted by MOEFCC vide OM F. No. 1-1/2022- Forest Policy Division dated 31st March 2022 headed by DGF&SS having ToR to develop synergies between the National Forest Policy, Forest (Conservation) Act, 1980 and National Agroforestry Policy, 2014.

The task force in their draft report gave recommendations in the following aspects:

- 1) Amendment in Forest Conservation Act, 1980 including removal of obstacles in growth of agro/farm forestry.
- 2) Increasing forest and tree cover in recorded forest areas.
- 3) Increasing ToF areas including agroforestry.
- 4) Implementation of National Agroforestry Policy 2014
- 5) Role of Wood Based Industries (WBI)
- 6) Regulatory framework dealing with transit of harvested agroforestry timber
- 7) Import substitution
- 8) Carbon fund and green credits

Composition of Task Force is as under:

Shri Chandra Prakash Goval, Director General of Forest and Special Secretary (DGF&SS), MoEFCC : Chairman Shri Arun Singh Rawat, Director General, ICFRE 2. Member Shri Bivash Ranjan, Additional Director General of Forests (WL), MoEFCC 3. : Member Shri Satya Prakash Yadav, Additional Director General ofForests (FC), MoEFCC 4. : Member 5. Shri A.K. Bansal, Retd ADG(FC), Odisha : Member PCCF & HoFF, Govt. of Odisha 6. Member 7. PCCF & HoFF, Govt. of Telangana : Member 8. CEO, National Authority, MoEFCC, New Delhi : Member Shri R. Raghu Prasad, Inspector General of Forests (Forest Policy), MoEFCC, New Delhi : Member 10. Shri Ramesh Kumar Pandey, Inspector General of Forests (Forest Conservation), MoEFCC, New Delhi : Member 11. Shri Prem Kumar Jha, Inspector General of Forests (NAEB), MoEFCC, New Delhi : Member 12. Shri Suneesh Buxy, Inspector General of Forests (Surveyand Utilisation), MoEFCC, New Delhi : Member 13. Joint Secretary/ Representative of DAC&FW looking after Agroforestry and Bamboo Mission : Member 14. Joint Secretary, Department of Legal Affairs, looking after MoEFCC issues or his nominee : Member 15. Shri Padamshree Anil Joshi, HESCO, Uttarakhand : Member 16. Shri Rajive Kumar, Ex-IFS, Forestry Consultant, Lucknow : Member 17. Shri Aman Jha, Legal Consultant, Noida : Member 18. Shri Vijay Dhasmana-Eco-restoration Practitioner, Delhi : Member 19. Shri Maneesh Kumar, Assistant Incpector General of Forests (Forest Policy), MoEFCC : Member

2. Recommendations of the task force:

2.1 Amendment to FCA:

Secretary

- 2.1.1 Application of FCA to areas that are forest as per the dictionary meaning needs to be reviewed in the light of the fact that sizable forest areas including in the NE states have not been recorded as forests in any government record or have not been mapped and/or properly demarcated and the guidelines issued by the Ministry in November 2022 wherein States/UT are required to frame criteria for "deemed forests" taking into account the spirit of the order of the Supreme Court, NFP, the rational of having adequate forests, site quality of naturally occurring forest species for supporting healthy environment.
- 2.1.2 All activities included in approved Working/Management Plans should be taken as forestry activities. Moreover, the following areas may be kept out of the purview of FCA:
- Forest areas acquired by the concerned Government Departments as ROW for laying railway tracks or road construction prior to

- 25.10.1980 and owned by them (for the purpose for which such lands were acquired)
- · Non-forest areas in ROW along roads and railway lines where plantations have been raised and notified as forests for protection
- Development of infrastructure along international boarder (up to specified kilometre) if Ministry of home/ defence certifies that this project is needed for national security and sovereignty.
- The matter regarding "keeping lands belonging to individuals/ organizations out of the purview of FCA may be decided after wider consultations with the States/UTs.
- · Provision Agroforestry enabling Agroforestry
- 2.2 Increasing FTC (Forest and tree cover) in recorded forest areas
- Rapid assessment of RFA shall be done by FSI that is presently devoid of 'forest' cover but may be suitable for ecological restoration as 'forest' along with areas that are under other ecosystems/land uses for which efforts to grow forests are not warranted.

- · Forests need to be classified into two main categories:
- a. Ecological forests including PAs that need to be conserved and managed primarily for their ecological functions, along with proper valuation of ecological services; and
- b. Production forests that need to be managed intensively for improving quality and enhancing production of timber as well as non-wood forest produces by adoption of best scientific management practices/interventions and ensuring availability of required funds for all operations including those necessary for regeneration before initiating harvesting.
 - Forest areas with Forest Development Corporations (around 1.12 M ha) need to be managed primarily for timber production coupled with sustainability certification. This has huge potential to reduce imports and increase exports (high value furniture for which there is niche market in developed countries and having increasing trend).
 - FDCs may be encouraged to partner with financial banks and/or private entities for optimizing production of timber from forest lands with them.
- · Promotion of QPM in all regeneration efforts needs to be included in the Working Plan Code
- Indian Institute of Forest Management, Bhopal may be asked take up development of Indian Forest Management standard to be made part of National Working Plan Code.
- 2.3 Increasing ToF areas including under agroforestry
- Assessment of AF Resources: "Agroforestry" is not same as "Trees Outside Forest" but is its important sub-set and is a more active source of production of timber of fast growing as well as medium rotation Indian tree species. From the management perspective (silviculture) also agroforests are different other ToF areas.
- The current assessment of ToF resources done by FSI as a part of biennial assessment of Forest and Tree cover in the country does not give information required by Wood Based Industries. A separate program of detailed

- assessment of ToF including agroforestry once in five years, is needed to provide details of tree species, girth, potential availability of wood, etc. This task can be entrusted to the FSI. This will also facilitate planning for augmentation of plantations of tree species required by the WBIs and establishment clusters of wood processing facilities/WBIs. To start with development of detailed framework along with pilot implementation may be explored under the ongoing USAID TOFI project. And an expert consultative group may be constituted by the MOEFCC.
- MOEFCC should also decide and circulate the methodology for wood availability studies by the states required under the WBI (Establishment and Regulation) Guidelines, 2016.
- 2.4 Implementation of National Agroforestry Policy 2014
- Various interventions mentioned in the NAFP namely access to Quality Planting material, research extension and capacity building, institutional credit and insurance cover, facilitating increased participation of industries, farmers access to markets, and sound data base and information system etc. need to be planned and executed in a holistic manner covering the entire value/supply chain for achieving the growth of the Agroforestry sector.
- R& D on various of AF production system including marketing, processing for development of substitutes for forest timber.
- There should be online registration of Wood based industries and e-compliance for legitimate sourcing of wood. The system can be developed as a pilot project in 1-2 willing states and gradually extended to other states.

2.5 Role of Wood based Industries:

In the agroforestry production system key stakeholders are the tree growers and the processing industry in addition to the Government whose role lies primarily in creation of conducive environment comprising facilitative policy and legal framework, credit and technical support.

Industry is required to play a major role by establishment of a direct relationship between the factory and the grower by supporting with inputs including credit, constant technical advice and finally harvesting and transport services. Barring Paper industry, others including plywood, wood based panel composite and furniture industry has yet make a head way in this direction due perhaps to its unorganized nature.

Critical input that can and should come from the WBIs include

- a) Investment in Research & Development
- b) Development of Industry standards/ specifications for various end uses in construction, builder and joinery, furniture etc
- Development and adoption of quality standards for various semi-finished products and finished products
- d) Adoption of voluntary sustainability certification standards
- 2.6 Regulatory framework dealing with transit of harvested AF timber
- Regulatory framework is often quoted hurdle in growth of agroforestry despite the exemption of tree species raised by farmers under various agroforestry models in various states. However, liberal/no transit regulation on Agroforestry species may be a necessary but not sufficient condition for growth of agroforestry. Downstream processing using appropriate technologies and improvement of infrastructure and creating public awareness about use of wood and wood substitutes made from plantation wood and other renewable fibers are very important.
- Possible by suitable amendment in the existing Indian Forest Act, 1927 and the State Forest Acts. It has to be worked out after wider consultations with the states and all stakeholders and needs to be done gradually so as to not cause indiscriminate unauthorized felling in forests that are being looked after by inadequate staff.
- Electronic timber traceability protocol or standard based on IT technologies should be established by the Union Government for and

subsequent block chain-based tracking and traceability. IT based technologies are possible to create a database of all trees planted and harvested outside forests and use this inventory for analysis, forecasting and demand supply management including associated risk management, as well as issuance of certificate of ownership and origin (COO). This should however be developed and tested through a pilot project in one-two districts or so and subsequently scaled up.

2.7 Import Substitution

- Development of appropriate strategies for import substitution by domestic production of timber from forests, ToF, Agroforestry it is important to undertake detailed quantitative assessment of various end uses of imported timber/Swan wood etc.
- It is crucial to examine if and up to what extent imported timber can be effectively substituted by fast growing tree species and medium/long rotation tree species generally grown in agroforestry systems, or medium/ long rotation tree species found in ToF areas with identification of gaps in processing technologies, infrastructure in WBIs, and ways to address the same, and facilitate development of WBIs around AF growth centres.
- Development of product standards and user guidance manuals to enhance consumer acceptance and for promoting wider use of import substitutes.
- Mandatory use of wood, engineered wood and products made from wood substitutes in building constructions, interiors, furniture etc. by all government agencies.

2.8 Carbon fund and Green Credits

There is a need to explore green credits and voluntary carbon markets as an additional incentive to the Farmers'/tree growers and communities conserving forest areas (viz. in North East and other states).

Activities of Chhattisgarh Rajya Van Vikas Nigam-Furthering the Cause of Timber Production in Central India

A brief background:

Chhattisgarh Rajya Van Vikas Nigam (CGRRVN) was formed in the year 2001, after the formation of Chhattisgarh State. The main objectives of the Nigam are:

- · To accelerate and increase forestry production by creating plantations of -
- o Fast growing species
- o Species of higher economic value
- o Species capable of diversified use for industrial and commercial purposes.
- To bring suitable forest areas under intensive management practices in order to improve, enrich and enhance production, both in quantity and quality.
- To convert existing lowquality forests into high quality productive forests by adopting intensive management system.
- To formulate financially viable projects in order to draw institutional finance to execute its forestry activities.
- To plant, grow cultivate, produce and raise plantations of all kinds of forest plants, trees and crops.
- To convert low valued/ degraded/ poor site quality forests into high value man-made forests to obtain high quality produce for diversified uses.

Tapesh Kumar Jha Managing Director

- Conservation, development and sustainable management of the natural forest resources.
- · Enhancement of productivity in teak plantation areas by scientific thinning.
- To improve the ecological status of the State by enrichment of the forest cover.
- · Restoration of ecological balance in the degraded forest areas.
- · To maintain the bio-diversity of the area

Major activities of CGRVVN

The main activity of the Nigam is to raise commercial plantations of teak, bamboo and miscellaneous species. In addition to this, the Nigam also undertakes the work of rehabilitation of degraded forests, compensatory afforestation, deposit work plantation (plantation works for PSUs/government agencies on payment basis) and execution of plantation schemes of Central and State Governments.

Administrative structure of the Nigam

The overall management of the Nigam is carried out by a management committee which has eight members. The day-to-day administration is headed by a Managing Director and there are 9 Divisional Managers and 2 Regional General Managers who look after the field activities. Against the sanctioned 723 posts, 350 people are employed in the Nigam and in addition, there are 92 regular chowkidars.

Details of the land under the possession of Nigam:

Sl No	Regional Office	Division	Forest Area (in ha)	Sl No	Regional Office	Division	Forest Area (in ha)
1	Raipur	Barnawapara, Raipur Panabaras, Rajnandgaon Antagarh, Bhanupratappur Kawardha, Kabeerdham Industrial Plantations, Jagdalpur	35,201 49,910 29,040 25,436 14,349	2	Bilaspur	Kota, Bilaspur Surguja, Raigarh Industrial Plantations, Korba Industrial Plantations, Raipgarh	30,825 33,120 Plantations in revenue/industry lands Plantations in revenue/industry lands 2,17,881

Activities of the Nigam

1. Commercial plantation of teak, bamboo and eucalyptus: From 2001 to 2022, the Nigam has planted a total area of 1,00,084 hectares with teak, bamboo and eucalyptus. In the year 2023, teak seedlings numbering 27,69,750 were planted over an area of 1748.50 hectares.

2. Plantation in Industrial areas:

With the objective to improve the environmental conditions in industrial sites, Nigam takes up plantations in industrial areas such as Bhilai Steel Plant (BSP), National Mineral Development Corporation (NMDC), National Thermal Power Corporation (NTPC), South Eastern Coalfield Limited (SECL), Mahanadi Coalfields Limited (MCL) etc. From the year 1990 to 2023, 297.338 lakh plants have been planted by the Nigam in the Industrial areas. In the monsoon of 2023, about 8 lakh seedlings were planted. These plantations were done both in the mined areas and non-mining areas.

3. Nurseries of the Nigam:

Production of teak root-shoots is taken up in the six nurseries of the Nigam, as per the requirements of divisions. Apart for teak root-shoots, seedlings of different species are also produced in the nurseries. In the year 2023, these nurseries produced 37.97 lakh teak root-shoots and 16.86 lakh seedlings of various species. For the year 2024, the target of teak root-shoot production is 64.58 lakhs and that of seedlings is 25.54 lakhs.

4. Tree felling activities:

The Nigam does two kinds of tree fellings. One is thinning in plantations and the other is improvement felling in the areas for raising commercial plantations in the following years. The material obtained during felling is auctioned through the six commercial depots of the Nigam. Bamboo is sold through tender process.

The details of forest produce obtained in the year 2022-23 is given below:

Year	Timber (in CUM)	Fuel wood lots	Commercial bamboo (in numbers)	Industrial bamboo (Notional
		(III Humbers	of culm)	tons)
2022-23	28,497	14,142	2,01,180	434

5. Details of income and expenditure of the Nigam:

The financial figures of income and expenditure of the Nigam for the past three years are as below:



(in crore rupees)

Financial	Revenue	Expenditure	Profits	Profits
year				after taxes
2020-21	57.71	45.32	12.39	11.56
2021-22	69.11	31.80	37.31	36.49
2022-23	69.44	15.58	53.86	52.65

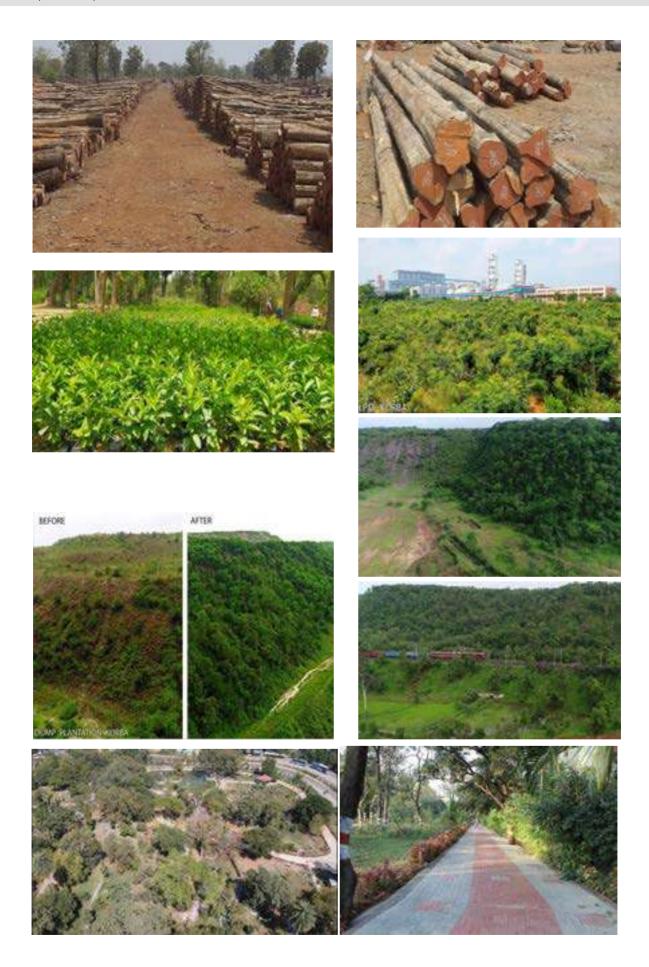
6. Corporate Social Responsibility (CSR):

Chhattisgarh Rajya Van Vikas Nigam is a registered company under the Companies Act. Accordingly, it abides by the CSR rules and in the financial year 2022-23, works worth Rs 53.99 lakhs were sanctioned under CSR.









Activities of Goa Forest Development Corporation Ltd. (Government of Goa Undertaking)

Nandakumar E. Parab Managing Director and General Manager

INTRODUCTION:

oa Forest Development Corporation Ltd (GFDCL) was constituted from the erstwhile cashew division of Goa Forest Department having approx. 6853 Ha. of Cashew plantation (i.e. 16 % of total cashew area of Goa is contributing by GFDC) and 60 Ha. rubber plantation on leasehold for a period of 40 years. These plantations were handed over by the Forest Department to GFDC consequent on its formation during early April, 1997. The Plantations were taken over as to increase their productivity by improved management techniques as well as introducing high yielding varieties of grafts there-by making the plantations a profitable venture in the long run.

Most of the area under Cashew and rubber plantations are either reserved forest or communidade lands therefore ownership vests entirely with the forest department.

Objectives:

The main objectives of the Corporation are:

- 1. To develop and raise forest plantations, horticultural and plantation crops and in particular Cashew, Rubber, Teak and such other suitable species in the State of Goa for the purpose of increasing production and development of industries based on their produce.
- 2. To plant, grow, cultivate, produce and raise plantations of all kinds of varieties of forest plants, trees and crops and natural products of every kind and other agricultural crops and to buy, sell, export, import, process, distribute or otherwise deal in all kind of forests plants, trees crops, natural produce and agricultural crops.
- 3. To carry on the business of planters, cultivators, sellers and dealers in timber, plywood, pulpwood, matchwoodand such other products of every description and to manufacture, dispose off, sell and deal in products of such plantations and other forest crops of every description.
- 4. To plant, grow, cultivate, produce and raise plantations of all the types of horticultural, floricultural and plantation crops in the state.
- 5. To establish, promote, eco-tourism, eco-

development and other environment related activities.

Besides, there are other activities ancillaries or incidental to the attainment of the main objects of the Corporation.

Authorized Capital:

The authorized share capital of the Company is Rs. 500,00,000/- (Rupess Five hundred lakhs) divided into Rs. 1,00,000/- (Rupees One lakh) equity shares of Rs. 500 /- (Rupees Five hundred) each of which Rs. 268.71 lakhs is held by the State Government.

Structure of GFDC:

GFDC is governed by Board of Directors from the State Government headed by Chairman. The Government has power to appoint all or majority of the members of the Board of Directors, out of which at least two shall be from the State Forest Department.

Presently Dr. Deviya Rane, M.L.A. Poriem Constituency is the Chairman of the Corporation, PCCF Goa Forest Department and Dy. CF (South Goa Division), Margao are the Directors and

Managing Director, GFDC is the member secretary of the Board.

The Head quarter of the Corporation is located in Junta House Building on 3rd Floor, Panaji. The Managing Director of GFDC is an officer of the Indian Forest Officer in the rank of Addl. Principal Chief Conservator of forests (APCCF). He is assisted at headquarter by General Manager an Officer in the rank of Dy. Conservator of Forests (DCF), Manager (Finance & Administration) is an officer on deputation from Directorate of Accounts and associated staff.

There are 5 Range Offices of the Corporation located at Ponda, Morlem, Quepem, Canacona and Botanical garden, Salaulim headed by officer in the rank of Range Forest Officer assisted by Round Forester and Forest guard. All these posts are filled on deputation from Forest Department except Manager (Finance & Administration) & Accountant filled on deputation from Directorate of Accounts in this Corporation.

Management of Cashew & Rubber:

Initially, Cashew Plantations were raised with local seed variety by the Forest Department during the period from 1964 to 1981 in the coupes clear felled at that time as well as on acquired communidade lands. Though it was successful at most places nevertheless there were certain areas which did not do well due to locality factors.

In regards to marketing of the produce, the corporation following the methodology of auctioning cashew plantation in situ, wherein average of the bid for the last three years for a particular plantation is added with 10-15% and thereafter this figure is compared with the individual bids of the preceding years. The highest figure of these is taken to be the upset price for the year in question. The annual auction is conducted only for the rights of collection of nuts and apples from the plantations. Sales are conducted at respective Ranges for the Cashew estates falling in their jurisdiction. Total 307 cashew estates distributed among 4 ranges of Corporation, however those which are having sufficient number of fruit yielding trees and the bidders are interested to bid those estates are placed for auction sale.

The revenue generated from Cashew plantation is totally depends on prevailing rates for Cashew nut in market as well as conditions of cashew coupes, so it always varied year after year.

GFDC is having rubber plantation in an area of 60 ha at Talsai in Quepem Taluka, raised by forest department in 1986. It is of seed origin and planting was done along the contours at a spacing of 4 mts keeping with a minimum distance of 7 Mts between contours. At present latex is collected from the trees on alternate days and converted in to rubber sheets. The sheets after smoking are auctioned in open market. The corporation has maintained smoke house at same site and its capacity isunder fully utilization.

The main management issues of Cashew plantations are till 1980s the same were maintained well, but there after due to paucity of fund proper management was not done as a result, areas got infested with weed Eupatorium Spp, Climber & Creepers, insect & pests attack etc. Also some of the plantations passed through phase of inter-planting with Acacia and Eucalyptus by Forest department, leading to low productivity of cashew. It is observed that most of the plantations are gradually losing their productivity since trees are turning senile every year.

GFDC is attempting to maintain the yield and cashew tree stock by gap planting with grafts , but found to be very difficult to maintain the yield potential of each estate.

Main Activities:

a) Recent Cashew Plantation:

GFDC has taken up Gap Cashew plantations in degraded patches of the estates in an area 350 Ha. in two years 2021-22 and 2022-23 under revenue fund and results are promising. These plantations are maintained for three years. The planting stock was used from in-house Cashew nursery. The cashew grafts raised in GFDC nursery are used for planting in their ownestates as well as to sale public.

b) Development of Botanical Garden and Ecorestoration Park at Salaulim:

Goa's biggest Botanical garden cum Ecorestoration Park created, developed and well maintained at downstream of Salaulim Dam in





Sanguem Taluka by GFDC. In 2006, State Government assigned the task of development Botanical garden on acquired area of 14.20 Ha. belongs to Water Resource Department. The developmental work of lawn and botanical garden was completed in 7.9 Ha area during first phase and Development of Medicinal garden and eco-tourism activities are in progress.

Local as well as foreigners visitsthis parkto enjoy scenicbeauty and tranquility provides by nature. Well maintained lawns, topiary in different shapes, variety of flowering plants, rock garden with waterfall, Burma bridge, Arch, Gazebos in lawns are the main attractions. Every year in monsoon, big crowd of all over the Goa rush to the park to get fascinating experience and spectacular view of Spray rising over on top of the duct bill spillway occurs only when salaulimdam gets overflow. More than 140 forest birdsand around 25-30 butterflies recorded in this park. It acts as a birders paradise for budding birders& entomologistto catch these creatures in their camera. Keeping the needs of visitors, required amenities and activities have been provided in the park.

c) Development of Nagar Van at Chapoli, Canacona:

On behalf of Goa Forest Department, GFDC has undertaken work of development of City Forest /Nagar Van at Chapoli , Canacona in 50 Ha. area, out of which 35 Ha is reserve forest and remaining 15 Ha. is non forest land under possession of Water Resource Department. It is located at down stream of Chapoli dam. GFDC focused on promotion of native

indigenous floral species of Western Ghat especially found in Goa region to generate awareness about species amongst the public and visitors. The work is taken under Nagar Van Yojana Scheme of MoEF &



CC, GOI. The foundationstone of this Park was laid on 28/12/2021 at hands of Hon,ble Chief Minister of Goa Dr. Pramod P. Sawant ji. The main attractions for tourist and locals are Walking path, Nature trails, Open gym, Play equipment area for Children, Mini waterfall, Meditation hut, Landscape garden, public convenience, natural forest rich with indigenous floral and faunal species etc.

d) Apiculture/Honey Production:

GFDC has taken up new initiative in current year to collects forest honey by managing honey bee colonies (Apis cerena indica). Most of GFDC estates are located along with forest areas and ideally suited for apiculture purpose thereby benefitting the fauna and generate revenue to the Corporation. The collected honey will be processed in-house and final product made available for sale to the public.





e) Promotion of Eco-tourism activities:

GFDC taken initiative and diverted their activity towards promotion of Eco-Tourism sites and activities especially in hinterland of Goa with intention to become a self reliant and self sustain. The main proposed projects are as below;

- Development of Yoga, Naturopathy and Wellness centre at Salaulim, Sanguem
- Development of Eco-camp at Surla plateau, Sattari Taluka.
- iii. Development of Eco-camp at Aranyak Camp, Collem.
- iv. Operation & Maintenance of Eco-Tourism Sites & Activities, including wildlife tours through jeep safari's in Netravali Wildlife Sanctuary to promote community based hinterland tourism.
- f) Special Event "1stGoa Cashew Fest-2023" of GFDC:

Goa is one of the main producer, processor and exporter of cashew in the world. Cashew is a "Way of life", so GFDC had mainly focused on fruit cashew and its products. All cashew products were made available to enjoy, experience and purchase during this fest.

It was first-ever cashew fest organized by GFDC



on 15th& 16th April , 2023 in city of Panaji and brought together various stakeholders from the cashew sector like SHGs , Farmers, Industry including processors, distillers, retailers, agriculturists, restaurant owners , academicians, technical experts and others. The festival aimed to showcase cashew and discuss ways to increase its production in the state. It was the first edition of Goa cashew fest and presented a unique opportunity to educate the youth, new generation in farming community etc about the significance of cashew harvesting and promoting and preserving the rich history of cashews in Goa.

It was a delightful celebration helped to bring together culture, tradition, and the significance of cashew in the state's identity.

Cashew festival promoted the traditional method of making feni, a local alcoholic beverage made from cashew juice through Cashew Gallery and showcased the Goan Kunbi fabric. In addition, byproducts made from cashews were promoted and sold at the event.

During inaugural function of this festival Hon,ble Chief Minister of Goa Dr Pramod Sawant Ji, while appreciating the efforts of GFDC declared during the inaugural function that Cashew fest as 'State festival' and henceforth will be celebrated every year on the lines of International Film Festival .Very good response was received, approximately 30,000 visitors include delegates, experts, event partners and other attended the festival. The main attractions of the event were technical session, start up stall, Cashew gallery, Food & beaverages stalls, Kunbi saree fashion show, entertainment programme etc.

Activities of Gujarat State Forest Development Corporation Ltd.

(Govt. of Gujarat undertaking)

HISTORY OF GSFDC LTD.

Gujarat State Forest Development Corporation Ltd (GSFDC) was incorporated on 20/08/1976 as a government company under the Companies Act, 1956.

Among its objectives, the Corporation mainly puts efforts towards the optimum utilization and sustainable development of the minor forest produce (MFP) available in the State of Gujarat for providing livelihood opportunities to the forest dwellers who reside in and around Forest areas of the Gujarat State and preventing their exploitation from the middlemen. Among MFPs, the majority people are involved in the activity of collection of Timru Leaves (Diospyros melanoxyion).

GSFDC is also engaged in the other activities like raising eucalyptus commercial plantations, production and marketing of teak & non-teak furniture, renovation of offices, manufacturing and marketing of Ayurveda formulations and forest produce with brand name Dhanvantri.

In the field of eco-tourism a nature based tourism site by the name of vanil ecoden has

Vision:

To achieve overall development of the ST & other Traditional Forest Dwellers through sustainable usage of the surrounding natural resources.

been setup by the corporation.

Mission:

To strive for the attainment of economic security of the Forest Dweller Communities

To eliminate Commercial exploitation of Forest Dwellers who collect MFP as means of livelihood.

To maximize and accrue financial benefits to the Principal user community in the forests.

Main Objectives:

To undertake commercially viable and ecologically sustainable forest based

Ram Ratan Nala Managing Director

enterprises.

To eliminate exploitation from private trade of forest dwellers in general and the tribal in particular, who derive sustenance through collection of Minor & other Forest Produce (MFP).

To maximize benefit percolation from such trade to the tribal.

BOARD OF DIRECTORS

Affairs of the Corporation and its policies are managed and decided by its Board of Directors. The present members of its Board are a statutory committee under the Gujarat MFP Trade Act, 1979 i.e. the State Level Advisory Committee, advises the State Govt. in fixation of Statutory Minimum Prices for nationalized MFPs. This arrangement is similar to the mechanism in Agriculture sector.

FINANCIAL POSITION AT A GLANCE BASED ON 45TH ANNUAL REPORT OF GSFDCL FOR YEAR 2021-22

	(Rs. i	n Lukhs)		
PARTICULARS		For the year ended on 31° March		
TAKING LAKE	2021-22	2020-21		
Revenue from Operations (Net Sales)	3368.49	2510.52		
Add: Other Income	408.46	771:07		
Total Revenue	3776.95	3,281.59		
Profit before Adjustment Relating to Prior Period (net), Extra-ordinary Item, Interest, Depreciation	896.13	930.56		
Less : Depreciation	43.45	28.98		
Less: Interest	0.25	0.68		
Profit Before tax before prior period (net) and Extra- Ordinary Item	852.42	869.64		
Add : Prior Period Items	514.08	234.11		
Profit Before Tax	1366.50	1103.75		
Less: Deferred Tax	(4.24)	6.00		
Less: Current Tax	(91.24)	(195.00)		
Profit After Tax	1271.62	914.75		
Dividend Proposed (68% (Paid 8 % for FY 2020-21)	50.53	50.53		

Total Revenue including other income of the Corporation is Rs.3776.95 Lakhs as against Rs.3281.59 Lakhs during last year.

Total Net Sale of the Corporation from its core activities has increased by 34% and remained at Rs.3368.49 Lakhs as against Rs.2510.52 Lakhs during the previous year. Net profit before tax of our Corporation for the year is Rs.1366.50 Lakhs as against Rs.1103.75 Lakhs during the previous year. Panam Division is the major contributor to the revenue and net profit for the year.

ACTIVITIES

1. COLLECTION AND PROCESSING OF MINOR FOREST PRODUCE

Government of Gujarat by promulgating the Gujarat MFP Trade Nationalization Act, 1979. nationalized the trade of four MFPs viz., the Timru leaf, Mahuwa flower, Gums in Gujarat.Later under the (Panchayat Extension to Scheduled Areas Gujarat denationalized all 4 MFPs on 24 May, 2017.



In the wake of 73rd constitutional amendment, the PESA act (1996) and the amendment to the Gujarat

Panchayats Act (1998) the Corporation now trades in MFP from Scheduled areas on behalf of Gram

Panchayats/Sabhas on a no-profit no-loss principle.

Over thirty two MFPs are now being collected. This translates into higher income to tribal close to his homestead during lean period



M.F.P. Collection and sale

Collection of M.F.Ps is done through Direct Purchase Centres (DPCs) at corporation's godown and weekly Bazars.

The collected M.F.Ps stored in Corporation's godowns are sold to traders through auctioning process





MSP (MINIMUM SUPPORT PRICE) SCHEME FOR MINOR FOREST PRODUCE

The GSFDC has been appointed as the state implementing agency by the Government of Gujarat for the implementation of the scheme for Marketing of

Minor Forest Produce (MFP) through Minimum Support Price (MSP) & Development of Value Chain for MFP.

This scheme has following objectives

- ☐ To provide fair price to the MFP gatherers for the produce collected by them and enhance their income level
- \square To ensure sustainable harvesting of MFPs.

Gujarat State Forest Development Corporation Ltd. has started 45 Direct Purchase Centers (DPC) for collection of various commodities.

VAN DHAN VIKAS KENDRA

The "Van Dhan Vikas Karyakram" as the name implies will add to the income and livelihoods for tribals by harnessing the wealth of forests.

It also provisions to bridge the last mile connectivity between the tribals and markets through activation of Haat bazars by strengthening of grassroots infrastructure for MFP procurement, storage, transportation, marketing etc. two Van Dhan Vikas



Kendras have been set up by GSFDCL.



DHANVANTRI

Gujarat State Forest Development Corporation Limited is engaged in collecting, processing and marketing of Minor Forest products among its various activities. The activity has tremendous bearing on forest resources utilization and tribal employment generation. Many of the Minor Forest





Products are principal raw materials for manufacturing of Ayurvedic medicines as well as herbal preparations and remedies.

Thus to enhance the collection of existing MFP and to augment resource mobilization and employment generation for the tribal and rural poor. The Ayurvedic and Herbal preparation project was conceived under the brand name of Dhanvantari.

Dhanvantri unit Manufactures many types of Churna, Tablets, and Oils. Apart from manufacturing of Ayurvedic medicines, GSFDC limited is also processing Honey. It has a processing capacity of 1,50,000kg per annum. Honey is sold in different

packings of 100, 200, 500 gms and bulk packing of 5 and 20 kg. The unit has state-of-art fully automatic Honey treatment plant and bottle filling plant to guarantee quality to the valued customers. Various MFPs like Amla, Harde, Baheda, Musli and various types of Gums like Babul, Guggal etc. are also graded &packed in 100, 200 and 500 gms in polythene bags. Entire range of products is marketed under the brand name of Dhanvantari.





PLANTATIONS

Panam Irrigated Plantation Project is managed by G.S.F.D.C. Ltd. which deals with the tree planting Commercially Important Species on 6194.7 ha. Degraded forest area of 11 Villages of Godhra Taluka and 13 Villages of Shahera Taluka in Panchamahals district From 1st April 1988

The forest area which is spread over above 24 villages has become potentially irrigable after Panam Dam constructed either by means of flow irrigation or by lifting the waters by the Panam Main Canals and its distributaries.



The Panam project of the corporation is giving continuous profits to the organisation as can be seen from the data table listed below:

Sr. No	Year of Harvesting	Harvested Area (Ha.)	Timber (cmt)	Firewood (Qtl.)	Productivity (cmt/ha)	Revenue (lakhs)	Revenue/ha (lakhs)
1.	2018-19	488	16188	35314	33	523	1.1
2.	2019-20	548	22228	92942	41	822	1.5
3.	2020-21	696	32332	103379	46	1409	2
4.	2021-22	628	23850	83208	38	1820	2.9
5.	2022-23	680	15952	129000	24	1856	2.7

The productivity per hectare is one of the highest in India and also the average annual turnover per ha isalso amongst highest in India.

INFRASTRUCTURE OF HIGH-TECH NURSERIES IN PANAM IRRIGATED PLANTATION DIVISION GODHRA

Sr. No.	Name of Range	Place of Nursery	Green House	Net House
110.	Name of Range		Capacity	Capacity
		Dhayaka High Tech	4(684Sq.Mt.)	1(240Sq.Mt.)
1	Shahera Irrigated	Nursery	150000Plants	50000Plants
•	Range	Sadara High Tech	1(120Sq.Mt.)	2(480Sq.Mt,)
2		Nursery	25000Plants	100000Plants
	Ratanpur Irrigated Range	Kabirpur High Tech	2(360Sq.Mt.)	2(480Sq.Mt,)
3		Nursery	50000Plants	100000Plants
		Karasana High Tech	1(120Sq.Mt.)	2(480Sq.Mt,)
4		Nursery	25000Plants	100000Plants
5	Godhra Irrigated Range	Isaravadi High Tech	1(120Sq.Mt.)	3(720Sq.Mt,)
5	Runge	Nursery	25000Plants	150000Plants

Plantation area Year of **Eucalyptus clones** Plantation Total Area in **Clonal Eucalyptus** Medicinal Plantation Ha. 2018-19 167 167 ITC-413JKSC-2JKSC-8 2019-20 57 20 77 ITC-413JKSC-2JKSC-8 2020-21 71.75 8 79.75 ITC-283,ITC-413,JKSC-2JKSC-8 2021-22 109.25 0 109.25 ITC-413,JKSC-2JKSC-8 2022-23 72 0 72 ITC-413,JKSC-2JKSC-8 Total 477 28 505

PLANTATION DETAILS

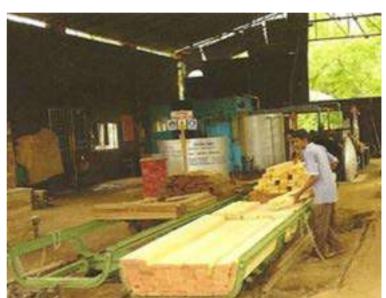
VANIL UDYOG

GSFDCL has an integrated wood working unit named "VANIL UDYOG". Vanil Udyog had been established at village Navtad, Taluka-Vansda, Dist. Navsari at the total cost of Rs. 1.66 Crores on 12-11-

1979 and started commercial production in 1982.

As of today VanilUdyog manufactures Wooden doors, Window frames & Shutters, Scantlings plank,

Furnitures etc. from teak wood and superior secondary non-teakwood species. Its objective is to facilitate consumers in getting good quality finished products at reasonable price.



Vanil Eco Den

Vanil Udyog has a state-of-art modern Saw Mill, Conventional and Solar Seasoning Plants, Wood

Processing Plant, Doors-Windows & Furniture Joinery Unit, Wood Art and finishing sections wherein local tribal workers are engaged under supervision of qualified and experienced engineers and quality products are manufactured as per the guidelines of Indian Standard Specifications. Vanil Udyog has recently received ISO 9001:2001 certificate for its quality management system from RWTUV Germany. Emphasis is laid on conservation of precious teakwood by promoting usages of treated Nonteak wood timber by making it more or

less comparable to teakwood. Non-teakwood is upgraded to the level of teakwood and yet reduces the cost by about 40% through chemical treatment and seasoning processes. Main customers are state PSUs like Gujarat State Police Housing Corporation Limited, Public Works department and other departments of the State Government and a host of a public and private institutions.

Vanil Eco Den is an Eco Tourism centre developed by GSFDC Ltd. located in lush green western Ghat

Forest area of Vansda Taluka in Navsari District. It is easily accessible by waghai-saputara road and tourists can experience nature amidst dense tropical forest area.

Activities of Karnataka Forest Development Corporation Limited, Bangalore

A. Radha Devi Managing Director

As a principle decision taken by the Government of India in the Fourth Five Year Plan, the Karnataka Forest Development Corporation was set up in 1971 for the purpose of supplying fast growing species as raw material for paper and yarn manufacturing factories. The Corporation will be a full-fledged government owned corporation.

There are two major functional activities in the corporation,

- 1. Cultivation of fast-growing pulpwood plantations and selling them to pulpwood -based industries (Raising and Sale of Pulpwood).
- 2. Management of rubber plantations cultivated by the corporation, harvesting of mature rubber trees and collection of Cenex, processing in rubber factories and selling in the market. (Raising Rubber Plantation, Rubber Extraction, Processing and Sale)

Karnataka Forest Development Corporation Limited has two main divisions:

- 1. Pulpwood unit
- 2. Rubber Unit

Details of current Leased Land in the Corporation: (In Hectares)

1	Pulpwood Unit	41,663.33
2	Rubber Unit	4,443.32
	Total	46,106.65

A total of 80,338.33 hectares of forest area has been handed over by the Forest Department at various stages since the establishment of the Corporation in 1971 to 1987.

A total of 38,675 hectares of forest area has been returned to the Forest Department by the Corporation for various reasons (National Parks, Wildlife Sanctuaries and non-productive areas).

At present the corporation has a total area of 41,663.33 hectares of Pulpwood Plantations.

4,443.32 hectares of rubber plantations planted and maintained by the Forest Department were handed over to the Corporation in 1980 as per Government orders.

HISTORY OF PULPWOOD PLANTATIONS

Eucalyptus and Acacia plantations were cultivated from 1971 to 2016.

From 1976-77 to 1979-80, a total area of 594 hectares of cocoa plantation was cultivated by the Corporation. This project was abandoned due to the less yield obtained from the said plantation. (Cocoa Plantation)

During the year 1996 and 1997, the corporation planted tamarind plantations in a total area of 409 hectares, the soil of the corporation's forest area was infertile as such shunting the growth of tamarind plants. As the expected yield could not be obtained from the said plantations, the project was abandoned in the following days. So far from the existing tamarind plantation, a total of Rs. 6.09 Lakhs of income is being received annually.(Tamrind Plantations)

From 1996 to 2004, the corporation has cultivated bamboo plantations in an area of 875 hectares and the Marihal and other bamboos were cultivated and these are given to Medars on Subsidised Rates.

A tea plantation has been grown in a total area of 56 hectares on behalf of the corporation, and since the plantation is generating a small amount of income, it has been given to a private individual on a lease basis to carry out further maintenance of the plantation. (Tea Plantations)

After the government banned the Eucalyptus crop in 2017, in the corporation's board meeting an expert committee was formed to find out the alternative species to be grown by the Corporation in place of Eucalyptus.

The said expert committee had conducted a study and gave an opinion that CasuarinaJunguniana and

Subabul species can be grown in the forest areas of the corporation.

In this regard, a workshop was organized on Subabul and Casuarina Junguniana crops by inviting scientists from ITC, Bhadrachalam Institute and IFGTB, Coimbatore.

As per the recommendation given by the Expert Committee, the Government vide Order No: ACS 82 FPC 2017 dated 27-08-2018 ordered to handover forest land of Acacia plantations under the Forest Department covering a total area of 10,000 hectares to the Corporation on Lease basis. (Transfer of 10,000

HA Acacia Plantations)

A total of 4,860.09 Ha, new plantations of Pulpwood is grown by the corporation in five years from 2019 to 2023. The proposed development in the area was sanctioned by the Government on 26-11-2019. Accordingly, pulpwood plantations have been grown since 2019.

The pulpwood extracted by the corporation is being sold to M/s. West Coast Paper Mills, Dandeli and the said factory is giving good price for Eucalyptus pulpwood.

Details of the plantations Raised by KFDC

Sl	N. C	T otal Land	Species								
No	Name of Division		Acacia	Eucalyptus	Hebbevu	Subabul	Casuarina	Bamboo	Tamrind	Teak	Red sander
1	Shimoga	6684.79	1046.40	5274.81	10.80	77.00	64.80	42.50	0.00	168.48	0.00
2	Chikkamagaluru	11257.49	242.80	10107.05	16.50	298.85	275.00	34.00	0.00	283.29	0.00
3	Dharwad	7985.94	1213.60	5642.44	3.00	70.10	17.50	566.30	0.00	473.00	0.00
4	Bangalore	15735.11	62.20	15078.98	110.00	284.50	119.00	20.00	50.43	0.00	10.00
Tota	al	41663.33	2565.00	36103.28	140.30	730.45	476.30	662.80	50.43	924.77	10.00

Rates Given to the Pulpwood by Paper Industries

CLAT		Eucal	yptus	Acacia		
Sl No	Year	With Bark Without Bark		With Bark	Without Bark	
1	2017 - 18	3,250	5,000	3,000	4,875	
2	2018 - 19	-	5,100	-	4,900	
3	2019 - 20	-	5,200	-	5,000	
4	2020 - 21	-	5,200	-	5,000	
5	2021 - 22	-	5,300	-	5,100	
6	2022 - 23	-	5,600	-	5,400	
7	2023 - 24	-	7,000	-	6,500	

Revenue earned by sale of Pulpwood

Financial Year		Yield in MT	Revenue in Lakhs
	2018 - 2019	72,352.21	350.54
	2019 - 2020	55,036.43	(111.15)
	2020 - 2021	53,310.14	151.83
	2021 - 2022	1,06,224.28	1,319.45
	2022 2023	1,78,173.35	11,030.89

HISTORY OF RUBBER PLANTATIONS

4,443.32 hectares of rubber plantations planted and managed by the Forest Department were handed over to the Corporation in 1980 as per Government ordersInitially, rubber plantations were cultivated in

Sl No	Name of Division	Leased Land by the Corporation
1	Subrahamanya Rubber Division, Puttur	1,825.99
2	Sullia Rubber Division, Sullia	1,346.66
3	Aivernadu Rubber Division, Sullia	1,270.67
	Total	4,443.32

Sulliataluk of Dakshina Kannada district in 1961 on an experimental basis using state funds. It was then converted into a Sri Lankan Refugee Resettlement Scheme under the India-Sri Lanka Agreement with central government funding. During the period 1970-71 to 1980-81, 926 Sri Lankan refugee families were resettled (Rehabilitation of Srilankan repatriates under the Indo-Srilankan agreement 1964).

From raw rubber milk collected from the corporation's rubber plantations

Factories producing Cenex

- 1. C.L.F. Medinadka, Sullia.
- 2. C.L.F. Billenele, Subrahmanya

(Two Rubber Factories for processing Latex)

Aivernad (Sullia) factory for manufacturing ISNR products from rubber waste.

(Rubber Processing Factory Aivernadu).

Revenue earned by sale of Rubber

Financial Year	Yield in MT	Revenue in Lakhs
2018 - 2019	3,152.00	3,682.76
2019 - 2020	2,503.72	3,213.63
2020 - 2021	3,021.67	3,865.76
2021 - 2022	2,436.37	4,065.24
2022 2023	3409.00	4,400.95

Bye-products of Rubber produced by the Corporation

SL. NO.	Rubber Products
1	Centrifuged Latex (60% DRC)
2	ISNR-20
3	ISNR-50
4	ISNR-Non Grade
5	Skim Crepe
6	Skim Lump
7	Latex Crepe
8	Skim Crepe Off Grade
9	Milling Waste
10	Sludge Sheet
11	R.M.S
12	Ground Waste
13	Field Scrap

Free accommodation is provided for staff and Sri Lankan refugees.

- 1. Umbrellas, gumboots and blankets are supplied as per the requirement of workers.
- 2. Family Planning Allowance and Entertainment and the facility of Dish Antenna has been provided.
- 3. Free education, free school textbooks, free school uniforms for children of laborers along with recruitment of Tamil teachers according to children's language is provided.
- 4. Funeral expenses are being covered.
- 5. Workers Children are provided nutritious food at 45 infant centers.
- 6. Free healthcare facility, bonus, labor provident fund, gratuity facility and hospital facilities are provided to Sri Lankan refugee workers.
- Medical Bill Reimbursement Facility, Annual Leave Facility, H.T.C And maternity facilities are provided.

- 8. Workmen's compensation is provided as per the Act.
- 9. The facility of paid holidays is provided for celebration of national and other festivals.
- 10. Around 1,110 families of Sri Lankan refugees are accommodated in 42 labor colonies with all kinds of amenities.

CSR in the year 2020-21. Out of Rs.28.00 lakhs earmarked for activities, Rs.25.00 lakhs will be donated to the Karnataka State Disaster Management Authority to manage the Corona Pandemic.

In the year 2018-19 Rs. 33.29 lakhs was spent on CSR activities. Gaskits have been distributed to 700 beneficiaries.

In the year 2017-18 Rs. 84.56 lakhs was spent on CSR activities. Gaskits have been distributed to 974 beneficiaries.

In the year 2016-17 Rs. 41.88 lakhs was spent on CSR activities. Under the CSR, Concord Desk with Bottom Rack, Round Table, Baby Chair, Neelkamal Chair, Computers & Computer Table, LG LED TV's have been distributed to the schools.

Thus the Karnataka Forest Development Corporation Limited has been established with the objective of protecting the forest lands handed over to the Corporation; Fertilizing forest land and conserving soil and moisture; Maintaining biological balance; Cultivation of saplings by the Corporation on forest land; Converting the pulpwood so grown to required sizes and supplying them to wood-based factories. Empowering them economically by providing employment; Growing bamboo and supplying it to artisans, cottage industries and Promotion of industries. To provide employment to the people there and improve their standard of living.

Manage rubber plantations and employ labourers, collect, process and sell rubber milk, Giving employment to deserving people, according to the rules under corporate social responsibility in the dividends received to contribute to the development of the society by providing the needs through various types of activities specified. The Corporation is celebrating its golden jubilee with 50 years of continuous service, well-functioning and efficient existence through active activities that complement such all-round development.

In this way the corporation is successful and active with the cooperation and assistance of the government, departmental officials Administration.

This is possible only with efficient and effective leadership of boards, administrators, cooperation of customers and contractors. All of them are gratefully remembered.

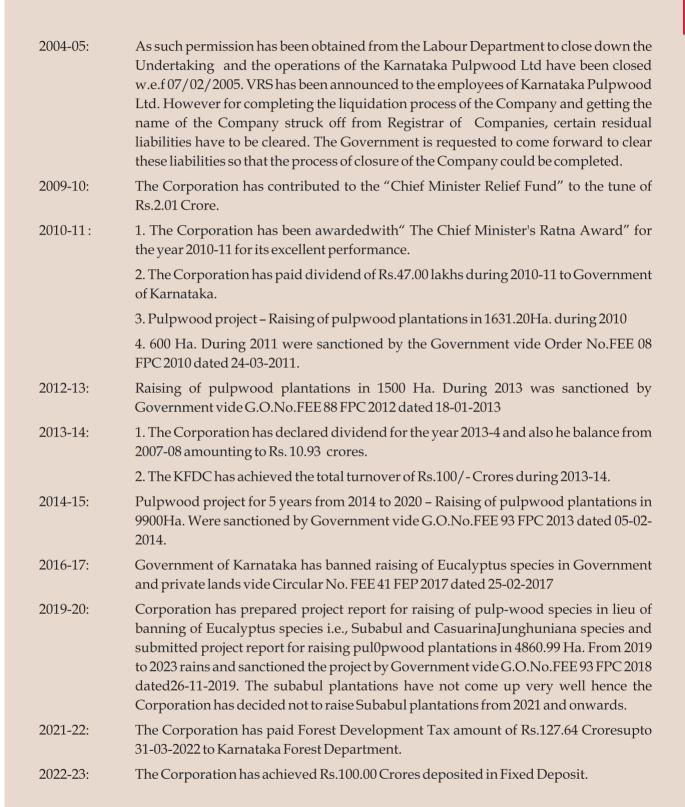
The enthusiastic cooperation of the Hon'ble Chairman, Hon'ble Vice Chairman to the Corporation, Governing Body Officer, Non-Executive Directors of the Corporation and the Departmental Officers who are working with the ultimate mission of the Corporation's progress.

Grateful thanks to all the officers and employees of the corporation who are working diligently for the progress of the corporation with efficiency, discipline, restraint and loyalty, to all the workers who are working faithfully, the customer companies who are supplying the raw materials of the corporation on priority, to prepare the raw materials produced by the corporation and ship them on time with awareness of time.

The cooperation of the contractors who are delivering has been memorable and I express my heartfelt gratitude to all.

MILESTONES OF THE CORPORATION

1975-76:	87,000 acres of departmental Eucalyptus plantations transferred to KFDC Ltd.
1977-78:	Cocoa plantations have been taken over from Forest Department.
1981-82:	4,444.32 ha. Of Rubber Plantations were taken over to the Corporation from Forest Department for further maintenance and development.
1984-85:	1. Wild lands (India) Resorts at Murkal launched.
	2. Tea Project launched.
	3. M/s. Karnataka Pulpwood Limited, a joint venture company launched with M/s. HariharaPolyfibers.
	4. Construction of Vanavikas, a multi storied office complex for this corporation was started.
1985-86:	Taken over Bursera Plantations from the Department for maintenance and development.
1986-87:	Silvi-pasture project started at Hassan District from the Government of India funds.
1987-88:	1. Name of the corporation again changed as Karnataka Forest Development Corporation Limited.
	2. Amended the Memorandum and Articles of Association towards enlarging the scope of objectives adding greater degree of diversification.
1988-89:	Declaration of dividend of Rs.42.01 Lakhs to Government of Karnataka
1989-90:	Registered office shifted from No.6, Kumara Park East, Bangalore to newly constructed building at Vanavikas, 18th Cross, Malleshwaram, Bangalore -03.
1995-96:	1. Eucalyptus II Phase and supplemental scheme loan completely paid ahead of schedule.
	2. Seven Forestry projects submitted to NABARD and Government. NABARD sanctioned all the projects, pending sanction by the Government the corporation initiated the projects with its own internal resources.
2004-05:	This subsidiary Company called Karnataka Pulpwood Ltd is now fully owned by KFDC. The Government have ordered to close down the Karnatka Pulpwood Ltd vide its order No. DDPER 56 ARU 2002 dated 02/01/2004 after obtaining permission from the Labour Department under section 25()) of Industrial Dispute Act 1947 and to offer voluntary retirement Scheme (VRS) to the staff.



Activities of Kerala Forest Development Corporation

"Sustainable consumption of forest resources by conserving forests and ecosystems.

49 years of successful journey continues....."

Georgi P. Mathachan Managing Director

INCEPTION

The National Commission on Agriculture in their Report (1972) had estimated the requirement of raw material for wood based industries for the future years and stressed the necessity to obtain increased production of industrial wood in the country. To ensure a sustained supply of raw materials to the wood based industries, more particularly for the pulp and paper, a change over from conservation oriented forestry to a dynamic programme of production forestry was warranted. To achieve this, substantial investment in the initial

stage was required and in order to facilitate commercial management and institutional financing, the formation of the autonomous corporations had been found expedient. Government of Kerala, after considering the matter in detail, had decided, like other states, to set up Kerala Forest Development Corporation Ltd (KFDC). with Head Quarters at Kottayam. The Corporation started functioning from 1975.



1 ACTIVITIES AND ANALYSIS

- KFDC has 6 Divisions. They are Trivandrum, Punalur, Gavi, Munnar, Thrissur and Mananthavady.
- Activities carried out by KFDC are Timber and pulpwood production & sale, Ecotourism, Cash crop plantation, usufructsextraction etc.
- The area under KFDC is a total of 10053 hectares of which 7011.607 ha are wood crop plantations and 2087.346 ha are plantations of Cardamom, Coffee, Tea, Pepper, Cashew and Rubber.
- At present, there are 99 employees in six divisions and head office. Both unskilled and skilled laboures are engaged for carrying out various forestry activities including regeneration works, cultural operations in the plantations, extraction of forestry crops, fire protection works etc. Local workers, hill tribes available in the forest areas etc are engaged for carrying out these plantation

activities. Also, there are 340 permanent workers and 150 casual workers in the Cash Crop areas of cardamom, tea, coffee and rubber plantations under Munnar, Gavi, Thrissur and Manathavady divisions of KFDC.

Details of Major species in KFDC

Sl. No	SPECIES	Total Area (Ha)
1	Eucalyptus	2605.561
2	Acacia auriculiformis	1673.054
3	Acacia mangium	36.450
4	Acacia crassicarpa	40.383
5	Teak	1387.890
6	Mahagony	9.400
7	Ailanthus triphysa	10.050
8	Melia dubia	86.762
9	Macaranga pelttatta	13.550
10	Euodia lunuankenda (kana	da) 2.000

11	Anthocopholus codombo (Ke	ndambu) 2,000
	Anthocephalus cadamba (Ka	ŕ
12	Acrocarpus	2.050
13	Albizia	65.670
14	Toona ciliata	2.000
15	Casuarina	6.020
16	Bamboo	739.576
17	Gmelina	53.084
18	Sandal	17.970
19	Red Sanders	80.977
20	Cardamon	994.710
21	Coffee	606.167
22	Rubber	57.936
23	Pepper	3.800
24	Cashew	334.163
25	Tea	100.670
	Total plantation area	8931.893

2. EQUITY DETAILS

Government of Kerala -90% Government of India -10%

3. BOARD OF DIRECTORS

KFDC is a fully Government owned company under Department of Forest, Government of Kerala. Board of Directors include Principal Secretary (Forest), Managing Director who is an IFS officer, Chairman of Board - non official, representative of forest department and representative of Government of India, who are all shareholders also. It also hasr representative of finance and forest in government and 3 more non official members.

4. BALANCE SHEET CHART OF MAIN POINTS OF PAST YEARS

Year	Asset	Liability	Turn over	Profit	
	(Lakhs)	(Lakhs)	(Lakhs)	(Lakhs)	
2020-21	7351.66	2624.52	1347.29	517.82	
2021-22	7788.62	3027.23	1321.71	33.16	
2022-23	7761.35	2851.28	3067.08	98.20	

5. PRIME ACTIVITIES CHART TAKEN UP DURING PAST YEARS

Year	Name of Activity & Scheme	Quantity taken up	Amount invested (Lakhs)	Returns realized (Lakhs)
	Timber	5060.16 MT		245.02
2020-21	Cash crop Cardamom	7488.0 Kg	451.38	379.71
	Coffee	50491.0 Kg		
	Green Tea	754663.0 Kg		
	Leaves		400.4	455.40
	Eco -tourism		109.47	155.49
	Timber	12897.392 MT		630.45
2021-22	Cash crop			
	Cardamom	6069.0 Kg	315.66	281.42
	Coffee	56322.0 Kg		
	Green Tea	591412.0 Kg		
	Leaves			
	Eco-tourism		131.03	311.50
	Timber	50252.19 MT		2022.86
2022-23	Cash crop			
	Cardamom	5370.0 Kg	525.72	208.01
	Coffee	48621.0 Kg		
	Green Tea	512702.0 Kg		
	Leaves			
	Eco-tourism	597632 No.s	243.45	678.83

6. CORE EXPERTIZE OF KFDC

Timber

There are around 1300 Ha of Teak plantations in KFDC. There are 700 Ha of mature Acacia auriculiformis and *Acacia crassicarppa* plantations after thinning for pulpwood supplying hardwood timber for furniture and construction work. There are minor plantations of Mahogany, Matty (*Ailanthus triphysa*), *Albizia falcateria* etc also.

Teak

Unlike long rotation teak plantations raised in Forest Department, KFDC was striving to develop good quality teak timber in shorter rotations of 30 years as mixed teak-pulpwood plantations. However after experience with previous crop planted from 1975 to 85 and harvested in 2005 to 2015, rotation age is re-fixed at 50 years and reverted to pure crop of teak. Plantations are raised with higher input and continued maintenance for 5 years and regular thinning. However proportion of teak plantations in KFDC is very low due to long investment period and our focus on pulp and

plywood industry. At present KFDC has around 1300 Ha of teak plantations. Unfortunately only around 500 Ha is thriving and have good stock. Rest of the area have failed due to wildlife attack.

Acacia timber

Acacia auriculiformis and Acacia crassicarppa plantations are raised with twin objective of pulpwood and timber. Thinning is done at 6 to 9th year for pulpwood. 1/3rd crop is retained for timber production from 18th year onwards. However, market for Acacia timber is down in recent years. Coupled with this there is degradation in timber due to splitting and high variation in timber quality due to hybridization.

Pulpwood & Plywood

The pulpwood Working Circle of KFDC comprises of the plantations of Eucalyptus species, Acacia species, Bamboo, Melia dubia etc comprised of a total area around 4000 ha. Total revenue during 2022-23 is around 20 crores.

With closure of Hindustan News Print Ltd and high production cost, we have shifted our focus to production of plywood raw material. Planting of exclusive pulpwood species like Acacia mangium was stopped. In other Acacia species thinned material was used for pulpwood and retained rest of the crop for timber production. Rotation age of Eucalyptus was increased from 6 years to 9 years to produce plywood raw material.

Eucalyptus grandis in high altitude Munnar and Eucalyptus pellitta in the plains are the main crop yielding revenue to KFDC. There is a boom in plywood industry in central Kerala due to diversion of Eucalyptus from pulpwood to plywood industry.

Other tree crops

Our cashew area is around 350 ha and is maintained as a forest plantation with only annual collection of usufruct. Revenue is around 50.0 lakhs/year. We had raised around 150 ha of various medicinal tree species like *Gmelina arborea*, Red sanders, Sandal with assistance from National Medicinal Plant Board. However Red sanders was not very successful.

Cash crop

Major cash crop plantations are cardamom (995 Ha), coffee (606 Ha), Rubber (57 HA), Tea (100.67 Ha), Pepper (3.8 Ha). These plantations are raised with permanent labour. They were raised mainly to rehabilitate Srilankan repartriates and providejob to local tribals and workers. Infact our 95% of work force of permenant and casual labourers are employed in these cash crop plantations. Tea plantations are most labour intensive followed by cardamom, coffee and rubber. Tea and cardamom plantations are running at loss and gap filled by income from ecotourism & wood crops. Total production in 2022-23 is 5.4 tonne Cardamom, 512 tonne Green Tea Leaves, 48 tonne Coffee and 13 tonne Rubber. In addition to bulk sale, various cash crop value added products from KFDC plantations are sold in retail through KFDC Ecoshops, FDA ecoshops in Kerala Forest Department, online platforms like Flipkart, Amazon, Kerala e-market & ONDC platform. There is a high demand for organic cardamom collected from naturally maintained plantations of KFDC.

Eco-tourism

KFDC has ventured in to Ecotourism activities since 2001-02 as part of diversification programme and to bring the revenue deficit from cash crops. At present, the Corporation has Eco-tourism programmes at Arippa and Kallar in Thiruvananthapuram Division, Gavi and Kochu Pampa in Gavi Division, Silent Valley, Rhodo Valley and Anayiramkalin Munnar Division, Nelliampathy in Thrissur Division, and Kambamala in Mananthavady Division. The Floriculture Centre at Munnar with ornamental plants collection and a nursery for sale is basically an interpretation cum awareness centre. Another interpretation cum awareness centre is the Vagamon Hills Garden at Vagamon under Gavi Division, with orchidarium, cactarum, fernarium, upcoming botanical garden etc.

The Accommodation facilities in the Eco-tourism Centres are provided in tents (temporary structures) or in the abandoned old buildings renovated for the purpose. Plantation visit/trekking in forest with the support of trained guides is also provided. Also provides boating (rowing boats) in Gavi Lake and vehicle safari, cardamom processing unit visit etc. Gavi is deep interior in the Periyar landscape – the largest continuous forested landscape in Kerala. One can enjoy the wildlife on the way, trek in the semi wild cardamom plantations, grasslands and view the Sabarimala temple and surroundings.

Meesapulimala ecotourism destination in Munnar operated by KFDC is the highest point in Kerala accessible to tourist for stay and trekking. KFDC is starting eco-tourism projects in one more new destination - Koottakuzy (Maniyarankudi) near Idukki. It is a vast rolling grassland, view sunrise and sunset and trek upto Tamilndu border to have a breath taking view of the majestic Anamudi, beautiful Kambam valley and surrounding. We have plans for expansion of ecotourism in Nelliyampathy, Thenmala etc. All our eco-tourism destinations are insured against any accidents, death and injury.

Total revenue in 2022-23 is around 6.7 crores. Guests at ecotourism centers – 44,791 nos, Visitors at



Products of KFDC sold through Ecoshops -Sandal oil, Sandal wood, Coffee & Pepper

7. OTHER PROJECTS OF KFDC Sandal oil Project

In 2005, Government of Kerala ordered the closure of all Sandal wood oil extracting units in the state and a policy decision was taken not to issue any license for sandal wood oil distillation in private sector. Later in 2007 in response to a request from Forest Department, Government gave permission to set up a Sandal oil extraction Factory in Government sector. Based on the decision, KFDC set up a sandal distillation unit during 2011. The installed capacity of the unit is to process 10 MT sandal wood per annum. The financial outlay for the establishment of the unit was Rs.208.70 lakhs. The sale of oil in bulk as well as in retail in small containers of 2gm, 5gm and 10gm are undertaken by KFDC. But, the response in the retail as well as wholesale market was not encouraging. Sale increased to 56 Kg in 2016-17, but reduced thereafter and is now 12 Kg/year. Reduction was mainly due to stoppage of bulk purchase by various agencies. Retail sale also dropped from around 25 Kg/year in the 2013-2018 period to 12 Kg/year now.

Exporting sandalwood oil can boost sandalwood oil sale. KFDC can generate more revenue from these exports. The Directorate Generalof Foreign Trade (DGFT) is the agency of the Ministry of Commerce and Industry of the Government of India to allow export of sandal oil. The Exim Policy restricts exporting of sandal oil to other countries. Currently KFDC does not have export license. We are trying to get export license from DGFT.



Sandal oil Distillation unit - Munnar

➤ Sandal Oil Perfumery Unit.

The Corporation has plans for installing a subsidiary unit for admixing the pure sandal oil with formulations in to perfumery items / cosmetics and sell it in the domestic and international market.

Vagamonorchidarium project (Vagamon Hills Garden)

An Orchidarium project was sanctioned by Kerala Government vide GO(MS) No. 81/2012/F&WLD dated 21.07.2012. The main objectives of this project includes

- i. Developing Vagamon into a destination for environmental education and conservation.
- ii. To serve as a conservation center for the wild anddomesticated orchids and fern of the Westernghats.
- iii. To act as demonstration unit for the commercial production and sale of cut flowers.



- iv. To provide an interaction space for the enthusiasts on the floriculture and high altitude forestry.
- v. To develop a high elevation botanical garden in the longrun.
- vi. To create income generation opportunities to the local people

An area of 15.22 ha of the grasslands of Vagamon falling within the proposed Vagamon Reserve Forest under Erumeli range of Kottayam Forest Division was handed over to KFDC by the Forest Department and a funding to the tune of Rs. 155 lakhs also given to KFDC by Kerala Forest Department. The project was commenced in 2013-14 in an area of 5.90 ha and opened to visitors in August 2015. The display of orchids suitable to the mid tropical climate was established in the centre and varieties of flowering plants attracted many visitors over the years. We are also providing the chance to purchase the orchids and other flowering plants to visitors. Currently we have added a cactarium and fernerium in addition to rose garden, fruit garden, flower beds, Children Park, boating, cafeteria etc.

KFDC organized a Flower show at Vagamon Hills Garden from 23rd December, 2023 to 7th January, 2024. Planning to organize flower show every year and expand the center with more attractions, interpretation materials, museum, botanical garden etc.

> Sabarijalam Projects.

The packaged drinking water project "Sabarijalam" had a noble objective of creating awareness against the dumping of plastic waste in forest areas and elsewhere. Empty bottles of Sabarijalam are brought back paying Rs.1/- per

bottle. The 1st unit of Sabarijalam project under Periyar West Division, Peerumedu commenced production in October 2009.

The Sabarijalam unit established at Punnala, Pathanapuram in Kollam District by Kerala Forest Development Corporationis the 2nd unit of the Sabarijalam Project as per Government of Kerala's Annual Program 2011-12 having the same objectives and principals as the 1st unit. The fund of Rs.50 lakhs was allotted to KFDC for the establishment of the unit from River/ForestProtection Fund (RFPF) available with the State Forest Development Agency (SFDA).

First phase for 50 lakhs was completed in 2013 and included building, pond, purifying system, tank, laboratory rooms, workers facilities, fencing and electrification. The second phase included a plant to produce 32 bottles of fresh water per minute, a water treatment plant. But the Ministry of Environment & Forests objected to it being anon-forestry activity, violative of section 2 of the Forest Conservation, Act, 1980, and was asked to stop all construction activities.

KFDC has halted the second phase of the Sabarijalam project. It was decided to transfer the project to Forest Department, as per decision of Minister of Forests. However based on direction from MoEF & CC Regional office Bangalore even the already running project at Moozhikkal in Periyar West Division stopped operation in 2019. Infrastructure at Pathanapuram is lying unutilized.

> Bamboo handicraft unit

KFDC imparted a training to our selected workers in collaboration with URAVUin "basic skill development in Bamboo products making with locally available bamboo varieties with minimum machinery usage". KFDC has also initiated steps to set up a bamboo handicraft unit. The raw materials are available from KFDC Bamboo plantations. We has asked for financial assistance from National Bamboo Mission to setup this unit.

> Central Nursery

KFDC is maintaining a central nursery facility at Kulathuppuzha where seedlings of timber species like Teak, Eucalyptus, Mahogany, Melia, Kadamba etc. are produced and used for planting and also sold to public which is used in planting in agro forestry.

e-marketing of products

Sandal oil, spices like cardamom, pepper and products like coffee powder etc were retail marketed mainly through KFDC's own ecoshops and ecoshops of FDA's at ecotourism centres. Our total retails sale through own ecoshops is 93 lakhs and through FDA ecoshops is 68 lakhs last year. We are regularly attending trade fairs conducted by state government, G-20 stall at Kumarakam, Kerala Bamboo fest, Plantation expo, Pooppoli of Agricultural university etc. Now, we have started utilizing e-marketing platforms of Government & private firms like Amazone, flipkart, Kerala E-market, and ONDC platform and last year online sales was for 6 lakhs.

For online booking of ecotourism facilities, in addition to online booking in KFDC website www.kfdcecotourism.com, Cleartrip and booking.com are also our booking partners. District Tourism Promotion Council and Kerala Tourism Department websites also promotes our tourism products.

Eco-restoration and carbon sequestration project

Some of the interior plantations are being converted to natural forest due to wildlife attack, lack of labour and profitability. Eco-restoration of those areas together with exploring carbon trading potential is explored. One such project is under the consideration of Government of Kerala.

8. FUNDING FROM OUTSIDE

> UNDP

KFDC is carrying out eco-restoration work in the Nilgiri Tahr habitat by eradicating invasive species like pine and wattle with the financial assistance of UNDP. Rs.35.0 lakhs allocated for eco-restoration work at 35.0 Ha.

NBM Fund

Bamboo was planted in 20 hectares in Thrissur Division with the financial assistance of National Bamboo Mission. Financial assistance to the tune



of 20 lakhs is provided.

Ecotourism fund

For the renovation of eco-tourism facilities at Arippa, Gavi & Munnar KFDC got financial assistance of Rs.187.0 lakhs, Rs.190.0 lakhs, Rs.32.0 lakhs respectively from State Government tourism fund

> State Plan Fund

For the rejuvenation of old cardamom plantations in Gavi, Munnar and Thrissur, KFDC got financial assistance of Rs.500.0 lakhs in 3 years through state plan fund. Planting work has been successfully completed and maintenance works progressing.

8. CHANGING CROPPATTERN OF TREES

➤ Eucalyptus hybrid to Eucalyptus pelitta and Acacia mangium to Acacia auriculiformis

Due to wide spread failure of eucalyptus hybrid plantations raised earlier, KFDC had shifted to new species Eucalyptus pellitta from 2004 onwards which is higher yielding and has better value in plywood market due to its pink colour. Acacia mangium which have a life span of only 10-15 years and useful for pulpwood only was stopped planting from 2014 onwards.

New Indigenous policy

In the Management Plan from 2020-21 to 2024-25, in accordance with the Kerala Government policy, it was recommended to completely avoid Acacia and Eucalyptus species and plant indigenous species like Meliadubia, Albizia, Gmelina, Macarangapeltata, Ailanthus and Bamboo for replanting. During the

years 2020-21, 2021-22, 2022-23 and 2023- 24, KFDC had raised a total of 262 hectares of native species plantations. These include mainly Teak and Melia dubia followed by experimental planting of Gmelina arborea, Ailanthus triphysa, Macaranga peltata, Albizia lebbek, Acrocarpus fraxinifolius, Neolamarckia cadamba and Euodia lunu-ankenda in smaller pots. But from these 4 years of experience KFDC had to face several financial and practical hurdles.

Major hurdle is absence of established silvicultural technology for native plywood or pulpwood species. Among indigenous varieties, only few species like Meliadubia and Macarangapeltata have market demand. Only these varieties can be grown commercially. The cost of planting these species is many times that of planting species like Eucalyptus. Native species are already highly prone to pests and diseases. Browsing is severe compared to Acacia & Eucalyptus which are not browsed. Seed collection, nursery techniques etc are not available. Meliadubia, which is a promising species is not very successful in forest areas of Kerala due to unavailability of nursery techniques, highly browsable nature and attack of porcupine. Planting these species without solar fencing leads to wildlife attacks. Installing a solar fence around the plantationincreases cost of raising plantation.

Even TBGRI which has come up with some literature and techniques for its management, has agreed they are most suited in agroforestry and fails in forest areas with pest and wildlife damage. Therefore in tie-up with such research institutions new suitable species, high yielding varieties, nursery techniques and protection or management measures are to be developed.

10 Challenges faced by KFDC

➤ Ban on Eucalyptus/Acacia planting

There are successful silviculture practices in species such as Eucalyptus and Acacia. KFDC's main revenue comes from the sale of eucalyptus timber. But now the Kerala government has banned the planting of exotic species like Eucalyptus and Acacia and promoting planting of indigenous species. Although we have tried many native species like Melia dubia in the last three years, we are struggling to make these plantations successful.

➤ Failure of plantations

In line with the government policy of planting native species, planted Melia dubia in KFDC plantations. But native species seedlings are more susceptible to wildlife disturbance and less disease resistant. Hence the success rate is very low. Planting these species without solar fencing leads to wildlife attacks. Installing a solar fence around the garden increases cost of planting. Even with solar fencing only animals like elephants, gaur etc. can be avoided. Barking deer, and Porcupine cannot be avoided. Attack of pests like thrips in Melia is also affecting growth. Therefore, the plantation success rate is very low especially in Melia dubia. Teak plantations also face similar threat for longer periods leading to failure. Bamboo and Eucalyptus hybrid plantation raised previously are also partially failed resulting in huge areas without proper stock and converted to natural areas.

Government Pricing of soft wood species

The minimum selling price fixed by the government for various timber species under the Kerala Forest Produce (Fixation of Selling Price) Act, is applicable to KFDC. But the rate fixed is not always is tune with market and resulted in plantations remaining unsold and company facing financial crisis.

➤ Unsold plantations of Acacia & Bamboo

Since 2017, KFDC has not been able to sell bamboo plantations due to dip in the market demand and the higherprice of bamboo fixed by Government. Acacia plantations that remain unsold despite several auctions are also a challenge for KFDC.

Due to high extraction cost of spiny bamboo, sale of Bamboo is stalled. Splitting noticed in wood during felling and high variation in timber due to hybridization are affecting market of Acacia.

11 OTHER DEVELOPMENTS OF KFDC

- ➤ KFDC achieved ever highest turnover of Rs.35 crores in 2022-23 FY. Highest timber sale was in the last year.
- ➤ The process for getting organic and wild life Certification for cash crops such as cardamom & coffee are commenced and progressing. It is expected to get organic certification soon.
- ➤ Kerala Forest Development Corporation has set

up the social media handle in various platforms such as Instagram, Facebook and Twitter. Uploads have been doing on daily basis, to make more connections and engagement with the public. This also helps the public to have a better idea and working of KFDC. The uploads are mainly related to activities and updates of KFDC and subjects related to ecotourism.

- ➤ KFDC has an excellent website that outlines the activities of KFDC and the facilities available to people from KFDC. KFDC Eco Tourism booking can be done through this site.
- We are in the process of getting export license to our sandal & cash crop products. We have already obtained IEC from DGFT
- ➤ Kerala Forest Development Corporation is also supplying products to TRIFED (Tribal Co-



Teak Plantation - Trissur Division



Coffee Plantations - Gavi Division



Coffee Plantations - Munnar Division

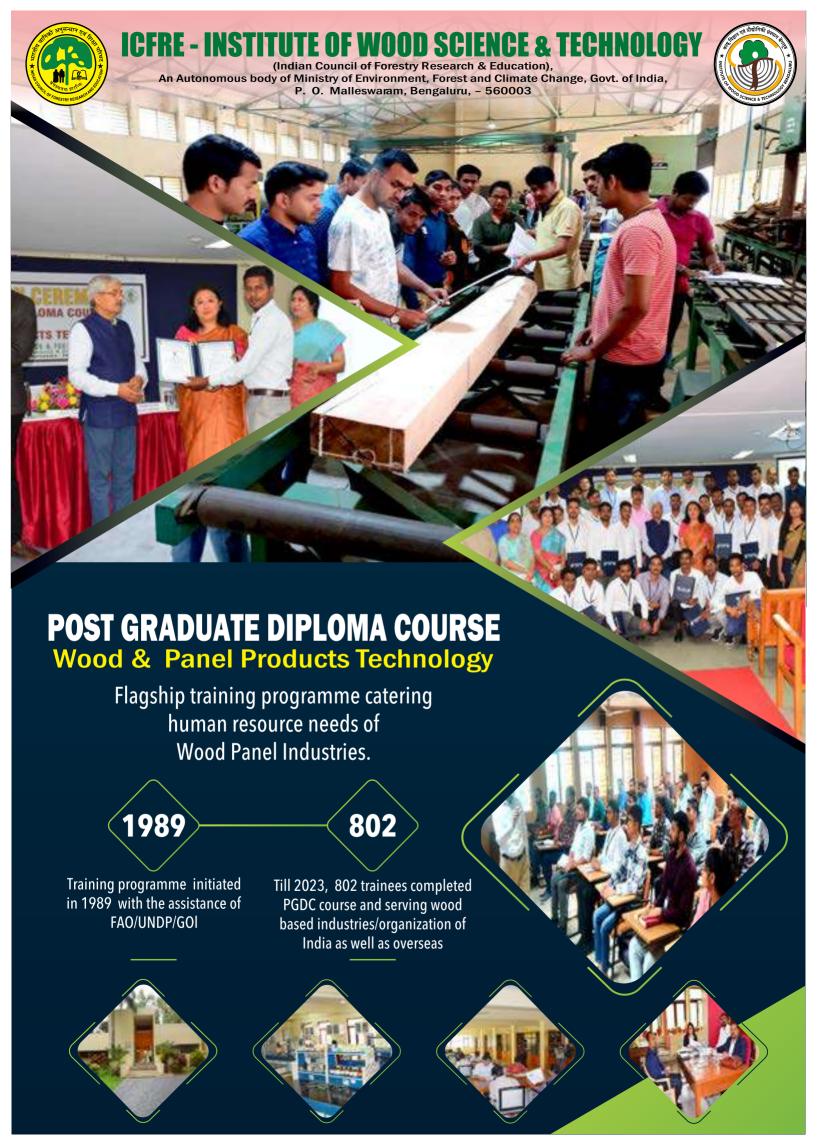
- operative Marketing Development Federation of India). One of such products is the Sandalwood Gift Hamper pack. In order to supply our products to TRIFED, there was a requirement of getting barcodes for the products which are globally recognized and therefore registration for new set of barcodes were made with the Global system of Supply chain and Standards (GS1). The barcodes are all GS1 certified as well as KFDC.
- ➤ KFDC obtained trade mark license to our sandal & cash crop products in the brand name "Vanopahar".
- We have started bee keeping activities in our cash crop plantations, directly by the workers, in order to provide additional income to them and diversify our products to honey, bees wax and other value added products.



Cardamom Plantations - Gavi Division



Cardamom Plantations - Munnar Division



Activities of Madhya Pradesh State Forest Development Corporation Limited

Abhay Kumar Patil Managing Director

Establishment and Objectives of MPRVVN

- A recommendation was made in the Interim Report of the National Commission on Agriculture (NCA 1972) on 'Production of Manmade Forests' to enhance the production of forest produce, to restore the productivity of degraded forest areas. To comply with this recommendation, State Governments in India established Forest Development Corporations (FDCs) to work on commercial lines by raising industrial plantations of teak, eucalyptus, bamboo etc.
- Ø Based on the recommendation mentioned above, Madhya Pradesh Rajya Van Vikas Nigam Ltd. was established as a company under the Companies Act, 1956 on 24th July 1975 with the following major objectives:
- a) To accelerate and increase forestry production by creating plantations of:
 - i. Fast growing species
 - ii. Species of higher economic value.
 - iii. Species capable of diversified use for industrial and commercial purposes.



b) To bring suitable forest areas under Intensive Management Practices in order to improve, enrich and enhance production, both in quantity and quality.

Share Capital of MPRVVN

➤ The Share Capital of MPRVVN is described as follows:-

Authorised Share	Paid-up Share Capital			
Capital	Shareholder	Investment		
	Government of India	Rs. 1.39 Crore(Shareholding 3.53%)		
Rs. 40.00 Crore	Government of Madhya Pradesh	Rs. 37.93 Crore(Shareholding 96.47%)		
	Total	Rs. 39.32 Crore		

Area under MPRVVN

Currently the Area under MPRVVN is less than 5% of the total forest area of Madhya Pradesh. The details are as under:-

Forest Area dealt by MPRVVN							
Total Forest	Total Forest	Percentage	Total Gross	Percentage of	Total Net	Percentage	Percentage of
Cover of MP	Area	of Total Area	Area	Gross Area	Area where	of Net Area	Total Net Area
as per ISFR	transferred	transferred	treated till	treated till	felling is	amongst the	under MPRVVN
2021 and	to MPRVVN	to MPRVVN	Date by	Date amongst	carried out	Gross Area	amongst the
state	till date	amongst the	MPRVVN	the Total Area	followed by	treated till	Total Forest
Government	(in Lakh Ha.)	Total Forest	[A/B/C/D	transferred to	Plantation	Date by	Area of Madhya
records		Cover of MP	type]	MPRVVN	[B type]	MPRVVN	Pradesh
(in Lakh Ha.)			(in Lakh		(in Lakh Ha.)		
			Ha.)				
94.68	4.25	4.48%	3.79	89.18%	2.1	55.41%	2.21%

The entire working Area of MPRVVN is divided into 3 project circles constituted from 11 project divisions. The working Area can be detailed as under:

S. No.	Region	Name of the Project Division	Year of Establishment	Area (in Ha.)	Districts Covered
1		Khandwa	2004	34631.45	Khandwa, Dewas, Indore
2	Indore	Chhindwara	1990	28104.01	Chindwara
3		Rampur-Bhatodi	1976	33714.56	Betul, Hoshangabad
4		Sehore	2011	26518.86	Sehore
5	Bhopal	Vidisha-Raisen	2004	42338.16	Vidisha, Raisen, Bhopal
6	БПОраг	Barghat	1975	50584.02	Seoni
7		Lamta	1975	52449.38	Balaghat
8		Kundam	1977	39883.44	Katni, Jabalpur
9		Mohgaon	1976	65954.36	Mandla, Dindori
10	Jabalpur	Rewa-Sidhi	1980	19184.14	Rewa, Sidhi, Singrouli
11		Umaria	1976	31800.68	Umaria, Anooppur, Sahdol
Total	3	11		425163.05	

▶ Workforce in MPRVVN

For the execution of different operations smoothly, MPRVVN currently employs vast workforce under the SeniorOfficers at Headquarters as well as on the field:





➤ In the past few years, MPRVVN is experiencing shortfall of staff and is currently operating on about 40% of the sanctioned Workforce strength of 1300.

Plantation Work taken up from the Corporation Funds

Plantation work carried out under this head include plantation of teak and bamboo, which is the main activity of MPRVVN. In this process, mainly two kinds of silvicultural treatments are carried out depending on the land topography and existing vegetation. Different Plantation works carried out in the past years are described as under:

Year	202	0-21	20	21-22	202	2-23	202	3-24
	Treated	Number	Treated	Number of	Treated	Number	Treated	Number
Plantation	Net Area	of Plants	Net Area	Plants	Net Area	of Plants	Net Area	of Plants
	(Ha.)	(Lakh.)	(Ha.)	(Lakh.)	(Ha.)	(Lakh.)	(Ha.)	(Lakh.)
Rainfed Teak	4304.50	107.61	3267.35	81.68	4203.50	104.97	3924.00	91.88
Rainfed Bamboo	500.00	3.10	131.00	0.82	131.00	0.82	517.00	3.23
Neem	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Miliya Dubiya	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.03
Area under Encroachment / Failed Plantations	282.00	7.05	5.00	0.13	0.00	0.00	0.00	0.00
Miscellaneous	0.00	0.00	0.00	0.00	12.00	0.13	0.00	0.00
Total	5086.50	117.76	3403.35	82.63	4346.50	105.92	4444.00	95.15

Nursery Activities

In order to meet the plantation requirements, MPRVVN had setup a total of 15Nurseries distributed amongst the 11 divisions.

S. No.	Name of Nursery	Name of Project Division	S. No.	Name of Nursery	Name of Project Division
1	Matthagaon	Sehore	9	Jiyavan	Rewa-Sidhi
2	Lawaghoghri	Chhindwara	10	Katanga	Lamta
3	Narmada Nagar	Khandwa	11	Kanki	Lamta
4	Rajaour	Khandwa	12	Kanchangaon	Mohgaon
5	Peguai	Vidisha-Raisen	13	Chandia	Umaria
6	Dhapada	Rampur Bhatodi	14	Dhooti	Barghat
7	Saapana	Rampur Bhatodi	15	Hirrisangam	Barghat
8	Belkund	Kundam			

Collection of seeds is carried out generally in the warmer months of the years. The sorting and further treatment is performed in the respective Nurseries of different Project Divisions. The treatment involves a challenging process of simulating natural weathering of seeds, which is carried out by alternatively moistening and drying of seeds accompanied by manual repeated churning at regular intervals. The main challenges across this process are maintaining adequate moisture and availability of skilled labour which can in turn effect the germination capability of the processed teak seeds.

Working Process of MPRVVN for Crop I (Plantation Working Circle)

- Area is transferred by the Forest Department to Nigam.
- Proposal of Working Plan for the transferred Area is prepared by the Nigam.

- ➤ Working Plan Approval by the GoMP&GoI.
- ➤ In Working Plan, the area to be worked is allocated for the plan period.
- ➤ Canopyliftingfelling process of Crop-I is carried out in the respectively allocated Working Plan areas.
- Upon felling, a microplan is prepared (based on the approved Working Plan of the area) for the respective area for carrying out the Plantation work.
- ➤ Timber obtained from felling is put up for Sale (through Auction).
- ➤ Lease rent is paid to the GoMP from Net Income obtained from the Sale of Timber of Crop I.
- ➤ Nigam receives 2% of the net income from Crop I in the form of commission from GoMP.

Details of Lease Rent paid in the past years

			Lease Rent Amount Details				
S. No.	Year	Due Lease Rent (in Lakh Rs.)	Paid Lease Rent (in Lakh Rs.)	Date	Balance (in Lakh Rs.)		
1	2015-16	9,911.69	9,911.69	28.03.2017	0.00		
2	2016-17	8,805.95	8,805.95	12.03.2018	0.00		
3	2017-18	8,674.09	8,674.09	07.03.2019	0.00		
4			3.47	07.03.2019			
5			2,000.00	07.11.2020			
6	2018-19	9,193.50	2,000.00	10.02.2021	-3.47		
7			2,000.00	24.03.2021			
8			3,193.50	27.12.2021			
9	2019-20	7,037.69	7037.69	04.03.2022	0.00		
10	2020-21	5 794 56	500.00	25.03.2022	3.47		
11	2020-21	5,784.56	5281.09	10.04.2023	5.47		
Tota	al (6 Years)	49,407.48	49,407.48		0.00		

Working Process of MPRVVN for Crop II (Plantation Management Working Circle)

- Silvicultural operations are carried out in the plantations as per the provisions of the Working Plan.
- Cleaning operation is carried out in the 6th year of plantations.
- Thinning work of the plantations is carried out
- beginning from the 11th year and thereafter after every 5th consecutive year, till the 46th year of plantation.
- Final felling is carried out in the 60th year of plantation.
- ➤ Forest Produce obtained through cleaning & final felling is put up for Sale (through auction).
- > Income from Crop II (i.e. from thinning

operations and from final felling) is the income of the Nigam from which profit is calculated.

> 20% of the Net Profit (Total Revenue - Total

Expenses) is credited to the GoMP & GoI in the approximate ratio 27:1 as per their shareholdings in the form of dividend every year.

		Dividend Amount					
S. No.	Year	Due Dividend (in Lakh Rs.)			Balance (in Lakh Rs.)	Shareholder	
1	2015-16	1,277.82	1,232.78	28.03.2017	0.00	GoMP	
2	2013-16	1,277.02	45.05	24.03.2017	0.00	Gol	
3	2016 17	1 250 16	1,213.81	12.03.2018	0.00	GoMP	
4	2016-17	1,259.16	45.35	12.03.2018	0.00	Gol	
5	2017 19	1 472 41	1,422.44	07.03.2019	0.00	GoMP	
6	2017-18	1,473.41	50.98	24.05.2019	0.00	Gol	
7	2018 10	1 170 52	1,137.95	30.09.2020	0.00	GoMP	
8	2018-19	1,179.53	41.58	30.09.2020	0.00	Gol	
9	2019-20	515.00	496.85	22.09.2022	0.00	GoMP	
10	2019-20	313.00	18.15	22.09.2022	0.00	Gol	
Tot	al (5 Years)	5,704.92	5,704.92		0.00		

Protection of Forest Area

- ➤ The Area under MPRVVN is demarcated with boundary pillars which are constructed and maintained every year as per the Working Plan.
- Within the demarcated area, soil moisture conservation is ensured through imple mentation of water harvesting structures like check dams and water holes.
- ➤ A comprehensive Protection Plan for each of the 11 divisions is approved which constitutes the availability of amenities like Forest Range Offices, Forest Staff Quarters, Patrolling Camps, Patrolling Vehicles along with equipment like Chester, helmets, electric batters, drones etc.
- ➤ A Special Projects has been also implemented in the Buffer Zone of Protected Areas of Project Division Kundam, under the provisions of National Tiger Conservation Act, 1980 with guidance and direction from National Green Tribunal. The mission of this project is to improve the habitat of the Tiger corridors to

make them more favourable for wildlife.

Fire protection is deemed to be a major concern as it not only causes damagetothe Timber, but also poses a threat to the quality of the upcoming crop and to the fauna.

Plantation Work carried out under the Deposit Works Head

- ➤ Plantation Projects that are funded by other Organisations or Companies fall under the Deposit Head.
- ➤ These Plantation Works are mainly of two types depending upon the ownership of Land. The plantation might be in the land owned by the organisation or company as in the case of WCL, NCL, SECL, MOIL, NHAI, etc. or in the Forest Land under Nigam like Site Specific Rainfed Teak funded by Havell's India and Carbon Sink Project by NTPC.
- ➤ The Deposit Plantation Works carried out in the past years are described as under:

Type of Land	Year wise Plantation (in Lakhs)				
Type of Land	2020-21	2021-22	2022-23	2023-24	
Land owned by Organisations / Companies	8.62	11.99	10.46	10.48*	
Forest Land under MPRVVN	4.50	0.50	5.50	5.11	
Total	13.12	12.49	15.51	15.59	

^{*} For the Year 2023-24, 1.97 Lakh more plants are to be planted in the Land owned by Organisations / Companies

Haulage & stacking of Timber

➤ The timber yielded from crop I & crop II is sorted and stacked on respective sites and divided into truck loads. The timber is then hauled to the depots for auction.

S. No.	Name of Nursery	Name of Project Division	S. No.	Name of Nursery	Name of Project Division
1	DhaknaChapna	VidishaRaisen	8	Satnoor	Chhindwara
2	Behrai	Barghat	9	Umaria	Umaria
3	Ladkui	Sehore	10	Tikri	RewaSidhi
4	Kanki	Lamta	11	Pandiwara	Mohgaon
5	Padriganj	Lamta	12	Devridadar	Mohgaon
6	Bhoura	Rampur Bhatodi	13	Gosalpur	Kundam
7	Narmadanagar	Khandwa			

A major challenge across the procedures of production and stacking is site quality assessment which is presently being carried out manually.

Revenue of MPRVVN

The revenue obtained across the previous years is as follows:-

Financial Year	Revenue from Crop - I (in Lakh Rs.)	Revenue from Crop - II (in Lakh Rs.)	Miscellaneous Revenue (in Lakh Rs.)	Total Revenue (in Lakh Rs.)
2019-20	13366	8119	851	22336
2020-21	10432	6812	576	17820
2021-22	10373	8969	944	20286
2022-23	14385	10357	1100	25842
Total (4 Years)	48556	34257	3471	86284

^{*} For the Year 2023-24, Total Revenue obtained till August 2023 is 12200 Lakh Rs. against target of 26798 Lakh Rs.

Activities under Corporate Social Responsibility in the past years

- As per Section 135 of the Companies Act, 2013, a Committee for Corporate Social Responsibility has been constituted, along with a Designated Cell, that presents proposals before the committee.
- > The description of work carried out under Corporate Social Responsibility can be described as under:-

Year	Expenditure (in Lakh Rs.)	Primary Activities
2019-20	155.46	Distribution of Dual Desks, Sports Kits, Water Filter to Schools, Distribution of Sewing Machine, Gas Cylinders, Provisioning Training for Upgrading Skills, etc.
2020-21	166.04	Distribution of Dual Desks, Sports Kits, Water Filter to Schools, Distribution of Sewing Machine, Gas Cylinders to Villagers, etc.
2021-22	89.65	Distribution of Dual Desks, Sports Kits, Water Filter to Schools, Provisioning Sanitary pads Vending Machine, etc.
2022-23	116.33	Distribution of Sets of Utensils and Pickup Vehicle, Provisioning Solar Street Light, Solar Water Heater, Accessories for Solar Tube well, Dispensing System for Water Vending Machine, Distribution of Seeds of Seasonal Vegetables, etc.

Innovative & New Activities Undertaken by Nigam

- Plantation of 95093 tall trees without fencing by the Nigam through the funding provided by National Highway Authority of India in various National Highways:
 - NH347 (Multai-Chhindwara-Seoni Highway)
 - NH 547 (Chhindwara-Narsinghpur Highway)
 - NH 75 (Jhansi-Gwalior Highway)
- ➤ High-quality plantation done by Nigam in severely degraded areas of Omkar Mountain.
- Managinggood quality teak nurseries.
- Plantation done under Corporate Social Responsibility for various Private Organizations.
- Tissue Culture bamboo plantation of various bamboo species.



Picture 01:Rootshoot beds in Nursery in Chhindwara Project Division of MPRVVN.



Picture 02: Plantation with Root shoots in Chhindwara Project Division of MPRVVN.



Picture 03: A5-Year-old Teak Plantation in Chhindwara Project Division of MPRVVN.



Picture 04: A10-Year-old Teak Plantation in Chhindwara Project Division of MPRVVN.



Picture 05: A15-Year-old Teak Plantation in Chhindwara Project Division of MPRVVN.



Picture 06: Felling Operations in Chhindwara Project Division of MPRVVN.



Picture 07: Felling Operations in Chhindwara Project Division of MPRVVN.



Picture 08: Stacked Timber at Satnur Depot in Chhindwara Project Division of MPRVVN.



Picture 09:Stacked Timber at Satnur Depot in Chhindwara Project Division of MPRVVN.



Picture 10: Construction of Check Dam under Wildlife Conservation in Chhindwara Project Division of MPRVVN.



Picture 11: Check Dam under Wildlife Conservation in Chhindwara Project Division of MPRVVN.



Picture 12: Sports Kit Distribution under Corporate Social Responsibility in Chhindwara Project Division of MPRVVN.

Activities of Odisha Forest Development Corporation— A Journey from Forest Contractor to Green Developer

Suresh PantManaging Director

rior to 1962 forests were being worked by private contractors. But it was noticed that contractors were actually not adhering to Working Plan prescriptions leading- to unscientific exploitation causing damage to forests. There were instances 'of evasion of payment of taxes and non payment of royalty to Government. Contract system did not contribute towards systematic employment of local labourers specially the forest dependent tribalcommunity. Hence the State Government took the decision for creation of the Orissa ForestCorporation with the mandate of "Working of State's vast forest resources scientifically without sacrificing the apparent forest values, ensuring a fair wages to forest labour forces, to promote feasible forest based industries in the State and to generate Tax & Nontax Revenue to the State".

Odisha Forest Development Corporation was then incorporated on 28th September 1962by the Government of Odisha as "Orissa Forest Corporation" to replace the privately working contractor system of forest working for producing timber and firewood with a view to use forest resources for generating revenue for the State and also to sell various forest produces acting as Commercial Wing of Forest Department. It is first of its kind Forestry based Corporation in the country for Forest working and revenue generation to the State from Forest Produces. It was incorporated with a paid up capital of Rs 10,00,000/- only which was subsequently increased to Rs 5.00 crore over a period of time.

During first year of its incorporation, Saw Mills were also installed at Rourkela, Jeypore, Mathili and Ballimela to provide the sawing facility to the people of the state as per demand of people and at present there are 9 saw mills are in operation at different parts of State of Odisha.

While timber, firewood and allied products remained its main activity, it entered into KenduLeaf trade from the year 1965-66 and Sal seed trade from 1974-75. Subsequently, kendu leaf was nationalised from the year 1973 and Orissa Forest Corporation was made the sole selling agent of Kendu Leaves as per the provisions of the Orissa Kendu Leaves (Control of Trade) Act 1961. Further, from the year 1983 when Sal seed was nationalised, Corporation was entrusted with the task of collection of Sal seeds from a major part of the State as per the provisions of the Orissa Forest Produce (Control of Trade) Act 1981. Further it also collected Mohua Flower during 1991-92 to 1992-93 to fulfil the mandate of the Government.

In 1991, as per decision of the State Government two forestry-based corporation namely Similipal Forest Development Corporation Ltd which was operating in the Similipal Biosphere region of the state and M/s Orissa Plantation Development Corporation Ltd which was looking after afforestation activities of the Forest Department were merged with Orissa Forest Corporation to form a mega Corporation in the Forestry Sector of the State. The name of the Corporation was then changed to Odisha Forest Development Corporation Ltd.

OBJECTIVES

Align with the policy of the Government, the Corporation objectives are as follows:

- Scientific and sustainable working of forest resources
- Marketing of various forest products, both raw and value added within and outside the state
- To plant, grow, cultivate, propagate, produce and raise plantations of all varieties of forest species, trees, grasses, medicinal plants and crops.

- To buy, sell, export, import, process, manufacture, distribute or otherwise deal in all kinds of forest plants, trees, kendu leafs and other forest products
- To establish depots at convenient places for supply of timber, firewood and other forest products to the local people at reasonable rate
- To act as a nodal agency of the state for promotion of Ecotourism in the State.
- To undertake projects and scheme to discharge its Corporate Social Responsibility to the society.

ORGANISATION

OFDC operates through its 7 nos. of Commercial Divisions, 12 nos. of Commercial-cum-Kendu leaf Divisions and 1 no. Plantation Division. Besides Head Office, it has 4 nos. of Zonal Administrative Offices. OFDC has following operational units

TIMBER & FIREWOOD

Timber and firewood is the main trade activity of the Corporation. Corporation receives maximum timber and firewood from coupe working based on the prescription of Working Plans ensuring scientific working of forests. In addition, timber is also

Units	Numbers
Zone Offices	04
Division Offices	20
Sub-Division Offices	63
Central Timber Depot	52
Retail Timber/Firewood Depot	67
OFDC Kendu Leaf Central Godown	39
Saw Mill	09
Commercial cashew Plantations	199
Other Commercial Plantations	728
Rubber Plantation	3
Canning & Pickling Unit	1
Theme Park (JaydevBatika)	1

received by salvaging from forests floor, from seized timber relating to different types of offences cases, developmental site clearance projects, from mining areas and tenants timber etc. Till 1990, clear felling and coppice working of coupes were quite prevalent, replacing miscellaneous forests with economic species. This system has been gradually phased out and conservation of biodiversity has got precedence over commercial exploitation of forests.

Many productive forest areas of State have been declared as Sanctuaries and National Parks. From the year 1992-93 to 2004-05, Government of Odisha had imposed total ban on green felling of trees in forests of the State. Thus coupe working in the forests came to a standstill. All these steps reduced theavailability of timber and timber trade of Corporation suffered badly. After lifting of banfrom 2005-06, the new Working Plans have become very conservation oriented as a result many coupes have become economically non-viable. Many of forests areas are also affected with extremists problems where working was not congenial and these coupes were also not worked. Thus, availability of timber has been reduced considerably. From other sources also timber availability fluctuates depending on many factors. Thus, Corporation which traded about 3.29 lakh cubic meter of timber during 1982-83 is now trading only a meagre quantity of 0.30 lakh cubic meter per annum.

The timber so obtained is put to sale through auction/tender by forming lots generally ofvolume equal to one truck load with same species and similar type of timber. Later on, to meetthe requirement of local people, some timber as per choice of the purchaser are sold to them at fixed retail rate. From



the year 2006-07, Government have taken decision to sell 30% of coupe timber to local people on retail basis confined to 35 cft. per family per year. With effect from 2008-09, Government have also earmarked 40% of irregular lots for sale on retail. It is

seen that only for species like Teak and Sal there is more demand among retail purchasers.

Production of Timber & Firewood and Revenue earned by the Corporation during the last Five years are furnished below:

Timber Production (in cum)

Financial					
Year	Coupes Worked	Coupe Salvaging & UD Case		Other Sources	Total
2018 -19	95	15206	6506	12733	34445
2019 -20	97	14001	9621	6462	25001
2020 -21	119	16069	3970	5994	26033
2021 -22	100	12528	3436	4666	20630
2022 -23	144	20346	3431	5919	29696

Firewood Production (in Stacks)

Year	No.of	Firewood Production					
	Coupes Worked	Coupe	Salvaging	Other Sources	Total		
2018 -19	95	8405	1805	19013	29223		
2019 -20	97	6381	4551	11108	22041		
2020 -21	119	6402	1112	12232	19747		
2021 -22	100	7014	2228	12402	21644		
2022 -23	144	8724	1929	1410	24760		

Revenue from Round Timber & Firewood (in Crore Rs.)

Financial Year	Timber	Firewood	Total
2018 -19	109.78	14. 34	124.12
2019 -20	79.05	10.36	89.41
2020 -21	66.94	7.21	74.15
2021 -22	50.52	8.87	59.39
2022 -23	56.10	11.55	67.65

SAW MILL OPERATION

OFDC Ltd is operating 9 Saw Mills at Berhampur (Ganjam), Khapuria (Cuttack), Jeypore (Koraput), Maithali (Malkanagiri) Nowrangpur, Remed (Sambalpur), Muniguda, Kantabanjhi, and Rourkela for meeting sawing requirement of the general people. The Corporation also sells different sawn sizes by sawing timbers. It has sawn sizes godown at all these places. Recently the Corporation has upgraded the sawing capacity of 4 nos. of existing saw mill units followed with installation of automated saw mill units shifting from conventional operation to automation thereby improving the quality of sawing and reduction of wastage.



KENDULEAF

Kendu leaf is an important 'Non-Timber Forest Products (NTFP) item of Forest Department. It is used as wrapper of Bidi. In Odisha these leaves are collected, stored, processed and bagged by Kendu Leaves organisation of Forest Department. There are two different ways of trading these leaves - 'Phal' leaves which are the dried leaves bagged in standard bags, each weighing about 40 Kg. Such type of collection is common in Kendu leaves producing states like Andhra Pradesh, Bihar, Chhatisgarh, Jharkhand, Madhya Pradesh, Maharastra, Rajasthan, and U.P. The other kind of trading involves processing of leaves at Phadi house into different grades of quality and leaves are bundled quality wise weighing 5 Kg each and bagged with each bag weighing about 60 Kg. These processed leaves are the monopoly of Odisha State only and best quality processed leaves are exported by the purchasers to countries like Sri Lanka, Bangladesh, Pakistan etc. This trade creates about one croreman days of job mostly during peak summer season. Corporation entered into this trade from the year 1965-66. However, after nationalisation of produce from the year 1973, Corporation has been made the sole selling agent. After collection, processing and bagging, the leaves are delivered to Corporation by the Kendu Leaves Organisation and the Corporation through its marketing strategy sells the leaves through tender or Auction. Tender or Auction takes place at regular interval. The manual tender and auctions for sale of Kendu Leafs are now being replaced with e-tender and e-auction mode through e-tender/e-auction portal of OFDC Ltd. For kendu leaves working in the field, Corporation arranges working fund advance for Kendu Leaves Organisation which are subsequently recovered from the sale proceeds. Corporation gets commission at fixed rate. After realising taxes, working fund advance and commission, balance fund is paid to Kendu Leaf Development Fund.





Crop Year	Quantity delivered	Quantity sold	tals)	Sale Value	
	to OFDC (in Lakh Qntl)	Processed	Phal	Total	(Rs.in Crore)
2018	2.84	2.36	0.48	2.84	461.71
2019	2.033	1.584	0.449	2.033	377.98
2020	1.915	1.584	0.331	1.95	410.81
2021	2.649	2.118	0.420	2.538	593.45
202 2	2.785	2.327	0.457	2.784	589.77

BAMBOO

Like Kendu leaves, Bamboo is also a nationalised forest produce in the State. It is worked in the forest areas as per the prescriptions of Working Plans and Working Schemes. For managing the working of Bamboo there is an 'Empowered Committee' at State level under the Chairmanship of Additional Chief Secretary, FE & CC Department. Bamboo working is

done by OFDC Ltd through Raw Material Procurers (RMP) as per guidelines approved by the Empowered Committee. Most of the Bamboos in the form of Industrial Bamboo [I.B] are sold to different industrial units whereas Commercial Bamboos [C.B] are harvested for supply to local people and Bamboo artisans at concessional rate. Till 2016, the paper Mills were major procurers of Industrial bamboo. In

the meanwhile, Paper Mills have adopted a new technology for paper manufacturing replacing bamboo with soft wood as raw materials. Thereby, requirement of bamboo as a raw material is reduced to minimal which has resulted in drastic reduction on the demand of Industrial Bamboo.



Financial Year	No.of	Production of			
	Coupes Worked	Industrial Bamboo (in SU)	Commercial Bamboo (in nos.)		
2017 -18	37	9268.45	449413		
2018 -19	32	3748.78	306562		
2019 -20	24	3502.26	351938		
2020 -21	38	4873.47	375851		
2021 -22	29	3245.00	204810		
2022 -23	29	4459.72	101590		

COMMERCIAL PLANTATION

Commercial Plantations including Cashew, Rubber, Eucalyptus and other suitable species have been raised by OFDC over an area of 53,389 ha. The Cashew Plantations are leased out through competitive bidding process to the interested bidders for collection of cashew nuts. The Corporation has taken steps for enrichment of 10 nos. of Cashew Plantation fields through nurturing of naturally regenerated seedlings by taking up enrichment measures such as weeding, soil working & manuring etc.

The Rubber Plantations have been raised during 1985-86 in Khurda and Mayurbhanj districts. For collection of latex, the existing Rubber Plantations are leased out to entrepreneurs through competitive bidding process. The OFDC Ltd. also collects latex and sells processed rubber to different entrepreneurs as value added product, where plantations could not be leased out.

CANNING CENTER

The OFDC is also processing MFP items like honey. It is also producing pickles from mango, lemon, green chili etc. and squash and also a non-carbonated soft drinks made from honey, ginger and lemon. These items are sold through various outlets of OFDC and also through authorised selling agents. There is good demand of all these products in the market throughout the State. Keeping the demand in view, OFDC has set up an Automated Honey Processing Plant at Jashipur of Mayurbhanj District of the annual capacity 15 MT.

ECOTOURISM AND THEME PARK

OFDC has been appointed as the Nodal Agency for promotion of Ecotourism in the State and to provide one stop solution for this purpose. The OFDC is operating the ecotourism portal www.ecotourodisha.com and doing advance booking for all the accommodation facilities available at 49 numbers of Eco-tourism Destinations. The OFDC is also doing advance booking for safari vehicles and boating facilities wherever available in these sites. ((Photo-8)

During the financial year 2022-23, there were 10701 nos. of online booking for accommodation

with total transaction value of Rs.13.79 Crore.

The OFDC Ltd has developed a natural park at Jaydev Vatika in the outskirt of Bhubaneswar. JaydevBatika is an aesthetic park having more than 300 native and exotic species with medicinal trees, shrubs, herbs, climbers, grass and bamboo spread over an area of 39 hectares. The natural topography added with creative landscaping with vast expanse of lawn and meadows, lilies ponds &lotus ponds, floating fountains, artificial waterfall and cascading stream have indeed made it a wonderful picturesque landscape park with scenic beauty for the visitors to have mental peace with ecstatic joy. Further development work in the park has also been taken up on a continuous basis for providing better facilities to the visitors. During the FY 2022-23 earnings of Rs.168.44 lakhs has been made by the OFDC from the Park.

With the reduction of timber working, bamboo working and reduction in sale of kenduleafs due to more than one external reasons, the OFDC Ltd has diversified its activities by taking up new areas of working vizplantation, landscaping, sports ground development, selling other value-addedforest & non-forest produces and promotion of ecotourism.

The OFDC Ltd is the one specialized agency in removal of trees for site preparation for any infrastructure developmental projects.

In recent years, it has expanded its field of operation to green consulting and turnkey projects which now contributing 10-15% of its total revenue as commission by implementing several plantations and greening projects. It has established a strong credential in reforesting mining area, degraded lands, industrial zones and establishing several eco parks and landscaping stadiums and institutional campus.

The OFDC Ltd is also engaged in raising avenue and block plantations, plantations around industrial, urban and coastal areas, landscaping etc. for various institutions like IOCL, Dhamra Port, NHAI, East Coast railways, Airport Authority of India, MCL, NALCO,OMC,SAIL etc. The landscaping project of Kalinga Stadium at Bhubaneswar, Birsa Munda Hockey Stadium at Rourkela, IOCL campus at Paradeep Port area, Ravenshaw College Stadium, Raj Bhawan at Bhubaneswar and Eco- Park at Jayadev Batika and many more greening projects of

the State under implementation by this organization demonstrates the newly acquired expertise of the OFDC Ltd and now become a major green developer of the State. (Photo-14,15&16)

The Corporation is also discharging its social responsibilities effectively as a responsible partner of the Government and always stood by the Government during cyclone and other natural calamities for tree clearance work in order to restore road communication, power restoration for safety of life & property of public and thereby ensuring immediate assistance and relief to the people of the affected area. The untiring, dedicated service of its staffs and officers in bringing normalcy among the people of the affected area during post severe cyclonic storm "Hudhud", "Titli' and "Fani" have been appreciated at various quarters.

Towards fulfilling its mandate, this organization directly and indirectly helps in creating employment opportunities for people living within and at periphery of forests especially for weaker sections of society and thus helps in reducing dependency of these people on forest leading to better protection of forest and wildlife. The Corporation has also been contributing substantial amount to the exchequer which helps the Government to take up various developmental measures for the people associated with the trade.

It is a fact that inspite of low capital base, the corporation which is a Zero Debt PSU of the State has made its best efforts to turn around its financial conditions. This Corporation has been not only earning profits consecutively for last 15 years and paying cash dividend to Government every year complying to the direction of the Government, it has also exceled in its workings for categorization as Gold Category State PSU in terms of guidelines of the Public Enterprises Department, Govt. of Odisha. The turnover, income from operation and profit before tax for last five years are as follows:

Turnover & Profit for Last 5 years (in crore)

Financial Year	Turnover	Income from Operation the year	Profit for (Before Tax)
2018-19	647.23	195.72	25.84
2019-20	562.46	152.03	20.15
2020-21	611.75	140.21	25.58
2021-22	740.58	242.50	27.42
2022-23	754.04	256.23	30.02

Corporation working is totally based on forest products. At the time of its inception there were no regulatory laws except 'The Orissa Kendu leaves (Control of Trade) Act, 1961 and subsequently Orissa Forest Act, 1972, Wildlife (Protection) Act, 1972 and 'The Orissa Sawmill and Saw Pit' (Control) Act, 1991 were promulgated. The Rules under these Acts also came into force at different point of times. Thus after 1972, trade of Corporation was affected due to various regulations. From the year 1980, Forest Conservation Act 1980 came into force. The restriction imposed on running of Saw Mills during 1st decade of this century had not only affected its revenue but also deprived the people of sawing facilities. Now Forest Rights Act 2002 is further going to affect its trade of timber, KL and Bamboo.

In this background, OFDC has to search new avenues for diversification of activities align with its expertise for sustenance. Apart from Ecotourism, Government's programme of afforestation through various schemes has created mass awareness among masses for tree plantation on their private lands and farm lands. These have to be harvested by the owners to get the benefit by selling it and earning the income.

In tenant timber business, there is vast scope for Corporation to get the work. The removal of such timber from tenant's land as per tenant's convenanceneed Government's special attention by simplifying the rules and procedures.

Further OFDC needs land for taking up plantation from its own resources which after harvesting can meet the requirement of people and Industry and will generate revenue to the Corporation. Ther plantation raised by OFDC onForest lands from its own resources in the past are yet to be harvested fell due to various reasons. By having its own land Corporation can have its own scheme of plantation and harvesting.

There is a potential market for pure and natural honey and the quality of the honey processed and sold by the OFDC is quite good compare to other branded honey available in the market. A step for setting up of production of processed honey through Automatic Processing Plant is a welcome move by the Corporation. However, there is a needto create and establish a marketing channel for marketing of canning MFP products to augment its revenue activities.

ADMISSIONS OPEN One year Diploma in Advanced Woodworking

Course Description:

The Diploma Course was launched in the year 2018-19 jointly with M/s. Biesse Manufacturing Company Private Limited. This program offers an excellent opportunity for trainees to acquire required skill set to work on wood and wood products. This course structured to provide first hand experience in handling state of the art machineries to make them employable in wood based industries. This course has eight major modules namely, Fundamentals of wood materials, Fundamentals of Engineering, Wood processing using advanced machines & allied processes, Loading & unloading systems, machinery safety, maintenance of machines, Assembly & Joinery, Advanced application of software (CNC, CAD/CAM & 3D-Pytha) and project work. Upon successful completion of training, the trainees will be able to handle most of the advanced woodworking machines that are used in the wood based industries.

Eligibility : Pass in Pre-University Course/Senior Secondary/ XII/ Equivalent from recognized

Board. (Graduates in Science / Forestry / Engineering are encouraged to apply).

Course Fee : Rs. 35,000/- for the entire course

Extra : Rs.1,650/- per month towards Accommodation Charges Food Charges (as per actual)

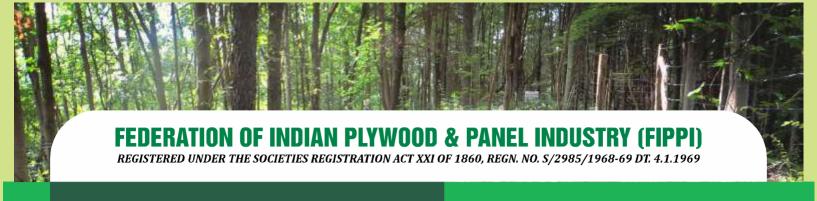
Security Deposit : Rs. 5,000/- (Refundable)
Intake : Maximum 30 Candidates



INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY

(Indian Council of Forestry Research and Education)

An Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India P.O. Malleswaram, Bengaluru – 560 003, India Website: http://iwst.icfre.gov.in/awwtc/awwtc.htm Ph: 080-22190148, 150 Fax: 080-23340529 E-Mail: awtc_iwst@icfre.org,dir_iwst@icfre.org



Part of FIPPI Achievements

With great efforts of Federation of Indian Plywood & Panel Industry (FIPPI), an Apex representative body of Plywood / Panel / Other Allied products including Furniture and Wood / Bamboo Working Machinery Manufacturers in India alongwith close cooperation with various Ministries and Premier Institutes through Agro and Farm Forestry and other Captive Plantation programme, the dying woodbased industry is again reviving in the country to produce various standard products like Veneer, Plywood, Panelboard, Particleboard, MDF, Laminates etc. which are internationally accepted. Further with great pursuance of the President and Senior Executive members of FIPPI we are highlighting and representing the crucial issues confronting the Plywood & Panel Industry. FIPPI also publishes quarterly Journal Indian Wood & Allied Products highlighting the development taking place in India and abroad, market profile, world timber market report, statistics, international exhibition and conferences, articles. write-ups etc.

FIPPI is cordially inviting all plywood / panel / bamboo / Laminates and other allied products manufacturers to become active member for the strengthening the platform of FIPPI and working for the development of the industry which is Internationally recognized by ITTO, FAO, European Union, IWPA, BIS, MoEFCC, Ministry of Commerce & Industry, BIS, FICCI, CII and other renowned Organizations.



















FEDERATION OF INDIAN PLYWOOD & PANEL INDUSTRY (FIPPI)

404, Vikrant Tower, 4, Rajendra Place, New Delhi110 008, India Ph.: (Direct) +91-11-25755649, Other Nos. +91-11-25862301

Fax: +91-11-25768639, E-mail: fippi@fippi.org

Website: www.fippi.org

Activities of Rajasthan State Forest Development Corporation Limited

Uday Shankar Managing Director

राजस्थान राज्य वन विकास निगम लिमिटेड से संबंधित संक्षिप्त लेख

स्थापना :--

वन सम्पदा जैसे कि काष्ठ व अकाष्ठ तथा लघु वन उपजों का दोहन व मूल्य संवर्धन कर सुनियोजित तरीके से बाजार में सर्वजन के उपभोग हेतु उपलब्ध कराना,वन क्षेत्र व संरक्षित क्षेत्रों में ईको—पर्यटन तथा उससे जुड़ी गतिविधियों व सेवाओं का संचालन के उद्देश्यों को प्राप्त करने के लिए राजस्थान में राजस्थान राज्य वन विकास निगम के गठन की घोषणा राज्य बजट में दिनांक 20 फरवरी 2020 को माननीय मुख्यमंत्री द्वारा राज्य विधानसमा में की गई। इस बजट घोषणा की अनुपालना में दिनांक 16.12.2020 को राजस्थान राज्य वन विकास निगम लिमिटेड का रजिस्ट्रेशन कम्पनीज एक्ट 2013 के अन्तर्गत रजिस्ट्रार ऑफ कम्पनीज में किया गया। राज्य सरकार के आदेश दिनांक 05.01.2022 द्वारा निगम में 154 पद स्वीकृत किये गये हैं, जिसमें 17 पद अतिरिक्त कार्य भार से एवं 77 पद वन विभाग से प्रतिनियुक्ति से भर लिये गये हैं। निगम अन्तर्गत ईमारती लकड़ी एवं बांस की कटाई /कल्चरल ऑपरेशन संबंधी करवाए जाने वाले कार्य प्रक्रियाधीन है।

राजस्थान राज्य वन विकास निगम के मुख्य उद्देश्य :-

- राजस्थान सरकार से पट्टे पर ली गई भूमि पर ईमारती लकड़ी, ईधन की लकड़ी, बांस, लघु वन उपज और अन्य वाणिज्यिक वृक्षारोपण को बढ़ाना, वैज्ञानिक रूप से कटाई और विपणन कराना।
- इस उद्धेश्य के लिए वन विकास निगम को सौंपे गए सरकारी जंगलों से पेड़ो की कटाई और लकड़ी एवं अन्य वन उत्पादों का दोहन करना।
- आम जनता को गुणवत्ता ,पूर्ण बीज, पौधे और अन्य वन—उत्पादों की आपूर्ति करना।
- लकडी और अन्य लकड़ी के उत्पादों, एनटीएफपी, आदि के मूल्यवर्धन के लिए औद्योगिक इकाईयों की स्थापना और संवर्धन करना।
- आमजन, सरकारी विभागों और वन विभाग को फर्नीचर, लकड़ी की निर्माण सामग्री, पॉली बैग, कांटेदार तार और ऐसे अन्य उत्पादों की आपूर्ति करना।
- वानिकी, जैव विविधता संरक्षण और पर्यावरण से संबंधित अन्य गतिविधियों जैसे प्रशिक्षण, विस्तार, खरीद, अनुसंधान, परामर्श, प्रमाणन, विपणन, बाजार विकास, प्रौद्योगिकी आदि को कियान्वित करना।
- विभिन्न एजेंसियों के लिए टर्नकी आधार पर बनों का विकास करना।
- परामर्शी सेवाएं प्रदान करना।
- राज्य की इको—ट्यूरिजम पालिसी 2021 के अनुसार इससे सम्बंधित विभिन्न गतिविधियों को क्रियान्वित करना।

प्रशासनिक व्यवस्था :-

राजस्थान राज्य वन विकास निगम लिमिटेड के नियंत्रण में प्रदेश में वन उपज के विदोहन व निस्तारण का कार्य किया जाता है। इसके अधीन पांच उप वन संरक्षक स्तर के कार्यालय निम्न प्रकार से कार्यरत है:-

- महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय, बीकानेर।
- महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय, अजमेर, मुख्यालय, बीकानेर।
- 3. महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय,सूरतगढ
- महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय, उदयपुर।
- महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय,जयपुर।

महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, क्षेत्रीय कार्यालय,अजमेर/बीकानेर/ सूरतगढ द्वारा इन्दिरा गांधी नहर परियोजना के प्रथम चरण एवं द्वितीय चरण में भारत सरकार द्वारा स्वीकृत योजना के अनुसार नहर के किनारे एवं नहर क्षेत्र में कराये गये वृक्षारोपणों का विदोहन एवं विक्रय का कार्य कराया जा रहा है।

महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, उदयपुर में मुख्यतः भारत सरकार द्वारा स्वीकृत वर्किंग स्कीम के अनुसार बाँस का विदोहन कार्य उदयपुर जिलें में करवाया जा रहा है।

महाप्रबंधक, राजस्थान राज्य वन विकास निगम लिमिटेड, जयपुर द्वारा राष्ट्रीय राजमार्गो के चौडीकरण के फलस्वरूप वृक्षों के विदोहन से प्राप्त होने वाली लकडी एवं प्रादेशिक वन मण्डलों से प्राप्त गिरी पडी लकडी के विदोहन पश्चात विकय करने का कार्य कराया जा रहा है।

राजस्थान राज्य वन विकास निगम लिमिटेड द्वारा वर्तमान में निम्न कार्य कराये जा रहे है :-

- गंग भाखड़ा नहर के किनारे वृक्षों के विदोहन का कार्य एवं प्राप्त लकड़ी के निलामी का कार्य कराया जा रहा है।
- महाप्रबंधक राजस्थान राज्य वन विकास निगम लिमिटेड अजमेर द्वारा जैसलमेर में इंदिरा गांधी नहर के किनारे वृक्षों के विदोहन का कार्य एवं प्राप्त लकड़ी की नीलामी का कार्य कराया जा रहा है।
- जूलीफ्लोरा उन्मूलन/खडे पेडों की निलामी का कार्य वन मण्डल सिरोही, जयपुर एवं सवाईमाघोपुर में कराया जा रहा है।
 - इकों ट्यूरिज्म स्थलों की विस्तृत परियोजना रिपोर्ट (DPR) बनायी जा रही है।
 - उच्च गुणवत्ता के टाल प्लांट के उत्पादन हेतु हाई—टेक नर्सरी की स्थापना हेतु विस्तृत परियोजना रिपोर्ट (DPR) तैयार की जा रही है।

राजस्व आय:-

वित्त विभाग की स्वीकृति के अनुसार विदोहन से प्राप्त लकड़ी एवं बांस के विक्रय से प्राप्त राशि निगम के पी.डी (PD) खाते में जमा करायी जा रही है।

उक्त प्रकार से निगम के पी.डी (PD) खाते में प्राप्त राशि का उपयोग निगम में प्रतिनियुक्ति से पदस्थापित कर्मियों के वेतन, भत्ते, वृक्षारोपणों एवं बांस के पातन, परिवहन, संग्रहण एवं अन्य कार्यों में किया जा रहा है।

Cement Bonded Bamboo Board

Manish Ranjan,
PPPT Division ICFRE –
Institute of Wood Science and Technology,
Malleswaram, Bengaluru
Email: ranjanm@icfre.org

ood-based panel products are important materials for a variety of domestic, commercial and industrial applications. Wood-based industries are facing the gap between the demand and supply of solid raw materials in India and looking for alternatives. A lot of work has been done on mineral-bonded wood particle boards to reduce the cost of wood raw materials and give a new dimension to woodbasedpanels. This work was attempted about five decades earlier "Duratuff" and "Bison Panels" and the merit of such boards is doing away with costly resinous and other glue systems. Phenolic and ureaformaldehyde are basically petrol eumbased synthetic binders, which are very costly for wood panel products. The technologies in this direction are continuously evolving and are glue based. The anisotropic behaviour of solid wood, growth stress behaviour of plantation woods in this being overcome to some degree, if not fully and specification based panel products are emerging. In contrast to conventional urea and phenolformaldehyde resin-bonded wood composite panels, cement bonded wood composites possess much higher fire, insect, and fungal resistance. Synthetic resins are also so costly, which favourmineral-bonded composites.In contrast, the cement gives the desired bond strength and is capable of producing weather-friendly components for prefabtype housings. Now a day, customer is so concerned about environmental health and economy which demand a value added product from the waste material. Many studies were done to achieve these

objectives. Recently there has been a spur in interest, in the commercial manufacture of cement-bonded composites from agriculture and wood residues in developing countries for low-cost housing projects. Because of their versatile nature, the boards found large-scaleapplications in shuttering, sandwich-type boards for insulation, ceilings etc. They are superior in physical properties such as thermal conductivity, sound absorption, possess adequate strength and excellent working qualities. Cement bonded particle boards are classified as Class-I fire-resistant materials based on the surface spread on the flame test. All these factors have contributed significantly to the adoption of this material in low-cost housing and the construction of industrial and commercial complexes.

Wood-cement boards, fibre-cement boards, gypsum fibreboards, and gypsum particle boards are now manufactured in various parts of the world. Industries have an opportunity to use chief raw material, which is locally available for strong and durable building products. Several lignocellulosic materials have been tested and found suitable for use in manufacturing cement bonded particle board over the years. The use of alternate raw materials for the manufacture of panel products can play a crucial role in wood-based industries. During the manufacture of cement bonded particle board the compatibility of species with cement play an important role. Basically wood contains extractives and other chemical constituent, which may interfere with cement setting and bonding. The utilization and availability of fast-growingbamboo as futuristic raw materials to augment panel products because of low extractive like soluble sugar and tannincontent. Cement bonded board has gained favour throughout the industries due to its extended applications compare to plywood, resinbonded particle board and other allied products.

Advantage of Cement Bonded Particle Board (CBPB):

1. Fire Resistance: CBPB is highly fire resistant and has been classified as an incombustible material in many countries around the globe.

- **2. Weather Resistant:** With cement constituting 62% of its composition the CBPB gives excellent resistance to weather. The board has been subjected to many cycles of soaking, freezing and heating without any sign of disintegration. The board should generally be painted for external application to provide a weather seal.
- **3. Biological:** Due to the mineralisation of wood particles by cement, CBPB is resistant to termite and vermin attack. It does not support fungus growth. Even untreated samples exposed to contact with the ground surface for several years have shown no sign of rot or decay.
- **4. Sound Insulation:** Airborne sound reduction varies between 30 and 37 dB for the frequency range 100- 3150 HZ according to the thickness of CBPB. When used in stud partitioning, a reduction of over 60 dB can be achieved with suitable construction.
- **5. Chemically Stable:** CBPB is produced by an irreversible process combining cement and wood particles into a chemically stable building material which maintains its strength with time and exposure to elements. The board is unaffected by many dilute chemicals such as brines, bleaches, detergents and chlorine solutions.
- **6. Dimensionally Stable:** CBPB has excellent dimensional stability in variable ambient temperatures and humidity conditions. The swelling in thickness after 2 hours of immersion in water is 1% and after 24 hours of immersion is only 1.5%. Longitudinal and transverse swelling will be approximately 0.3% for change in relative humidity of air from 30% to 95% at 20°C.

MATERIALS AND METHODS

Materials:

- i. Bamboo particles of Bambusabamboo.
- ii. Pozzolana Portland Cement.
- iii. Additives [Sodium Silicate (Na2SiO3) and Aluminium Sulphate (Al2SO4)3)].

Methods:

Preparation of raw materials: The properties of the final product primarily depend on the type of particle used, thus the preparation of the particle itself is one of the most important factors in the CBBB manufacture. Steps in the preparation include the





types of particles employed and quantity of cement are the major factors that are closely related to handling, drying, screening, mixing and mat formation. Particle geometry (shape and size) has a considerable effecton both the boards properties and its manufacturing process. Bambusa bamboowas purchased from the market and IWST-IPIRTI Campus, Bangalore. The following steps are involved in the particle preparation:

- a) Chipping: Bamboo was cut into small pieces and chipped out manually.
- **b) Drying of chips:** Chips were dried up to get better quality particles.
- c) Grinding: These chips are converted into cuttertypeparticles in a condux mill.
- d) Screening of Particles: The Particles were sieved through 20 and 40 mesh screens to get uniform sizes of coarse and fine particles. The coarse and fine particles are separated in 2.0:1.0 ratios for board preparation.

Quantity of water: The quantity of water depends on the quantity of cement used for cement bonded particle board. The quantity of water added was calculated using a relationship developed by Simatupang (1979). The water required was determined as follows:

Amount of water (litre) = $0.35 + (0.3C - MC) \times W0$ Where,

C = Cement weight (Kg)

MC = Moisture content of wood (Oven-dry)

W0 = Oven dry weight of wood (Kg).

Soaking of particles: The dried coarse and fine particles were soaked in water for 48hrs before mixing with cement. This was mainly done to reduce soluble

sugar content (leachable type) in wood and also to prevent heat of hydration after mixing cement (Mohamed et al. 2011).

Additive application: 2% Sodium silicate (Na2SiO3) was added with cement to reduce the heat of hydration and 2% Aluminium sulphate [Al2(So4)3] was added on the basis of cement weight used for board preparation to accelerate cement setting.

Cement mix proportion: Pozzolana Portland Cement (Type IV) was used for board preparation. Three different proportions of cement/particles were used 2.0:1.0 (930 g cement and 470 g particles), 2.5:1.0 (1000 g cement and 400 g particles) and 3.0:1.0 (1050 g cement and 350 g particles).

Mat formation: Mat formation 300X300 mm iron frame was used. After mixing coarse and fine particles with water, additives and cement, a layered mat formation was made. The fine particle mixture was on the top and bottom layer and the coarse

particle mixture was on the middle layer. It was mainly done to get a smooth surface of the cement particle board. The moisture of the mat before the cold press should not exceed more than 48%. The thickness of the mat before the cold press was 22 mm.

Cold press: After mat formation, the entire iron frame was kept in a cold press for pressing of board. The specific pressure was kept in a cold press at 28 kg/cm2 for 6 hrs.

Maturing and conditioning: The boards were removed from the iron frame and covered with a cellophane sheet. The boards were kept at room temperature for 7 days for conditioning. Boards were removed from the cellophane sheet and kept under the dryer to reduce moisture content up to 9%. After conditioning the boards were trimmed and sized for testing. The number and size of the test samples from each prepared cement bonded particle board for various tests as per IS: 2380 (1998).

RESULTS

In order to develop a cement bonded particle board, Bambusa bambooparticle was used in three different ratios i.e. 2.0:1.0 (R1), 2.5:1.0 (R2) and 3.0:1.0 (R3) cement: bamboo particle. Cement bonded board of 10 mm thickness were madein all three ratios

applying specific pressure at 28 kg/cm2 (400 lbs/sq. inch) for 6hrs in cold press. The prepared board was conditioned, and tested for physical properties such as density, moisture content, water absorption after 2hrs and 24hrsand pH of the board. Table 1 presents mean observations of physical properties of CBBBand its comparison with IS: 14276 (2009).

Table 1: Physical Properties of Cement Bonded Bamboo Boards

Cement: Particle Ratios	Density (g/cm3)	Moisture Content (%)	Water Absorption (%)		pН
Tutios .	(8)	Content (70)	2 hrs	24 hrs	
2.0:1.0 (R1)	1.28	9.96	13.46	25.28	11.1
2.5:1.0 (R2)	1.33	6.98	12.77	18.91	11.1
3.0:1.0 (R3)	1.36	6.62	12.15	18.05	11.7
IS: 14276 (2009)	1.25 (Min.)	6.00 - 12.00	13.00 (Max.)	25.00 (Max.)	11 -13

Mean density of CBBB was found 1.28, 1.33 and 1.36g/cm3 in Bambusa bamboo particle board. It was noted that density of the board significantly increased with increasing cement particle ratio in boards. Although it is fulfilling the criteria of desired density as per IS: 14276 (2009) at all ratios. Compare to MDF and Particle boards, density of CBBB is quite higher. It is because of high specimen weight of cement particles as compared with wood particles or high density of cement than wood. The mean moisture content of 9.96, 6.98 and 6.62 % in CBBB at

R1, R2 and R3 ratios respectively and met the minimum requirement of board as per IS: 14276 (2009). The mean moisture content decreased with increasing cement wood ratios. Similarly, water absorption by CBBB were found 13.46, 12.77 and 12.15 % after 2hrs and 25.28, 18.91 and 18.05 % after 24hrs soaking in waterobserved in R1, R2 and R3cement: particle ratios. Results revealed approximately double water absorption after 24hrs as compared with 2 hrs. As per IS: 14276 (2009), board should have maximum

13 and 25 % water absorption after 2hrs and 24hrs. So only 2.0:1.0 ratio of cement particle does not satisfy the criteria as per IS: 14276 (2009) but in compare to particle board water absorption is less in cement bonded board. The pH value ranges of all the boards is found in between 11.1 to 11.7 in all three cement particle ratios. It was also observed that moisture content and water absorption after 2hr and 24hrs

decreased with increasing amount of cement in wood. It is well known that wood is hygroscopic in nature, so high content of wood particle in CBBB tends to absorb more water as compared to cement particles. Cement particles also provide coating to wood particles, which prevents them from absorbing water.

Table 2: Mechanical Properties of Cement Bonded Bamboo Boards

Cement: Particle	Modulus of Rupture (N/mm2)		Modulus o (N/r	f Elasticity nm2)	S crew Withdrawal	Tensile Strength
Ratios	Dry	Wet	Dry	Wet	Face (N)	(N/mm ²)
2.0:1.0	5.40	4.86	3204	3069	1331	0.35
2.5:1.0	9.01	7.49	4805	4642	1451	0.41
3.0:1.0	9.17	7.64	4884	4721	1460	0.43
IS: 14276 (2009)	09 (M in.)	5.5 (M in.)	3000 (M in.)	2200 (M in.)	1250 (M in .	0.40 (M in .)

The mechanical properties of the boards such as modulus of rupture (MOR), modulus of elasticity (MOE) both dry and wet condition, screw withdrawal (Face) and Tensile strength (Internal bonding) was determined and presented in Table2. Mean MOR of CBBB at R1, R2 and R3 5.40, 9.01 and 9.17 N/mm2 dry and 4.86, 7.49 and 7.64 N/mm2in wet condition. Only R1 cement particle ratios do not fulfil the minimum criteria of IS: 14276 (2009). Mean MOE of 3204, 4805 and 4884 N/mm2was recorded at three different test ratios. As per IS: 14276 (2009), cement bonded particle board should have minimum 3000 N/mm2 MOE, where board prepared at all the three cement particle ratios meet the requirement. It was also observed that MOE and MOR of the boards significantly increased with increasing cement ratio in CBBB. Mean screw withdrawal in face of the board was recorded 1331, 1451 and 1460 N in cement bonded boards in all three ratios R1, R2 and R3. It shows that alignment of particles in board is important in case of screw withdrawal strength, since it is hard to withdraw screw across the grain than along the grain. However, board manufactured at all the three ratios meets screw withdrawal strength face as per IS: 14276 (2009). It indicates that high mechanical strength is obtained at high cement/wood particles ratio in board, which is significantly different from the lower ratios. Mean Tensile strengthof CBBB was determined 0.35, 0.41 and 0.43 N/mm2.It was observed that cement particles in board developed strong internal bonding and further improved the tensile strength of board. Although CBBB at only R1 ratiodo not perform satisfactory results as per IS: 14276 (2009).

APPLICATIONS:

Table 3: Cement Bonded Particle Board Recommended Thickness:

Application	Panel Thickness in MM
False Ceiling	6-8
Doors	12-18
Almirah	12-20
Furniture	6-14
Partitions	40
Modular Kitchen	8-18
Temporary Structure	40
Floors	16-30
Wall claddings	10-16

CONCLUSION

Cement Bonded Bamboo Board prepared with Bambusa bamboo species particles in three different cement particle ratios 2.0:1.0 (R1), 2.5:1.0 (R2) and 3.0:1.0 (R3). Density of the boards increases with adding cement proportion. Moisture content of bamboo cement board was recorded highest in R1 ratios. Apart from this, the moisture content of board decreased with increasing cement: particle ratios. The minimum water absorption of cement bamboo bonded board was recorded in R3 cement: particle ratios. In case of mechanical properties like MOR, MOE (both dry and wet), Tensile Strength and Screw Withdrawal strength increases with increase in cement ratio in the board. All these physical and mechanical properties of cement bonded bamboo boards in R2 and R3 cement particle ratio fulfil the requirement of IS 14276 (2009) but no significant difference observed in both cement: particle ratio.

References: Contact author at: ranjanm@icfre.org

Development of Medium Density Particle Board from Lantana camara

*V R Ramkumar, K Thanigai, M C Kiran, V Prakash, and Manoj Kumar Dubey ICFRE – Institute of Wood Science and Technology, IPIRTI Campus, Bengaluru 560 022, India *Email:vrramkumar@icfre.org

INTRODUCTION:

lant species that are considered to be invasive such as Ageratum conyzoides, Eupatorium sp., and Lantanacamara, give rise to deep concerns related to the alteration of ecosystem and biodiversity. A species native to South-Central America and the Caribbean Islands, Lantana was introduced in India during 1809 and intended to be an ornamental plant that has now invaded the forest as well as non-forest land across the country. The rate at which lantana is infesting the land has flagged a notice of the threat to the ecosystem that the Lantana is capable of posing. A study has revealed that this weed has invaded an area of more than 20 million ha across the globe [1].

The Invasion of Lantana camara in this fashion can be positively regarded as the source of biomass to produce value-added products such as particle board. Studies in the past have revealed that this weed can yield about 10-28 tonnes/ha/year,70-80% of which is woody biomass [1,2]. Studies have revealed that about 154000 sq. km of forest land (more than 40% by area) is occupied by Lantana camarain areas designated tiger ranges of India [2]. To check the ill effects of the invasion of Lantana camara several methods are being put into practice to remove the weed as well as to control the invasion. These measures are dependent on factors viz. availability of manpower and the method of extractions (Manual / Mechanical). In spite of all these efforts to check the invasion of Lantana camara and related cons, Lantana still remains a threat which requires immediate attention. Researchers have explored the management and utilization of lantana biomass/stalks for a variety of value-added products. Forest Departments/other ecology conservators are constantly working for the eradication/control of lantana through uprooting and other different strategies. Recently the Forest Department, Government of Karnataka has invited the quotation to uproot this weed of about 20000 ha for five years. It has been reported that huge volumes of lantana stalks have been accumulated and less utilized in and around hot spot areas of lantana invaded areas. As a part of regular practice, uprooted lantana stalks were burnt in the forest area or sold as firewood material with less utility. Hence there is a need to identify the viable utilization potential of accumulated lantana bio-resource [2-6].

Impacts and Utilization

Invasive plant species such as Ageratum conyzoides, Eupatorium sp., Lantana camara, Mikaniamicrantha, and Parthenium hysteophorus pose a severe threat to ecological and biodiversity throughout the globe [2]. Lantana camara, in particular, has been shown to have numerous ecological effects on a variety of ecosystems around the world. Lantana invasion has more negative impact on the native ecosystems, biodiversity, and key categories of ecosystem services such as supplies, controlling, subsidiary, and cultural functions. India has witnessed undesirable impacts of lantana on ecosystem and biodiversity through the vigorous invasion in forest & nonforest areas, cultivable & wastelands, pastures, orchards & fallow lands, due to the unique ability of lantana with ecological divergence, tolerance, prolific regeneration, and wide adaptability. Also, researchers have explored the possible uses of lantana such as herbal medicine, bio-mass as fertilizer, biofuel, a raw material of pulp and paper industry, fiber and developing roofing material, handicrafts, oil-based insecticides, bio-ethanol production, mosquito repellents, incense stick fragrance, etc. Parts of lantana such as stalks, leaves, and flowers are used in traditional and tropical medicines known in the folk medicines; for the management (treatment) of cancer, asthma, and respiratory infections; in the treatment of tumors, tetanus, rheumatism, and malaria, and also in the treatment of leprosy, chickenpox, measles, skin itches, antiseptic for wounds[2,3].

According to Negi et al. and Sharma et al. [2,5], Lantana roots are a rich source of oleanolic acid, which has anti-inflammatory, hepato protective, anti-tumor, antioxidant, and anti-hyperlipidemic activity. Lantana flowers are a major source of nectar for butterflies, bees, and moths. Lantana stalks comprise furfuroids (21.6%), lignin (14.0%), and cellulose (30.6%), making them an excellent source of pulp for the paper and pulp industries. Utilization in Paper Industry and Bio-bioethanol production shall be enhanced by providing suitable pre-treatments [2-4].

The use of lantana stalks of suitable sizes for furniture has been well studied and it was reported that lantana stalks may be used as similar as a cane in furniture making. The furniture made out of lantana was found to be cheaper and at par in strength with cane furniture [4]. In addition, the furniture made by lantana was reported to be termite-resistant and durable. Soligas, South Indian tribal artisans, use Lantana as a substitute for rattan and turn it into valueadded products such as furniture, toys, and other household utility items[2-4]. Currently, artisans and other skilled community members are producing over 100 registered value-added products such as toys, furniture, baskets, and other household utilities. Being the lingocellulosic material, lantana stalks can be used as a source of energy (fuelwood), pulpwood, furniture, bio-composites, etc. Small experiments concerning the utilization of lantana for furniture making (ATREE, Shola Trust -NGOs), charcoal production, fencing material, aromatic oil

(SIDHI), wood polymer composites (IWST), polymer matrix composite, lantana epoxy composite, etc., have been attempted but none has been scaled up to economical utility till date. Lab-scale trials indicate the furniture making from lantana requires a specific size of stalks and also a large amount of biomass with heterogeneous crooked stalks may not be utilized effectively [2, 6]. Wood and lingo-cellulosic composites namely particleboard and medium-density fiberboard are developed from a variety of lingo-cellulosic materials and the production mechanism is independent of the size/shape/maturity of the biomass [8-12]. Because lantana stalks are thin, crooked, tough, and long-lasting, they can be an excellent source of raw material for biocomposites [9]. With the advent of technologies and machines, lantana stalks can be effectively processed into chips/ particles to manufacture panel products. Processing of lantana stalks and utilization in particleboard manufacturing at an industrial scale may be the effective, viable, and sustainable way to utilize and manage this noxious species through adaptive management [9-10].

Particle Board Manufacturing

Particleboard (PB) is a kind of wood composite manufactured by aggregating particles of wood into a panel using an economically viable binding material depending on the intended end-use application of the product. The advantage of this panel is that wood material like lops and tops, small diameter wood trunks, sawmill and planer mill waste can be utilized to produce panels in addition to this, even agricultural waste and residues such as wheat straw and rice straw which when burnt in the fields contributes to hazards can also be considered as raw material for producing particle board. Particle board finds its applications mostly in furniture and partitions where the strength of the panel is not an important criterion i.e. in non-structural applications. The growth of the wood-based panel industry has resulted in unregulated harvesting and utilization of wood resources without proper plans for the replacement of extracted timbers. This exploitation of trees in both natural forests and private plantations has prompted exploring the possibilities of producing panels using low-grade logs and substandard materials such as saw mill waste and planner mill waste, which were otherwise considered fuel wood. In spite of various panel products developed viz. plywood, medium density fiber boards (MDF), block boards and flush door etc. which are intended to be used for specific applications in an economically viable fashion, the demand of raw material for industries producing these panels are still alarming requiring all of us to be mindful of challenges that are to be countered in the near future concerning the uninterrupted availability of timber raw material for these industries [7].

Three-layered particle board was developed by consolidating the *Lantana camara* particles into a panel by a suitable binding agent in a flat hydraulic hot press. The panel's density was targeted at 700-800 kg/cm². On the weight of oven-dry core particles, 8% ureaformaldehyde glue was used, and 12% solid resin was used on the

weight of face particles. A mat of three layers of particles were formed in such a fashion that on both the surfaces fine particles called face particles were laid and in between the layers of face particles, a layer of core particles was laid. Mat (particle board mat) was formed manually using *Lantana camara* particles in face-core-face fashion with the help of a mould of 126 cm × 66 cm × 19 mm. The mat was sandwiched between aluminum plates with releasing agent for pre-press. The flow of the manufacturing process

was as shown in Fig 1, 2 & 3. The Mat was prepressed for one minute applying a specific pressure of 6 kg/cm2, subsequently the pre-pressed mat was loaded into a hot press of platen size 1.4 m X 0.72 m. The temperature of the plate was sustained at 160°± 5°C. The first stage of hot pressing i.e. the compression cycle was for 8 min with applied specific pressure 25 kg/cm² followed by the curing cycle for 7 min with an applied specific pressure of 12 kg/cm2. Uniformity of the thickness of the board was achieved by 19 mm spacer bars which limited the vertical movement of the platen of the hot press. When the prepressed mat was consolidated into a composite, the particle board was unloaded from the hot press and stacked for stabilization following which the boards were trimmed to the required dimensions. The final product is shown in Fig. 5a and 5b

Materials and Test Methods

Lantana

Lantana stalks Lantana stalks are used in this study were collected from the IPIRTI campus, Bangalore, Karnataka, India. Lantana stalks were cut into suitable lengths of 2 to 4 feet and are dipped in water to remove mud and other adhering extraneous material. Knots and other irregularities such as crooked stalks were segregated and converted into 2 feet stalks. The outer epiderm layer of 1 mm is peeled before drying. Lantana stalks are sun-dried and converted into patterns of the irregular shape of around 2 feet in length by a cross-cutting saw as shown in Fig.4. The ideal moisture content of

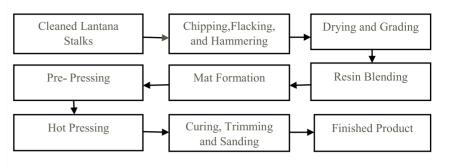


FIGURE 1. Manufacturing Process of PB



FIGURE 2. Three - layered PB

Lantana stalks for processing by chipper is 30 to 40%. However, moisture content up to 50% of Lantana may be suitable for processing in the chipper. Lantana stalks are fed into the chipper to produce chips by using shearing action and impact of the knife. Further, chips were fed into the hammer mill to produce particles. Particles are dried to moisture content up to 3 to 5%. After drying, the particles are sieved and segregated based on particle size as shown in Fig.4 (a). Face particles vary from 1.4 mm – 2.00 mm and coarse particles vary from 2.00 mm - 3.35 mm using ASTM E 11 Sieve No. 14 and Sieve No. 6. The proportion of face and core particles was 40% and 60% respectively for the board making.

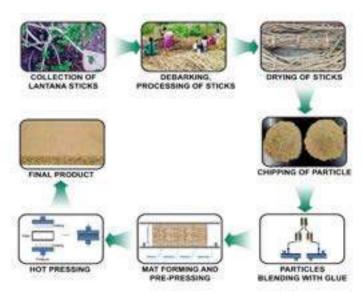


FIGURE 3. Manufacturing Process of PB at lab scale



FIGURE 4. Collected Lantana Stalks



FIGURE 5. (a) Lantana Particles; (b) Lantana Particle Board 2' × 4'

Binder

Conventional Urea Formaldehyde (UF) resin was used as a binder for developing particle boards from Lantana camara. Table 1 lists the properties of the adhesive used in this study.

Table 1. Properties of the adhesives used in the study

Particulars	Results
The flow time of resin [Seconds]	20 -22 seconds
Solid content [%]	50 %
Water tolerance	1:2 - 1:3
рН	7.5 -8.0

Testing of particle board

Particle board developed using urea formaldehyde

(UF) resin was assessed for its physical and mechanical performance in accordance with the Indian Standard, IS 2380:1977 - Methods of testing wood particle boards from lingo-cellulosic materials. Till constant masses were achieved, the test specimens were conditioned in an ambiance where the relative humidity was maintained at 65 ± 5 percent and a temperature of $27 \pm 2^{\circ}$ C. The specimens were tested as shown in figure 6 [13,14]. Tests such as moisture content, density, water absorption (2hrs and 24 hrs), swelling (thickness, width and length), static bending strength (modulus of rupture and modulus of elasticity), tensile strength – internal bond strength (perpendicular to the surface) and screw withdrawal strength were evaluated and compared.

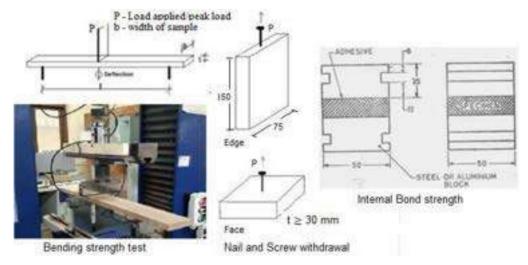


FIGURE 6. Testing of samples as per IS 2380

Results and Discussion

The density of the boards plays a key role in physical and mechanical performance during diverse applications. Three layered lantana particle board density ranged from 847 to 957 kg/m³, with a mean density of 889 kg/m³. The product achieved the target density and also confirms the IS 3087:2005 standard for general-use particle board. Care was taken to maintain the moisture content of particles (MC below 5 %) before mixing with resin as well as during pressing PB boards. If the moisture content of particles is low, the particles will absorb the resin from water which will inhibit the penetration/ spreading of resin around the particle, in contrast, the excess moisture content will result in squeezing out of resin, stream pocket formation, and blisters in the product. Hence, an optimal level of 5-12% has to be maintained for the end product, in this study we obtained 5.62 % as the mean value of moisture content of the product.

Ligno-cellulosic material has high sensitivity when it comes in contact with water, this is a serious impediment for durability and mechanical performance on different end applications. The presence of voids in the particleboards affects the absorption, swelling, and density. Therefore, the dimensional stability of particleboards was assessed through water absorption and swelling. Water absorption values for 2 hrs and 24 hrs range from 25.46 % to 32.48 % and 42.15 % to 48.47 % respectively. The IS 3087: 2005 specifies maximum water absorption for 2 hrs and 24 hrs as 40 % and 80 %respectively for Grade-2 general-purpose particleboard, the results obtained in this study met the requirements specified by IS 3087: 2005. Regarding swelling of particle boards, 10.8 % for 2 hr general swelling on the thickness and 7.33 % for 2 hr surface swelling were obtained in this study. IS 3087: 2005 specifies the maximum value in general swelling for thickness for 2 hrs and maximum value in surface swelling for 2 hrs as 12 % and 9 % respectively. The results attained in this study met the requirements specified by IS 3087: 2005. Lesser values of swelling and absorption obtained from lantana particle boards are due to the effective bonding with lantana particles along with 1 % of wax addition in the resin system yielding fewer voids [8-12].

The bending strength properties of the particleboards were strongly dependent on the density, Internal bonding, resin cure degree, adhesion on the interface, and cohesion between particles. In this study, the mean value of modulus of elasticity (MOE) and modulus of rupture (MOR) was $2896 \pm 154 \text{ N/mm}^2 \text{ of and } 16.40 \pm 1.36 \text{ N/mm}^2$ respectively. Also, the value of MOE and MOR ranged from 2740 N/mm² to 3060 N/mm² and 14.4 N/mm² to 18.54 N/mm² respectively. IS 3087: 2005 specifies the minimum average values modulus of rupture (MOR) and modulus of elasticity (MOE) as 11 N/mm² and 2000 N/mm² respectively for Grade-2 general-purpose particle board, the results obtained in this study met the requirements specified by IS 3087: 2005 for average and minimum individual values. The better results from lantana particle boards could be as a result of hard & tough particles of lantana, random distribution of particles, and better packing among the particles[2]. The results endorse that boards were performing better against bending, mechanical stability and can resist deformation under loading.

The internal bond strength of the particleboard depends on the geometry of particles (i.e., shape and size of particles), the resin content, pressure, curing temperature, the thickness of the board, and the density of the board. An increase in density of the board especially the core layer, enhance internal bond strength. Optimum packing of particles should be ensured among cores & fine layers, which can provide better internal bond strength. In our present study, the IB values ranged from 1.18 N/mm² - 1.58 N/mm² with a mean of 1.28 N/mm². This effect is due to the hard, tough nature and highly inhomogeneous nature of lantana particles. Also during the processing of particles, it was observed that particles were tough and durable when compared with bamboo and Meliadubia particles [2,9-12]. Screw withdrawal strength of lantana particle boards is 2961 N on the Face and 1335 N on the edge which indicates the good screw holding capacity for working in carpentry and other end-use applications. Both the mechanical and physical characteristics of lantana particleboards were comparable to those of particleboards made from wood and bamboo, recommending that lantana be used partially or entirely for particleboard production on an industrial scale. [8-12]. Overall from the table 2, both the mechanical and physical attributes of lantana particle boards meet the requirements of grade-2 particle boards as specified

in IS 3087: 2005 for particleboards of wood and other lingo-cellulosic materials (medium density) for general purposes.

Test results of PB tested as per IS 3087: 2005

Table 2 ·		
Tests	Prescribed Value	Results*
Moisture content, Average, %	5-15	5.62 ± 0.71
Density, kg/m³, Average,	500 -900	889 ± 14.82
Water absorption, %		
a) 2 hours of soaking	Max. 40	29.70 ± 3.78
b) 24 hours of soaking	Max. 80	45.23 ± 2.88
Swelling due to general absorption		
(after 2 hr soaking), %		
a) Thickness %	Max. 12	10.8 ± 0.71
b) Width%	Max. 0.5	0.34 ± 0.08
c) Length %	Max. 0.5	0.39 ± 0.08
Swelling due to surface absorption		
(after 2 hr soaking), %	Max. 9	7.33 ± 1.80
Modulus of rupture (MOR), N/mm ²		
a) Average	Min. 11	16.4 ± 1.36
b) Minimum Individual	Min. 10	14.4
Modulus of elasticity (MOE), N/mm ²		
a) Average	Min. 2000	2896 ± 154
b) Minimum Individual	Min. 1800	2740
Tensile strength perpendicular to the surface (Internal		
Bond strength, IB), N/mm ²		
Dry State	Min. 0.3	1.28 ± 0.13
Screw withdrawalstrength, N		
a) Face	Min. 1250	2961 ± 29.2
b) Edge	Min. 700	1335 ± 54.2

^{*} Average Values are reported

CONCLUSION

Utilization of lantana stalks after eradication from forest/ farmlands to produce particleboards seem to result in several benefits: circular economy, effective management of bio-resource, livelihood for communities, employment for local people, and industrial utilization. Three-layered lantana particleboards using urea-formaldehyde resin were developed and test results meet the technical requirements as prescribed in IS 3087:2005 Specification for particleboards of wood and other lingo-cellulosic materials (Density - Medium) for general-purpose applications. Additional research needs to be carried out in finding the porosity, particle density, and other process parameters (varying time, pressure, etc.,) for high-density composites.

References: contact author at vrramkumar@icfre.org

Improvement in Colour Uniformity and Dimensional Stability of Wood through Oil Heat-Treatment

Manoj Kumar DubeyWPP Division, ICFRE-Institute of Wood Science &

Technology, Bengaluru Email: dubeymk@icfre.org

INTRODUCTION

he colour of wood is very important for applications of aesthetic purposes. Colour preferences are cultural and depends on end use, location and change with time. Some markets such as Scandinavian and Japan prefer light coloured wood for certain end uses (Esteves et al. 2008; Wahl et al. 2002), whereas in South Asia people like dark coloured wood as it is considered to be a symbol of strength, stability and durability (Dubey 2001). Similarly, in Portugal also darker woods are preferred as the dark colour is associated with high quality tropical species (Esteves et al. 2008). In the latter markets mentioned above, species of pine, poplar and eucalypts are considered to be less attractive due to their light or pale colour. In addition, homogenous wood coloured is considered to be an advantage for uses with large surfaces such as flooring. This makes certain species like black locust (Robinia pseudoacacia) less preferable for such applications due to its non-homogenous colour caused by deposition of extractives (Tolvaj and Molnar 2006). Similarly, red alder wood (Alnus rubra Bong.) acquires a mottled orange colour after felling which is undesirable for decorative applications (Thompson et al. 2005).

Another important aspect of wood utilization is dimensional instability which is one of the major shortcomings of wood compared with synthetic materials coming from non-renewable resources. The instability issue is more important for fast grown plantation species like radiata pine in comparison to the indigenous, natural grown species due to higher proportion of juvenile wood in the plantation species. As a popular plantation species in Australasia, South America and South Africa, radiata pine has cream white colour, clear wood pattern and average mechanical properties, however, its stability and durability are regarded as inferior in comparison to other commercial species such as ponderosa pine (Maclaren, 2002).

Driven by mounting environmental and health concerns over the usage of specific chemicals in conventional wood treatments, the last decade witnessed remarkable academic and commercial interest in various wood modification technologies, with a notable focus on thermal wood modification (Zelinka et al 2022). Elevated temperature heat-

treatment of wood, particularly beyond 180°C within an inert environment, yields improvements in wood properties encompassing dimensional stability (Bessala, 2023; Duygu et al., 2008; Hill, 2006) and resistance against decay (Welzbacher and Rapp, 2002; Dubey et al., 2012). This decade has witnessed a substantial surge in the commercial pursuit of wood modification technologies, especially thermal processes (Bessala, 2023). Multiple European companies are presently engaged in the production of thermally modified wood, catering to a diverse array of above-ground applications. At present, thermally modified wood stands as a firmly established commercial commodity, finding applications in above-ground contact scenarios across Europe. Nevertheless, the commercial volume of thermally modified wood, approximately 500,000 m³ per year, remains dwarfed in comparison to preservative-treated wood (surpassing 21 million m³ annually in the United States and 6.5 million m³ in Europe alone; Zelinka, 2022).

While discoloration of wood during kiln drying is

generally undesirable, the uniform darkening of light coloured species during heat-treatment can be a tool to achieve a desired darker coloured wood giving them a tropical flavour. Furthermore, there are increasing environmental concerns within furniture industries over the use of solvent-borne wood finishes (Pandey 2005). The heat-treatment, unlike traditional wood finishing or painting, does not involve any emission of health hazardous volatile organic compounds such as toluene and xylene (Mitsui, 2004). Therefore, the heat-treatment could be an effective and environmentally friendly way to darken the wood colour and, at the same time, to improve wood stability (Gonza´ lez-Pena and Hale, 2009; Johansson and Morén, 2006).

However, studies also showed that the colour of heat-treated wood is not stable and fades with the time on exposure to UV radiations (Ahajji et al., 2009; Militz, 2002; Syrjänen and Kangas, 2000). In addition to discolouration, Mayes and Oksanen (2002) reported that surface checking occurred for the heattreated wood on exposing to UV radiations resulting in poor aesthetics. Several reports are available on study of colour after accelerated weathering of wood heat-treated in air, vacuum, nitrogen or steam. The exposure time to UV radiations in most of the previous studies was not more than 900 hours (Ahajji et al. 2009; Ayadi et al. 2003; Deka et al. 2008; Letourneau et al. 2005; Temiz et al. 2006). However, investigation on dimensional stability of heattreated wood after accelerated weathering is very limited (Feist and Sell 1987) and there has been no published work on the accelerated weathering of oil heat-treated wood.

This study examined colour changes and dimensional stability of wood, (1) after heat-treatment in linseed oil, and (2) after accelerated UV weathering of treated and untreated wood. Radiata pine wood was heat-treated in linseed oil over a range of temperatures and times. Treated and untreated specimens were exposed to an accelerating UV weathering environment for 2100hrs. Change in colour were studied by a spectrophotometer using CIE (L*a*b*) colour coordinate system and volumetric swelling percentages were determined after a water immersion test. The percentage weight changes were also measured to determine the net oil uptake by the

specimens after oil heat-treatment.

2. Experimental

2.1. Oil heat-treatment

Specimens were prepared from 3-4 m long boards of Pinus radiata obtained from a local sawmill. All boards were kiln-dried, flatsawn sapwood from which clear specimens with dimensions of 300 mm (long) \square 90 mm (wide) \square 20 mm (thick) were cut. These were oven-dried for 48 hours, cooled over silica gel in a dessicator and weighed before being placed in a conditioning chamber under 65% RH and 20°C for 2-3 weeks to attain equilibrium.

The conditioned specimens with equilibrium moisture content of 10-12 % were heated in an oil bath using commercial grade raw linseed oil as the heating medium at 160, 180 and 210°C for 1, 3 or 6 hrs. The oil was preheated to temperature before immersing the specimens and treating them for targeted time. The heated oil was recirculated throughout the treatment and the temperature was recorded at three points in the bath.

After treatment, heating was turn-off, the lid of the oil bath was removed and specimens were kept in the oil bath for 15 minutes, then the oil was drained. The specimens were oven-dried at 1030C for 48 hours, cooled over silica gel in a desiccator and weighed. Finally, the specimens were placed in a conditioning chamber at 65% RH and 20°C for 2-3 weeks by which time equilibrium was attained.

2.2. Accelerated weathering test

After the above oil heat-treatment, control and treated wood specimens were cut into two halves at the mid-thickness along the specimen length, thus each half was 90 x 10 x 300 mm. One of each pair of specimen was exposed for accelerated UV weathering and the other was kept unexposed in a dark room for comparison. The UV weathering tests followed the US standard ASTM G 154-2006. During the UV weathering tests, specimens were exposed to repetitive cycles of UV light and moisturization under controlled environmental condition in a weathering box. UVA 340 light was used and moisturisation was produced by spraying the specimens with water. Each test lasted 2100 hours consisting of 175 cycles, each of which included 8 hr UV 340 exposure at 60 + 3°C black panel temperature and 4 hr condensation at 50+ 3°C black panel temperature (ASTM-G154 2006). During the 4 hr condensation period water was sprayed for 15 seconds in every 2 minutes. All of the specimens were placed 100 mm beneath the light source.

2.3. Measurement of properties

2.3.1. Weight percentage change

The weight percentage change (WPC) was determined using Equation (1) which gives averaged relative difference in oven-dry weight of the wood specimens after the oil heat-treatment:

$$WPC = \left[\frac{(W_a - W_b)}{W_b}\right] \times 100\%$$

where W_b is the oven-dry weight of specimens before the treatment (g), and W_a is the oven-dry weight of specimens after the treatment (g).

2.3.2. Colour

Variation in wood colour after oil heat-treatment and accelerated UV weathering was examined by visual inspection and quantified through CIE (Commission internationale $de\ l'\acute{e}clairage$) L*a*b coordinates system which is a well established procedure for colour measurement (Ahajji et al. 2009; Esteves $et\ al.$ 2008; St-Onge $et\ al.$ 2005). This system measures total colour variation (Δ E) from changes in three spatial coordinates using the following equation (BS3900-a 1986; BS3900-b 1986):

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

where L* is the brightness coordinate or luminance ranging from black (0) to white (100); a* is the colour coordinate varying from redness (+) to greenness (-), and b* is colour coordinate varying for yellowness (+) to blueness (-).

Colour variation of wood specimens was recorded by a Minolta spectrophotometer of model cm2500d. The diameter of the colour measuring circle on the specimen surface was 10 mm with the corresponding area of 0.78 cm2. The light source was the Standard Illuminant D 65 which represents the average day light including UV region and 10° standard observer. For the colour measurement, the specimens were first stabilised at 65% RH and 202 C before the measurements. For each specimen, six

measurements were taken at different marked locations. The values of coordinates L*, a*, b* of the specimens before the oil heat-treatments, after the oil heat-treatment and after the accelerated UV weathering were used to determine the colour changes.

2.3.3 Dimensional stability

Dimensional stability was determined by measuring volumetric swelling percentage of the specimens which were immersed in a water bath at controlled temperature of at 20°C. During the tests, the water in the water bath was re-circulated continuously to maintain the required temperature (20°C). The specimens were weighed every 24 hours and, once the weight changes of the test specimens were less than 0.1%, it was assumed that the specimens had reached equilibrium which took two weeks. Then the dimensions in longitudinal, width (tangential) and thickness (radial) directions were measured to an accuracy of 0.01 mm. The volumetric swelling percentages were determined by Equation (3) given below.

$$S = \left[\frac{V_2 - V_1}{V_1}\right] \times 100\%$$

where V1 is the oven-dry volume of the specimens before water immersion (cm3) and V2 is the volume of the specimens after the water immersion (cm3)

3. Results

3.1 Weight percentage change

Figure 1 shows the effect of treatment temperature and time on the mean weight percentage change (WPC) of the treated specimens. The weight gain decreased with increasing treatment temperature and duration. For the treatment duration of 3 hours, the WPC at 160, 180 and 210°C were approximately 11%, 7.5% and 1%, respectively. At a given treatment temperature, the WPC values were maxima for the 1 hr treatments and minima for the 6 hr treatments. For the specimens treated at 210°C for 6 hrs, a net weight loss of 1.8 % was recorded.

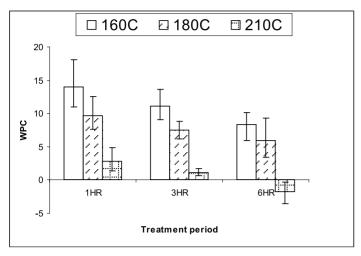


Fig.1. Effect of treatment temperature and duration on mean WPC of wood specimens (number of specimens, n=8).

3.2 Colour

The heat-treatment affected the wood colour as expected, with the wood turning darker. However, no surface cracking, warping or twisting was observed in treated wood. The surface appeared shiny near the rays which may be due to high uptake of oil by parenchyma cells compared to other wood cells. The colour change was identical on both flat surfaces (Table 1) with the difference between the two surfaces becoming reduced with increasing the treatment temperature.

When the wood was treated at 180 and 210°C, the total colour variation (ΔE^*) and brightness variation (ΔL^*) between the two surfaces were not more than 1.5 units although the wood surface became darker. The human eyes can only distinguish colour variation only if ΔL^* is more than 3 units (Phelps et al., 1994) or the value of ΔE^* is greater than 2 (Sundqvist, 2002).

Colour change was noted throughout the cross-section of the treated specimens and intensity of the colour being greater on the surfaces than in the core. Table 2 gives the values of CIE L* a* B* coordinates for the surface and core of treated wood. The average lightness values (L*) for the surface are 22-28% less than the corresponding values at the core. This difference in colour between the surface and the core decreased with increasing treatment temperature, i.e. for specimens treated at 210°C, the total colour difference between the surface and the core was 15 compared to the corresponding values of 15.9 and 16.7 for the specimens treated at 180°C and 160°C, respectively.

Table 1: CIELAB values at the two surfaces of treated and untreated specimens

		L*	a*	b*	ΔL^*	∆a*	Δb^*	ΔΕ
Untreated	Surface 1	64.3	12.2	31.8				
	Surface 2	68.1	11.5	33.8	3.8	-0.8	2.0	4.3
OHT 160°C	Surface 1	65.9	12.3	38.2				
	Surface 2	62.5	13.2	37.0	-3.3	0.9	-1.2	3.6
OHT 180°C	Surface 1	61.2	13.7	36.8				
	Surface 2	59.8	14.1	36.6	-1.4	0.4	-0.3	1.5
OHT 210°C	Surface 1	47.1	13.8	26.3				
	Surface 2	46.1	13.3	25.6	-0.9	-0.5	-0.7	1.2

Table 2: CIEI	AR values	at the surface	and core o	f treated	enecimene
Table 2: CIEL	AD values	at the Surface	: and core o	т пеатео	Specimens

						1		
		L*	a*	b*	ΔL^*	∆a*	Δb^*	ΔΕ
OHT 160°C	Surface	55	13.4	31.8				
	Core	70	7.3	27.5	15	-6.1	-4.2	16.7
OHT 180°C	Surface	01.2	12	33.3				
	Core	74.7	6.9	27	13.6	-5.1	-6.6	15.9
OHT 210°C	Surface	36.9	11.3	15.9				
	Core	47.3	11.8	26.7	10.4	0.6	10.8	15

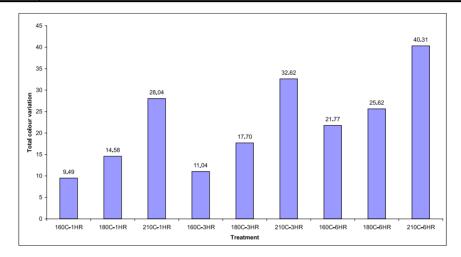


Fig. 2. Total colour variation ($\Delta E L^*a^*b^*$) for different temperatures and times

210°C the wood was, respectively, dark-yellow, reddish-brown and dark-chocolate. Figure 2 shows the total colour variation (ΔE^*) increased with treatment temperature and duration. For a given treatment time, the total colour variation was greater for specimens treated at 210°C than for specimens treated at treated at 180°C which, in turn, was greater than the specimens treated at 160°C. Similarly, specimens treated at a given temperature for six hour were darker than those

treated at the same temperature for one hour. However, the treatment temperature has more profound influence that the treatment time.

The colour of treated wood varied with the

treatment temperature, such that at 160, 180 and

Representative colour changes after the accelerated UV weathering test are shown in Figure 3 for both heat-treated and untreated samples. Figure 4(a) shows the results of total colour variation (Δ E*) during the accelerated UV weathering as a function of exposure time. The

untreated specimens displayed the greatest total colour variation throughout the exposure period. Among the treated wood, values of ΔE^* for specimens treated at 160°C were generally greater than those treated at 180 and 210°C. The ΔE^* values of specimens treated at 180°C and 210°C were very close.



Fig. 3. Comparison of colour in unexposed and exposed specimens of after 2100 hrs of accelerated UV weathering. The unexposed and exposed samples belong to the same piece cut from middle of thickness of the same specimen.

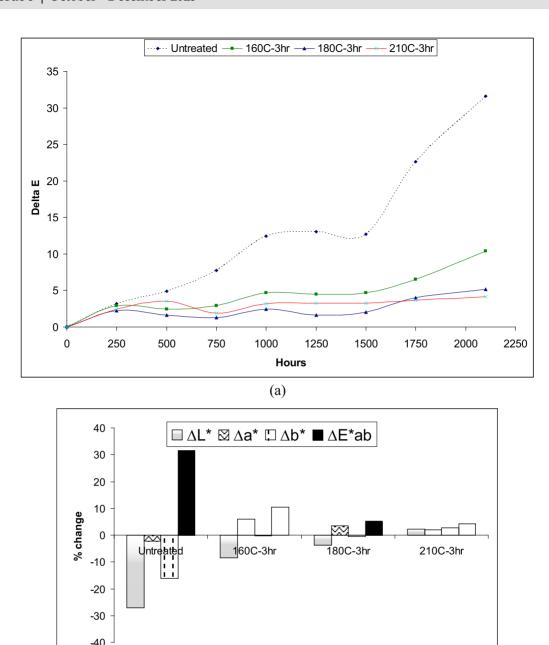


Fig. 4. Total colour variation for untreated and heat-treated wood with accelerated UV weathering tests (a) for different exposure times; and (b) changes in CIELAB coordinates after 2100 hrs.

(b)

Treatment

Figure 4(b) compares changes in chromatic coordinates (Δa^* , Δb^*) and the lightness coordinate (ΔL^*) after 2100 hrs of exposure to the accelerated UV weathering, The untreated wood clearly showed greater total colour variation ($\Delta E^* = 32$) than the treated wood ($\Delta E^* = 4$ -10). The darkness and blueness of the untreated wood increased significantly with weathering ($\Delta L^* = -27$ and $\Delta b^* = -16$), but after oil heat-treatment the colour of radiata pine wood was more stable and colour stability generally increased with treatment temperature. For

example, the total colour change (ΔE^*) was 10 for wood treated at 160°C compared to corresponding values of 5 for wood treated at 180°C and 4 treated at 210°C. All specimens were darker without any fading ($\Delta L^* = -4$ to -8) except those treated at 210°C which slightly faded ($\Delta L^* = 2$) during the weathering. Interestingly, specimens treated at 160°C became redder as evident by the increase in the value of the red/yellow chromatic coordinate ($\Delta a^* = 6$) in Figure 4 (b). In all of the observations of wood colour change through CIE ($L^*a^*b^*$) system,

lightness coordinate (L*) was the most affected and sensitive parameter during the wood oil heat-treatment and accelerated UV weathering.

3.3 Dimensional stability

Figure 5 shows weathered surfaces of untreated and oil heat-treated wood. The surfaces of treated wood were smooth without or with only minor checks on visual inspection. However, clearly visible cracks and checks appeared on the untreated specimens.

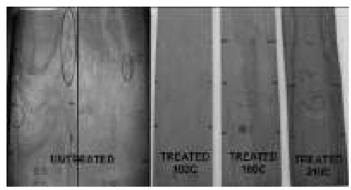


Fig. 5. Surfaces of treated and untreated wood after accelerated UV weathering. The cracks and checks appeared on untreated wood are marked.

Table 3 presents the results of volumetric swelling in water immersion tests. The results include the influences of oil heat-treatment (unexposed to weathering) and accelerated UV weathering (exposed to weathering). After weathering the volumetric swelling in untreated wood was 32-55 % more than that of the treated wood. With the treated wood the volumetric swelling decreased with increasing treatment temperature, which was true both for the unexposed and exposed to the UV weathering. However, with the UV weathering, the untreated wood gave higher increases in the volumetric swelling than the treated wood. For example, the volumetric swellings of the untreated wood increased from 13.8% to 17.5% with the UV exposure while the specimens treated at 210C increased from 7% to 7.9%. The difference in the volumetric swelling between exposed and unexposed specimens was about 21 % for untreated wood while for the treated wood; this difference was about 20%, 13% and 10% for the specimens treated at 160, 180 and 210°C, respectively (Fig. 6).

Table 3. Volumetric swelling of wood specimens in water immersion tests. The given values are average of six replicates and SD is standard deviation.

Treatment	Volumetric swelling (%)						
	Unexposed t	to weathering	Exposed to	weathering			
	Mean	SD	Mean	SD			
Untreated	13.9	1	17.5	0.9			
OHT at 160°C	9.5	0.4	11.9	1.2			
OHT at 180°C	9.5	0.7	11	0.7			
OHT at 210°C	7	0.6	7.9	1.1			

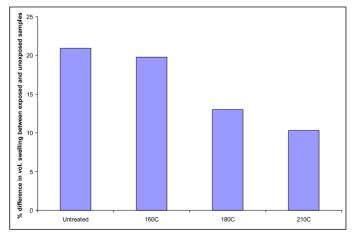


Fig. 6. Difference in volumetric swelling percentage (after two weeks of water immersion) between exposed and unexposed specimens to UV weathering.

4. Discussion

Both oven-dry weight percentage and wood colour changed after oil heat-treatment at 160, 180 and 210 C for 1, 3 or 6hrs. This may be the result of the combination of a number of factors: (1) degradation of chemical constituents of wood during heat-treatment (*Tjeerdsma* and *Militz* 2005; *Windeisen et al.* 2007); (2) removal or migration of extractives and other nutritive compounds such as low molecular weight sugars and amino acids (*Theander et al.* 1993); and (3) oil uptake by wood and the formation of an oil layer on the wood surface as a result of heat-treatment.

Some products formed after thermal degradation of hemicelluloses and lignin are coloured and lead to colour changes in wood (*Bekhta and Niemz* 2003). The removal or migration of extractives and other nutritive compounds also affects the weight and colour change in the treated wood (*Sundqvist* and *Morén*, 2002; *Theander et al.*, 1993). The extractives and other coloured products tend to migrate towards the surface (*Sundqvist* and *Morén*, 2002), resulting in darker surface than the core.

The greatest mean weight increase (14%) was found for wood treated at $160\Box C$ for 1 hour. This can be attributed to the oil uptake (Figure 1). However, the actual oil uptake by specimens was greater than the measured weight increase as account must be taken of indicative weight losses due to wood degradation and the removal of extractives at high temperatures. The weight gain tended to be less at higher temperature treatment as the wood degradation was more severe with increasing the treatment temperature which was confirmed by the observation that the treated wood actually lost about 2% its weight in heat-treatment at $210^{\circ}C$ for six hours.

The colour of two flat surfaces of the oil heat-treated specimens was found to be identical without resin patches. This contrasted with findings of Johansson and Morén (2006) who observed non-homogenous distribution of colour in thermally treated wood at 175-200°C for 1-10 hrs in steam. The similarity of the wood colour at the treated specimen surfaces is mainly due to uniform heat transfer with an oil medium compare to that in the air or other heating medium (*Sailer et al.*, 2000). Another possible explanation might be that during the heat-treatment in air or steam migration of extractives towards the

surface leads to the formation of unsightly resin spots in wood (*Mayes* and *Oksanen* 2002) whereas these extractives and other degraded products might have transferred in the heating oil.

No fading of treated wood was observed after weathering except for wood treated at 210°C. This was in line with the findings of (Deka et al. 2008) who noted improved colour stability of heat-treated wood (in vacuum at 210°C for 2 hours) during UV light irradiation for 400 hours. In contrast, (*Syrjänen* and Kangas 2000) reported that heat-treated wood starts fading if not protected from UV light and (Ahajji et al. 2009) observed mixed results depending upon the species on the artificial weathering of wood heat-treated at 210-250°C for one hour. Thus, oil heat-treated wood demonstrated better colour stability than untreated wood after the accelerated UV weathering test.

Similarly, after accelerated UV weathering, volumetric swelling of the treated wood increased less than that of the untreated wood which indicates treated wood is more stable. The oil heat-treated did not show noticeable checks with the UV weathering. This differs from the findings of Mayes and Oksanen (2002) who reported that surface checks after weathering were observed for wood heat-treated at 70-240°C for 3 hours in the steam environment.

The superior stability of colour and dimensional changes of the oil heat-treated wood than for untreated wood during artificial weathering might be due to an increase in lignin stability due to it undergoing condensation reactions during heattreatment (Ayadi et al. 2003; Deka et al. 2008). Another, possible reason for these improvements with the oil heat-treatment can be related to the lower moisture absorption by the oil heat-treated wood. Apart from the UV radiation, moisture is a critical factor in photo-induced degradation of wood as it facilitates light penetration into the wood surface (Ayadi et al. 2003). Due to the high linolenic acid (C18:3) content, the linseed oil has tendency to fast dry and harden on wood surface after the oil heat-treatment (Gunstone, 2002). This process forms a protective surface layer of oil on the surfaces of the treated specimens. Therefore, the oil layer acts as a barrier for the UV ray penetration and for water absorption, and thus improves the water repellency in the treated wood.

5. CONCLUSIONS

This study examined colour change and dimensional stability of oil heat-treated radiata pine wood before and after accelerated UV weathering.

The results of this study have shown that the oil heat-treated wood turned darker and was more dimensionally stable depending upon treatment time and temperature. The colour changes made the two flat surfaces of the specimens more identical without any colour patches observed although the surfaces were darker than the core. Colour homogeneity between flat surfaces and the difference between core and surface colour decreased with the increase in treatment temperature.

After accelerated UV weathering test, treated wood exhibits better colour stability and no colour fading was observed in the specimens treated for 3 hrs at 160 and 180°C temperature for 3hrs and those treated at 210°C slightly faded. In general, no surface checks were observed on the weathered surafaces of treated specimens. The percentage swelling after weathering in treated specimens was less than for untreated wood.

The results of this study indicates that oil heat-treatment can improve the wood stability and durability and this can be explained by the changes in wood chemical constituents and the formation of a protective oil layer on the wood surfaces. Based on the findings of this study, the oil heat-treatment of plantation wood could be an effective way to achieve uniform and stable dark colour for some markets and to improve stability and durability.

References

Contact author at dubeymk@icfre.org

Microbes Build Wood (Microbe Wood)

A Muthu Kumar

Forest Protection Division,

ICFRE - Institute of Wood Science and Technology, Bengaluru

Email: muthukumar@icfre.org

icroscopic interactions between plants, fungi, and bacteria impact the forests and we still do not know how much these microbes will help plants during stressful times. Researchers predict that global warming will increase the number of plant pathogens and these predictions may seem frightening that it would be more difficult to produce manufactured goods such as wood, and foods. However, researchers also focus on understanding the ways microbes can be used to enhance plant growth and development. For example, use of mycorrhizal fungi and bacteria can help plants obtain adequate nutrients, which can result in larger, stronger plants. In this line, intervention of microbes even has extended in the engineering field/construction sector. This article further narrates on some of such applications.

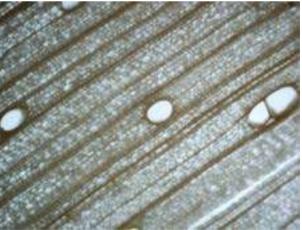
Mineral-producing microbes

Microbes capture carbon dioxide and synthesize sturdy materials, which in fact occur naturally in some trees. This process/mechanism of microbial synthesize is generally known as "bio mineralization". Using this mechanism, friendly bacteria or fungi is introduced into structural timber during the manufacturing process. The composite "living" wood will then pull carbon (add-on approach to carbon sequestration) out of the air to fill the wood's internal spaces with minerals, strengthening the wood. This wood is certainly believed to be the wood of generations to come. However, the challenge is these mineral-producing

microbes augment wood if they can be influenced to take up residence in the construction material, which depend on the speed of microbial growth and protective (against defense mechanism), nutrient-rich environment for the chosen microbes.

Similar to cross-laminated timber and other types of engineered wood, living wood also stands to increase demand for wood. Department of Biomedical Engineering and the Institute for Quantitative Health Science and Engineering at Michigan State, echoes the view of degradation and biomineralization as microbial activities that engineers can choose between.





A joint research project between Purdue University and Michigan State University. Picture No. 1: Lumber at the Michigan State lab awaits the bioink treatment (Image courtesy of Vittorio Mottini). Picture No. 2: Pores (to add minerals into the gaps inside wood) seen in a balsa wood cross section (Image courtesy of Tian Li, School of Mechanical Engineering, Purdue University)

Reinventing'wood'with programmable bacteria





Bacteria can be used to create sustainable biocomposites with a wide variety of properties from wood waste. Picture No. 3: Composite block made out of wood and microbe (as adhesives). Picture No. 4: Furniture made of the new material. This is in complete contrast to many materials previously made of wood, which involve processing petrochemical-based adhesives that are then considered hazardous waste. (Picture Source: Johannes Falkenstein, University of Freiburg)

Residual materials which accumulate in sawmills are one of the source as starting material for the inventive wooden composites/block material. Microbial bacteria like, Escherichia coli have been programmed to produce natural 'glue'. The bacteria are then allowed to intervene/grow along the wood, which then crosslinks the wood fibres, resulting in a new material. The mixture is subsequently dried in an oven or drying cabinet, which causes the material to harden and looks very similar to a press board. The microbes play a crucial role in the manufacturing of bio-composites, as the properties are highly

influenced by the programmable microorganisms in the material. The proteins produced by the bacteria serves as an adhesive for the composite, and is fully recyclable after use as the adhesives are easily degradable in nature. The researchers at the University of Freiburg launched a large-scale project called DELIVER (Data-driven Engineering of Sustainable Living Materials), brings together numerous researchers from the CIBSS and livMatS (Living, Adaptive and Energy-autonomous Materials Systems) clusters of excellence, for developing new sustainable wood-based materials.

Bacteria used tocreate "living" building materials



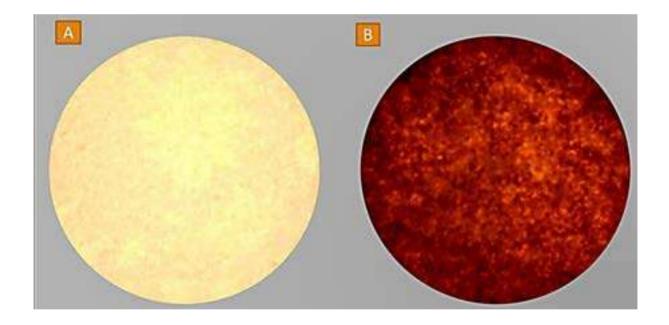


Bacterial species amalgamate different materials. Picture No. 5: Pieces of the brick, being "grown" in molds. Picture No. 6: The bricks are made from sand, hydrogel, and Synechococcus cyanobacteria (Picture Source: CU Boulder College of Engineering and Applied Science)

There are self-healing concretes that can repair on its own, at the times of cracks. Similarly, microbes have been used to create building blocks/materials. Team from the University of Colorado at Boulder used the mixture of sand, a gelatine-based hydrogel and Synechococcus cyanobacteria to produce building blocks. The bacteria present in the mixture absorb carbon dioxide gas from the surrounding environment and produce calcium carbonate in the process. The latter mineralize the hydrogel into a sort of mortar, thus binding the sand particles together to form solid bricks. Wood could also be used as one of the ingredient in the mix, for production of solid bricks.

Bacteria are biomaterials

Biological materials include chemically unrelated products that are synthesized by microorganisms or part of them under different environmental conditions. An important class of biomaterials is bioplastics, which can be defined as polyesters that are widely distributed in nature and accumulate intracellularly in microbes in the form of storage granules. Their physico-chemical properties resemble that of petrochemical (synthetic) plastics. Polyhydroxyalkanoates (PHA) belong to the polyoxoesters class of naturally occurring biopolymers. PHAs are completely biodegradable synthesized by bacteria as intracellular storage materials under conditions of stress and act as carbon and energy reserve. Forest Protection Division, Institute of Wood Science and Technology, Malleshwaram, Bengaluru, performed research on producing PHAs from wood waste. Bacteria from industrial effluents were used for the study purpose. A large proportion of isolated bacteria, especially Pseudomonas lignicola produced PHA as energy reserve material.



Detection of PHA(B) produced by Pseudomonas lignicola under light microscope. (A) Bacterial culture under light back ground (B) PHA bacteria under fluorescence back ground

References:

Contact author at muthukumar@icfre.org

Wooden Core Plugs from Paper Mill Waste

Mamatha, B, S

PPPT Division, ICFRE-Institute of Wood Science & Technology, Bengaluru IPIRTI campus, Bangalore-560022

Email: sheshagirimb@icfre.org

Paper mills generate waste such as wood dust. Storing or disposing this solid waste is a major issue and an environmental threat. This problem would be overcome by converting this waste into value added product wooden core plugs. Paper mills use the wooden core plugs to plug the cores on which paper is rolled up; thus, the core plugs follow the roll out to the customer. Thus the core plug made using paper mill waste can be reused by the same paper industry hence circular economy is achieved. In this study Institute has designed 3-inch diameter die to develop core plug using bagasse pith and wood dust generated from the paper industry. Crushing strength of the developed core plugs were higher than requirement of 10KN.

INTRODUCTION:

In paper mills, textile mills and the like, rolls of paper and/or fabric are generally wound on tubular cores which are usually made of a paper material such as cardboard or paperboard. These cores are relatively strong except that they are vulnerable at their ends where they can be easily damaged. During shipment and handling, the rolls of paper and other materials are repeatedly picked up and moved, and if the core ends become deformed in any way, the entire roll of paper or other material becomes unusable because it cannot be properly chucked. Thus, in order to protect such cores, core plugs are commonly inserted into the ends of the core.

A solid core plug formed from wood, plastic, or a composite woody material of substantially cylindrical shape with a body portion and an integral tapered forward portion. The outer face of the body portion has a diameter substantially equal to the inside diameter of the core for which the core plug is intended, and the inner face of the forward portion is of slightly less diameter than the outer face to facilitate entry of the core plug into the ends of a core. The core plug includes an opening or groove spaced from the center thereof and near its remote outer edge which extends the full length thereof for facilitating removal of the core plug from a core.

Wood core plugs can provide solid core protection and added holding power from the natural textured wood for even the largest and heaviest rolls. Highquality moulded chip wood, plywood and particleboard core plugs offer the strength needed to stand up under the weight of large rolls, unlike under specified plugs that might break and leave cores damaged. Plugs are available in a large range of sizes and hole diameters. Core plugs are presently available in a number of sizes to accommodate different sized cores. Such core plugs are formed from a variety of different types of materials, and include various distinctive features to increase their strength and utility. However, in general, the majority of such core plugs are formed from wood or molded wood material and are mostly imported.

M/s Tamil Nadu Newsprint and Papers Limited (TNPL), an enterprise promoted by Government of Tamil Nadu has production capacity of 400,000 TPA of writing and printing papers and is Asia's largest bagasse based paper mill consumes one million tons of bagasse every year. M/s TNPL uses both bagasse and wood species such as eucalyptus, casuarina and acacia for their paper making unit. During the chipping process of wood, wood dust is generated. Generation of wood dust is around 40 to 45MT / Day. Presently both wood dust and bagasse pith are being used as agro fuel in power boilers for steam and power generation. However, with bagasse pith, erosion and corrosion is being faced in boiler tubes and other mechanical equipment's while firing the pith due to considerable moisture and acidic nature of pith. Hence storing / disposing the solid waste is a major issue and an environmental threat also faced

by the firm. This problem would be overcome by converting this waste into wooden core plugs, and thus the core plug can be reused by the same paper industry hence circular economy.

MATERIAL AND METHOD:

Wood particles and bagasse pith received from M/s TNPL was used for the study. The core plugs size of 3-inch diameter mould were designed, fabricated and installed at institute. Die was designed for the size of 450 mm x 450 mm, where 9 core plugs of 3-inch diameter can be made at each trial. Fig-1 displays the core plugs developed using wood dust and bagasse pith. Phenol formaldehyde adhesive was used for making wooden core plugs as it requires high compression strength. Water

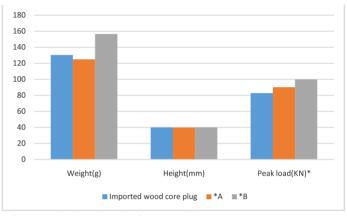


Fig-1. Wooden core plugs developed at Institute using wood dust and bagasse pith

absorption and crushing strength of core plugs were tested (Fig-2) and the properties were compared with the imported samples. (Fig-3)



Fig--2: Crushing strength test



*Institute developed product from wood dust waste

Fig--3: Properties of developed core plug against imported core plug

CONCLUSION:

wooden core plugs can be successfully made with $100\,\%$ wood dust and or with the combination with $30\,\%$ bagasse pith., a value-added product. The compression strength of core plug samples was above the requirement of $10\,\mathrm{KN}$ and higher than the imported core plugs strength. The product developed by using the generated waste by paper mills are not only reducing impact on raw materials. but also eliminating landfill waste – a commitment to sustainability that helps the industry to reach their corporate environmental goals.

References: Contact author at sheshagirimb@icfre.org

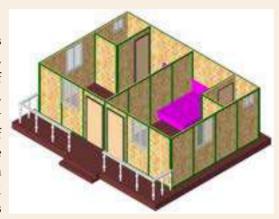
Use of Bamboo Composites as Components of Disaster Resistant Houses

Amitava Sil

ICFRE - Indian Wood Science and Technology, Field Station, Kolkata Email : silchief@gmail.com

INTRODUCTION

India is always has been vulnerable to natural disasters due to its geo-climatic conditions. As per Indian codes, more than 59% of landmass is prone to seismic hazards of moderate to high intensity. Other than human casualties, one of the most visible and striking effects of any earthquake is the aftershock which arises out of devastation and destruction. As the occurrence of the above natural calamities is unpredictable, there is an ardent need to design and construct the buildings and structures to reduce the damages, thus saving precious human lives. Thus for the development of disaster



resilient construction technique in pre-fabricated mode for disaster prone areas, the selection of the construction materials has a great influence on prefabrication technique. From the comparison of various construction materials conventionally used, bamboo-based composites are one kind of prefabrication materials with great utilization potential. This article discusses in brief the properties and application of bamboo composite in building and construction which can be constructed quite quickly for immediate and long term rehabilitation for post disaster relief. Moreover these types of demand driven projects on pre-fabricated houses with the involvement of stake holders can go a long way in developing innovative bamboo composites disaster resistant houses meeting quality and wider acceptance by the users thus contributing to the growth of knowledge based business in India.

In recent days, prefabrication, as a modern construction technique, where the whole fabrication is done in a factory unit in some other place and the assembly is done in the site by trained manpower which is attracting a ever-increasing attentions worldwide. In some developed countries, such as China, Japan, Canada, USA, and some European countries, prefabrication is becoming more and more popular. Prefabrication is an efficient construction technique and it dramatically reduces the need for on-site work, lessens time and cost during the construction process, and helps to enhance the construction quality and lower the harm to environment. This technique has a wide range of application during the construction process, from the simple prefabricated houses to advanced fullyfinished modular buildings.

The region of Kashmir, the western and central Himalayas, North and Middle Bihar, the North-East Indian region and the Rann of Kutch falls within seismic zone-V which makes it vulnerable to earthquakes.

After a natural disaster like earthquake, the houses get destroyed and therefore the inhabitants becomes homeless. Now it is responsibility of disaster mitigation team to re-build houses for them as quick as possible so that people can take shelter with their families.

Many researchers stated that panel composites made from bamboo have great potential due to their better strength, dimensional stability and other characteristics compared to panels made from several fast growing plantation timbers. Bamboo composite panels can be used for making wall or roof components for prefabricated based housing system. Bamboo composite panels which has already been brought to the market but mostly as a furniture item or for floor finishes with a proven research found that it can also be used for structural walls in housing construction, which is a first step to approach this material into more structural applications. The mechanical properties of bamboo composites are in the same level as those ones of wood-based materials like plywood. Bamboo composite wall panels might be able to withstand high seismic loads with second floor or on top of them but the gap accommodation effect must be avoided in order to comply with serviceability.

Effective housing construction and reconstruction is very much required to avoid destruction and to restore affected communities' dignity, society, economy and cultural identity. It is also believed that for developing countries like India, it is very difficult to meet the balance of demand of low cost mass housing and construction technologies that will offer an overall good package of affordable, sustainable and seismic safe housing. This article also considers the potential contribution of bamboo composites for mass housing in the earthquake prone zones.

The comparison of mainstream construction materials

During the past years in construction sector, different kinds of materials have been used viz. clay brick, steel, concrete, wood/wood composite, and chemical synthetic materials (foam and plastic), etc. All of these materials have exhibited their own advantages in some certain stage in the history of construction. In the view to cater natural disaster which is unpredictable in many cases, people are paying more and more attention to policies of construction after the defects of many materials which have emerged and some kinds of materials also have been replaced.

(i) Conventional Materials

Conventional materials such as steel, concrete and clay brick used for construction of houses are not suitable for modules in fabrication construction since their self weight is so high and also the raw materials of steel, concrete, and clay brick are un-renewable





resources, and the process of production of these construction materials will consume large amount of energy resources, such as fossil fuel and electricity. At the same time, it also generates lots of CO2 which intensify the influence of green-house effect and cause the formation of acid rain.

(ii) Wood Based Panels

Wood based panels with good mechanical properties are relatively good materials that can be used in the construction sector. In developed countries, the proportion of wood based panels used as construction materials is between 45% and 65%, especially for wall panels. However, this proportion in India is relatively low, only about 20% which is still far away from developed countries. Nowadays, the trend of construction industry is the standardization of design, prefabricated manufacturing and assembly construction. And the assembly construction can reveal advantage of wood based panels remarkably. It is a important direction for

researchers worldwide to further enlarge the sources of raw materials, enhance the production, and develop various construction panels with multifunction, which will make the plant based panels a promising construction materials in the future.

Potential of bamboo based panels as construction materials

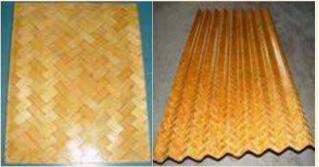
In recent scenario, the cost of wood is increasing so much and declining availability of wood resources has made people to use some other alternative material. Similar to wood, bamboo is one of the material which is strong, lightweight, renewable, and with a strong adaptability to the environment. The growth rate of bamboo far exceeds that of most natural growing trees and its yield is high. Its properties are superior to most of the juvenile fast growing wood. When compared to wood, bamboo has a higher strength/ weight ratio, better abrasive resistance, and a lower swelling rate after absorbing moisture. So, in the view of making eco-friendly material, bamboo is the best choice where on a large scale bamboo-based composite panels with different structures can be designed and functions according to the properties of bamboo.

The reinforcing slivers are the primary load carriers of composite materials with the matrix component transferring the load from sliver to slivers. Selection of optimal thickness of the materials is dependent on the property requirements of the finished part. It has been observed that a weight saving of over 20% is attainable in most of the structures. These are due to lower density of composites and in addition to their inherent properties provide performance benefits over other conventional materials.

The use of composite structures has become an increasingly important factor in engineering design. Composites of high performance fibres and a range of polymeric matrices have enabled many engineering achievements. Composite products meet stringent requirements such as satisfactory performance even at high temperature, pressure, corrosive environment or high stress.

Aadvantages of bamboo composite material over conventional material

- (a) Improved shear modulus and impact strength properties
- (b) Composites exhibit excellent corrosion resistant and fire retardancy
- (c) Composites have higher fatigue endurance limit.
- (d) Composite materials are 30-40% lighter than aluminum structures designed to the same functional requirements
- (e) Composites are less noisy while in operation and provide lower vibration transmission than metals
- (f) Composites are more versatile than metals and can be tailored to meet performance needs and complex design requirements.
- (g) Composites enjoy reduced life cycle cost compared to metals.
- (h) Improved appearance with smooth surface and readily incorporable integral decorative melamine are other characteristics of composites.



Development of bamboo composites

The cost effective technologies have been developed for the manufacture of Bamboo mat boards (BMB), Bamboo Mat Corrugated Sheets (BMCS) and Bamboo Mat Ridge Caps required for construction disaster resistant houses. All the bamboo mat composites possesses excellent physical and mechanical properties. They are water resistant, resistant to decay, termite/insects, environment friendly, energy efficient and will certainly revolutionize house construction activity, particularly in disaster prone areas through disaster resistant houses. All the bamboo composites were tested for their physical and mechanical properties of BMB and BMCS are given Tab 1 & Tab 2

Table 1: Physical and Mechanical Properties of Bamboo Mat Board

Sl No.	Property	Results of Bamboo Mat Board	
	1 ,	6 mm	16 mm
1.	Density, Kg/m ³	0.678	0.694
2	Tensile Strength, N/mm ²	9.907	19.86
3	Compressive Strength, N/mm ²	19.60	31.34
4.	Modulus of rupture, N/mm ²	57.98	44.93
5.	Modulus of Elasticity, N/mm ²	3077.0	2336.0
6.	Screw Withdrawal strength, N	2230.0	3120.0
7.	Nail Withdrawal strength, N	830.0	1770.0
8.	Panel Shear Strength, N/mm ²	14.33	12.21
9.	Modulus of Rigidity, N/mm ²	5050.0	4402.0
10.	Flammability, minutes	46.0	8.0
11.	Flame penetration, minutes	6.0	13.0
12.	Rate of burning, minutes	6.0	19.0

Table 2: Physical and Mechanical Properties of Bamboo Mat Corrugate Sheets

Sl No.	Tests	Results
1.	Load Bearing capacity N/ mm ²	
	(a) Dry State	4.26
	(b) Wet State (after 24 hr immersion in water)	3.31
2.	Falling hard body impact, visual observation	No sign of rupture,
		crack or tear
3.	Impermeability, visual observation	No droplets of water
4.	Water Absorption %	12.59
5.	Flame penetration, minutes	13.67
6.	Rate of burning, minutes	24.78
7.	Surface spread of flame, mm ²	3045
8.	Thermal Conductivity, k.cal/m0C	0.19
9.	Thermal resistance (1/k)	5.19

Properties of bamboo based panels

The materials used in the construction should be of sufficient mechanical resistance, to be able to bear the stresses resulting from self-weight, structural loads, snow, wind, and walking-on if they are used as roofs. Bamboo based panels can bear more load and have higher value of Modulus of rupture than wood and common concrete. Hence, it is more suitable to be used as construction material than wood and concrete. In addition, with the increase of world population and the ever-increasing requirement of space utilization efficiency, the effective utilization of construction space is becoming one of the major concerns of developers. Bamboo composite based pre fabricated disaster resistant houses and it can also enhance the resistance of lateral load, which can decrease the possibility of collapse of the buildings in many natural disasters, like seismic activity or high winds due to hurricanes or tornadoes.

Table 3: Comparison of Properties among some Construction Materials

Types of Materials		Properties			
		MoR (MPa)	MoE (MPa)		
Bamboo Based	mboo Based 6mm		3077.0		
Panels 16mm		45.0	2336.0		
Common Timber		13-17	10000		
Concrete (M25 Grade)		11.9	28000		

Acoustic Properties viz. sound absorption coefficient and transmission loss were evaluated using B & K acoustic pulse tester and are given in Table 4 and Fig 1 and Table 5.and Fig 2 respectively.

Table 4: Sound Absorption Co-efficient

	Absorption of	coefficient
Frequency	BM B (6mm thick)	Sandwich Wall Panels
125	0.02	0.005
250	0.04	0.0175
500	0.04	0.0163
1000	0.03	0.029
1500	0.06	0.036

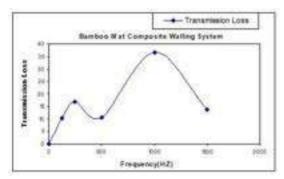


Fig 1: Sound Absorption Co-efficient

Table 5: Sound Transmission Loss

Frequency	Transmi	ssion Loss
1 3	BMB (6mm thick)	Sandwich Sample
125	14.74	10.39
250	6.4	16.86
500	23.8	10.62
1000	3.02	36.76
1500	25.33	13.7

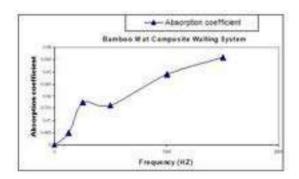


Fig 2: Sound Transmission Loss

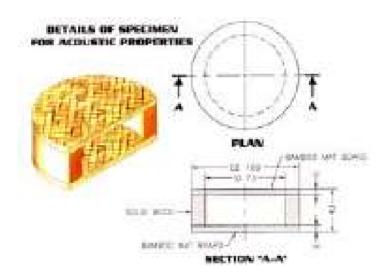
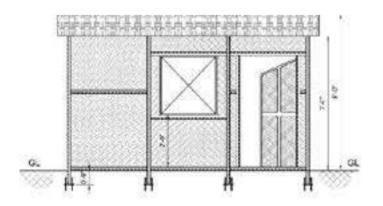
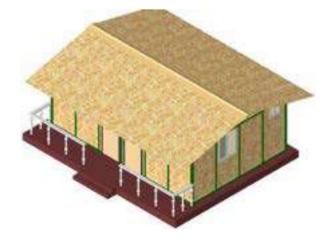


Fig 3: Bamboo Composite Sandwiched sample for acoustic properties

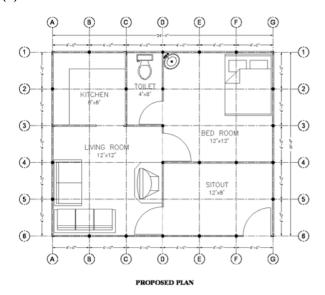
Pre-fabricated disaster resistant modular house

(a) Single Walled Modular House:





(b) Double Walled Modular House:





The material of construction to be used in disaster prone areas should be such that they absorb and reduce seismic energy and are able to withstand wind forces. Conventional heavy and brittle building materials such as stones, bricks, mortar, granite etc. do not absorb shock waves but they amplify them, causing more destruction. In contrast, lightweight bamboo mat boards fixed on steel frames with bolts and nuts are more flexible allowing lateral movements of the structures. They also absorb and reduce seismic energy.

CONCLUSION:

From the point of view of wood substitution, natural fiber composites would enjoy wider acceptance. India enjoys a niche for the manufactures of natural fiber composites (viz. bamboo), as the country is endowed with large varieties of natural fiber. Thus the usage of natural fiber based composites from bamboo in post disaster management of rehabilitation and re-building would become cost competitive to other building materials. International building and construction technology trends establish the fact that the composites occupy a prominent position as the building material dislodging many conventional houses. Bamboo composites are having attractive proposition considering the embedded energy (energy required to manufacture) especially aluminum, steel and other metals. Other properties such as impact resistance, corrosion resistance, thermal resistance and acoustic insulation all contribute favorably to bamboo composites claiming its position as an ideal building material.

Note: This article is taken from research paper published in "Amitava Sil, International Journal of Civil Engineering (IJCE), ISSN: 2278-9987, Vol. 5, Issue 3, pp 11-18 (https://www.iaset.us/archives?jname=11_2&year=2016&submit=Search&page=1)

References: Contact author at silchief@gmail.com

Electrical Resistance Tomograph (ERT): A Novel Technology in Forestry

Baragur Neelappa Divakara

ICFRE - Institute of Wood Science and Technology, 18th cross, Malleshwaram, Bangalore – 03. Email: bndsira@gmail.com

INTRODUCTION:

lectrical Resistance Tomograph (ERT) is an advanced nondestructive customized tree specific novel German-technology tool, developed to monitor and estimate the tree growth development by looking into the inner structure with greater resolution and precision to help in estimating the heartwood, sapwood and decay in the standing trees. This standout technique is used as a detection key to estimate the content of heartwood, level of decay and sapwood-heartwood demarcation in all kinds of trees. Electric Resistance Tomograph (ERT) is one among the advanced non-destructive methods aiding tree inspection developed in the field of geophysics. This method was applied on trees during 1998 by Just and Jacobs for the inspection of resistance offered by the wood in trees. The tomograms generated by ERT gives more precision in measuring the sapwood, heartwood, stress and decay in the living trees.

Electric Resistance Tomograph (ERT) is a significant and advanced nondestructive tool that aids for tree inspection by giving the greater resolution with accurate precision in estimating the heartwood, sapwood, stress and decay in the standing trunks. The effective use of prevailing tree resources and refining the superiority of wood products by improvising are regarded to be the imperative concerns faced by the forestry administration and lumber industries. The increasing demand to trees for its commercial venture and monitoring the health of trees inside/outside the forest or in the plantations, due to on-going climatic changes by the biotic and abiotic stresses appeals for new future-oriented, sustainable and non-destructive estimations and tracking techniques. Hence innovative approaches are needed for advance, effectively pre-symptomatic, detection of declined tree vitality, functional stress responses and wood content. Various surveys conducted and efforts have been made to spot decay, and health condition within the trunk of living trees in a triflingly invasive manner. Example models consist of resistographs, penetrometers, increment coring, and electrical sensors (e.g. Shigometer). All these models require the boring of one to several holes to the trunk for pulling in of a coring bit, probe or sensor, which makes a wound which potentially compromise the perpetual lifespan of the tree's health. To add up the discussion, the capability of getting a precise estimation of decay along wood content from a complete cross-section has been challenging, the results obtained conclude that for the most part being an unsatisfactory level of resolution. In past few years tomographic equipment has rapidly emerged as the least invasive method for evaluating internal decay with modified algorithms. Added to this, electrical resistivity tomograph pronounces a hopeful and novel approach, as it allows comprehensive internal understandings of the standing trees in-vivo and in-situ, based on Electrical Resistivity (ER) levels and ER crosssectional distribution patterns of stem. For the first time in the world, ERT, methodology was applied on economically important tropical tree species like Pterocarpus santalinus L.f. and Santalum album L. to decipher the accuracy of the instrument and effective mode of representing the resistivity distribution along the trunk to differentiate the sapwood and heartwood content within the standing tree at various heights. The instrument revealed the efficiency of the tomogram and indicated the potential application of ERT for quantifying sapwood-heartwood content. In this study, a concerted effort was taken to investigate the efficiency of ERT technique to precisely detect the physiological and practical aspects such as incipient stages of decay to screen the extent of rot occurred in standing trees, demarcating and quantifying the boundaries of wood assembly, stem water content of various different tree species in an experimental setting, in the light of more updated knowledge.

Tomograms generated from the instrument are based on electrical resistance and electrical conductance. The water content, ion concentration, cell structure and other properties of the wood influences the electrical impulses passed through them. The combined effect of resistance and conductivity offered by the heartwood and sapwood of the tree creates different zones that are depicted through colour ranges from blue (low resistance) to brown (high resistance). In general, the moisture content in the sapwood is because of the recently formed living cells and these cells are comparatively softer. In contrast the inner part of the tree consists of the older dead cells and they become compact and harder due to the pressure excreted from the outer newly forming cells. Therefore, the steep decline in moisture content is seen from outer sapwood to inner most heartwood region of the tree. The distinguished zones captured through this tomographic method helps in estimating the sapwood and heartwood width.

Fig. 1. 2-D and 3-D tree images captured using ERT In general the ERT is fixed on a testing tree at certain/standard level (chest height-1.37 mts) above ground level and internal tree image is captured by nailing tree with minimum of eight sensor. Capturing of image by ERT is very effective if there is clear demarcation in moisture difference between heartwood and sapwood.

The image captured in the device is uploaded to the PiCUS Tree Tronic software installed PC/Laptop and viewed for further details. The 2-D cross sectional image generated for each section, with the color differentiation from blue (low resistance) to brown (high resistance) to analyze the internal structural details of the tree (Fig. 1). The 3-D image displayed can give an effective way of understanding the variation of sapwood and heartwood growth along the stem of the tree. In

Advantages of ERT technology

- It is a non-destructive technology.
- The equipment is portable as it is light weight and compact.
- Process of operating and collection of data is very quick.
- The tomograms obtained is simple and easy to understand.
- The images captured from the device can generate a high resolution 3-D structure.
- ERT can be operated irrespective of PC in the field.
- Main control unit saves 120 scanned files on non-volatile memory.
- GPS and Bluetooth are inbuilt.
- The device works regardless of ambient condition (noise of vehicles, wind etc.).
- It can be used at ground level and on trees with buttress roots.
- Testing done by ERT does not harm/damages trees.

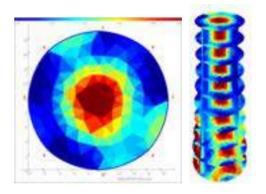


Fig. 1. 2-D and 3-D tree images captured using ERT

addition, resistivity distribution along the trunk was also reflected. Based on the color, the image can be data analyzed and the tomogram can be used to distinguish its hollowness, decay, formation of the heartwood-sapwood, if present then the content of the heartwood and its demarcation. A single image can give the overall details of the tested trunk at its measuring level with high resolution. Analysis of ERT image can be done very effectively if there is clear demarcation represented by colors based on resistivity pattern.

Brown	is indicates higher resistance because of low moisture content
Red	This indicates high resistance because of low moisture content (comparitively less than the brown color)
Yellow	This indicates medium resistance because of slight moisture content
Light blue	This indicates normal sapwood with low resistance because of moderate water content
Blue	This indicates sapwood with low resistance because of high water content

Decay in trees

When a tree is injured, it is hard to heal and thereby it seals off the wounded area but when the injury is too big the tree ends up decaying internally and hugely restricting its water and nutrients flow. Besides, other models which are able to detect



Fruiting body on Tree trunk, Rotting of tree trunk, 2-D and 3-D image of decaying tree

the decay in trees to some degree, are not suitable as it is limited, whereas ERT gives the 3-D image of the decayed standing tree and can even be tested at earlier stages and allows to treat the tree thereafter. The testing of hazardous avenue trees in urban areas helps to get rid of them to avoid the loss of humans and their properties. To study the decay in trees, casuarina trees with fruiting body and rotting was

selected at IWST campus. The tree was tested at the affected area and the tomogram was generated. The 2-D image showed an anomaly with respect to resistivity patterns, the formation of decay was depicted with blue color in the middle portion of the tree with decreasing resistance and high voltage. The 3-D image displayed below show the decay growth along the stem of the tree.

CONCLUSIONS

Application of ERT technology in tropical trees is tried for the first time in Institute of Wood Science and Technology and proven as novel idea in estimation of heartwood/sapwood, assessment of decay and examination of hollowness in standing trees. As of now, majority of the work using ERT is concentrated on economically highly valued timber species like sandalwood and red sanders. Both the species has expressed more than 90% efficiency in estimation of heartwood using ERT. However, work is on progress to assess the efficiency of ERT on other tree species in upcoming days.

References: contact author at bndsira@gmail.com

Incorporating Jute Felt: - A Novel Approach to Enhance Plywood Manufacturing

S.C.Sahoo

ICFRE-Institute of Wood Science and Technology, Field Station, Kolkata E-mail:-sahoosc@icfre.org

This research explored using jute felt, a strong natural fiber as a replacement for traditional wood veneer in making plywood. The jute fiber, strengthened with phenolic resin, was used to create plywood sheets of various thicknesses (4 mm to 18 mm). In this study, more than 60% of the materials used to make plywood were natural fibers, offering a sustainable alternative to wood. The Plywood were tested different properties like how rough the surface was, moisture content, density, water absorption, strength under compression and tension, and how well it held screws and nails. The results showed that the plywood met the requirements for different grades according to industry standards. Additionally, it showed increased resistance to pests and weathering. We also tested the glued core made with jute felt for three months before making plywood, and it held up well under different conditions. This study suggests that using jute instead of wood in plywood can be a great solution, especially as forests are getting smaller. Using renewable resources in plywood production can help when there's a shortage of wood and reduce costs associated with importing veneer.

INTRODUCTION:

Plywood is universally essential in the construction field, gaining increasing usage in building and furniture industries, in conjunction with particle board and block board. Its applications span across the construction of cabinets, decorative wall paneling, and partition walls. The development of more efficient synthetic resin adhesives has enabled the production of weather-resistant plywood, widely applied in exterior uses like building construction and concrete shuttering. Moreover, plywood is extensively utilized in constructing railway carriages, bus bodies, and ships.

Jute is an attractive natural fibre for use as reinforcement in composite because of its low cost, renewable nature and much lower energy requirement for processing. Since jute is a lignocellulosic material, it has an ample scope to make composite material in wood based panel industry for making composites with wood. There is an increased recognition of the demand for materials due to a growing global population and rising affluence. North America possesses abundant reserves of agricultural fiber residues. Bagasse, jute, straws, and sisal are identified as having significant

potential for ongoing development.

Typically, lignocellulosic non-wood fibers serve as a relatively cost-effective alternative to higher-quality wood fibers. Composites produced with bagasse present a viable option for areas abundant in this material, particularly due to the substantial production of sugarcane and other agronomic crops. The main objective of this research work is to utilize jute felt as as substitute to core veneer for manufacturing plywood to narrow the gap between demand and supply of wood and to increase productivity and thus saving large quantity of wood used in panel industry by getting rid of dependency and to reduce depletion of forest.

Materials And Method:

This research is based on manufacture of ply board and evaluation of mechanical properties of plywood by using different veneer species like Dipterocarpus(Gurjan), Eucalyptus and non oven jute felt (compact type of thickness ,12mm and 16 mm and of GSM 1850(appx.)) has been taken for core replacement of plywood, Phenolic resin which is one of the first synthetic resin exploited commercially has been used for impregnation of jute felt because of

its high heat resistance, excellent fire resistance, low smoke emission and compatibility with jute fiber. Non -Oven Jute Felt having thickness 12mm and16mm GSM - 1850 -1900 (Jute felt collected from local market in roll form having different width up to 2mt. was taken.

(I) Impregnation of Resin:

- i) Non-Oven jute felt having 16mm thickness and 1800 GSM (appx.) was cut to the size 1' x1'.
- ii) The weighed jute felt was soaked in different dilution PF liquid resin for 2 to 3 minutes.
- iii) It was squeezed to remove excess resin by passing it through squeezer.
- iv) The resin consumption on liquid and dry basis has been calculated as per formula given below.

Resin consumption (Liquid) = B - A/C

Resin consumption (Liquid) = (B - A) X solid content /C*100

A=Wt. jute felt

B = Jute Felt + Resin

C = Total resin dilution

- v) The squeezed impregnated jute felt was kept overnight in open air for drying and subsequently sundried for 3 to 4 hrs to bring down the moisture content up to 8 to 10 %.
- vi) Core Veneer and Face Veneer was cut according to the Size of jute felt and dried up to M/C6 to 8%.
- vii) Individual jute felt has compressed in cold press at pressure 12 Kg./cm² for 10 minutes to minimize the thickness.
- viii) Assembling of jute felt, core veneer and Face veneer was carried as per opposite grain direction of wood veneer as per required.
- ix) Plywood having various thicknesses was prepared by hot press as per following hot press condition.

Temp = 140-145 0C, Pressure = 14 Kg/cm². Time Period = As per thickness.

x) The ply board were then trimmed& evaluated for Physico mechanical properties, The results are given in table no -5,6,7 respectively.

(II) Process Flow Chart

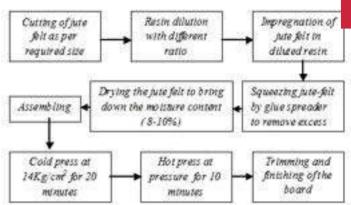


Fig – 1. A processing flow chart of plywood manufactured by using jute felt as core veneer

(III) Physico-mechanical Testing

The physico-mechanical properties of ply board incorporating non-oven jute felt were assessed in accordance with relevant Indian standards. Tests for Static Bending Strength, Compressive Strength, and Tensile Strength were carried out using a Digital Universal Testing Machine equipped with a 10-ton capacity and two interchangeable load cells of 1 kN and 10 kN capacity. Test parameters for Moisture Content, Density, Water Absorption, and Cyclic Test were determined utilizing a Digimatic digital caliper, Hot air oven, and Boiling Water Bath. All sample specimens underwent pre-conditioning at 27 ±2°C and 65±5% RH in a conditioning chamber.

(iv) Retention of resin media by Jute Felt

Jute felt underwent impregnation with different resin dilutions for a duration of two minutes, and the resin retention in 12 mm and 16 mm jute felt was assessed for various dilutions.

(iv) Percentage compression of impregnated Jute Felt

Jute fiber felt taken after impregnation in media and drying was studied for its compression at different specific pressures and at fixed temperature of about 145C. Compression data is shown in

(v) Tensile strength of compressed impregnated Jute Felt

Jute fiber felt was studied for finding its tensile strength after impregnation and subsequent compression in hot press at different specific pressures and at fixed temperature of 145C.

(vi) Accelerated stability study of Resin-jute reinforced composite veneer

The jute felt with resin (1:1.5 dilution) reinforced composite veneer was stored at a temperature of 27±20°C and RH-65% for 7, 15, 30, 45, and 60 days. Subsequently, plywood was manufactured utilizing it as a self-adhesive core veneer. The bond quality and mechanical properties were then examined.

Result and Discussion

Ply board of varying thicknesses was produced by employing jute felt as the core veneer, substituting the traditional wooden glue core. The resin absorption capacity of the jute felt and comparison between the thickness of jute felt and tensile strength is provided graphically in figure.. [Refer to Fig 4 and Fig 5].

The investigation suggests that PF Resinimpregnated Non-oven jute felt, acting as a natural fiber, can effectively substitute the wooden glue core veneer in plywood manufacturing up to 60%, providing an alternative to wood to address the gap between demand and supply for wood veneer. Table-2 illustrates that the 16 mm non-woven jute felt, with approximately 1800 GSM, exhibits a resin intake capacity of 68 gms (approx.) in a 1:1.5 (resin to water dilution) ratio on a solid basis, while the resin intake capacity for a 6 mm thickness of jute felt is 27 gm per sq ft. This implies that, even with three 6 mm jute felts, a single 16 mm jute felt can be utilized to minimize resin consumption and, consequently, reduce the density of the plywood board. From Table-4 and Table-4, it is evident that the impregnated jute felt was compressed to 75-80% of its thickness at a specific pressure of (13-16) kg/cm2, a factor considered in the calculation for manufacturing various thicknesses of plywood.





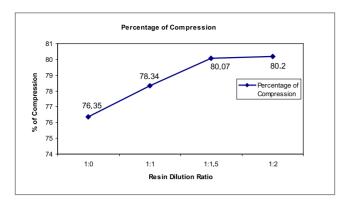
Fig. 2 : Plywood with Gurjan as face veneer

Fig. 3: Jute Felt of 12mm thick and GSM 1650 used as a glu core

Tensile strength results for the impregnated jute felt under different pressures show promising outcomes. The mechanical properties of the jute felt composite plywood board, presented [Refer to Fig 6 and Fig 7]., reveal superior Static Bending Strength and Tensile Strength compared to IS-303 BWR grade plywood prepared from 100% wood veneer. Plywood manufactured by compressing impregnated jute felt with a dilution ratio of 1:2.0 exhibited notably low mechanical properties, while an improvement was observed when a combination of jute felt was utilized as a core veneer for maximum replacement. Although no significant change was noted in glue shear strength, water absorption, and density remained consistent compared to commercial plywood.

Different resin dilutions with water were explored to improve economic viability. Adhesion and mechanical properties underwent changes based on the resin dilution, following the sequence: 1:0 > 1:1 > 1:1.5 > 1:2. The optimal levels of static bending strength and tensile strength fell within the range of $60-80 \,\mathrm{N/mm^2}$ and $40-42 \,\mathrm{N/mm^2}$, respectively [Refer to Fig 6 and Fig 7].

The accelerated study of the jute resin composite veneer reveals that there is no significant alteration in the bond quality and mechanical properties of the plyboard, even after storing the veneer for up to 30 days. In other words, the self-adhesiveness property remains unchanged. Plyboard manufactured using the self-adhesive core veneer underwent testing according to IS:303-2003.



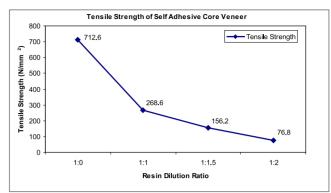
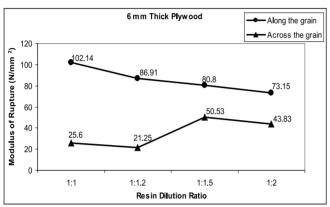


Fig 4: Percentage of Compression and Tensile Strength of Self Adhesive Core Veneer at different resin dilution



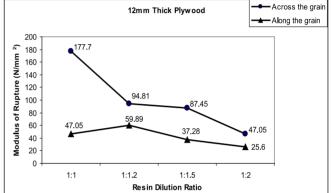
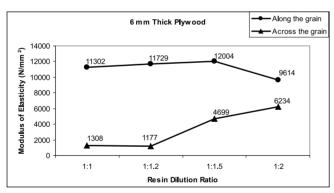


Fig 5: Variation of Modulus of Rupture at various resin dilution for 6 mm and 12mm thick plywood



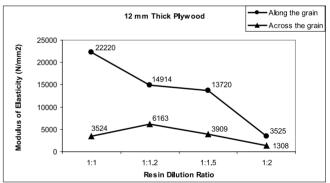
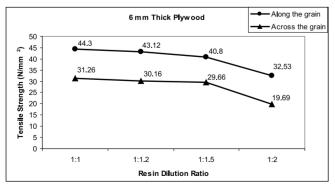


Fig 6: Variation of Modulus of Elasticity at various resin dilution for 6 mm and 12 mm thick plywood



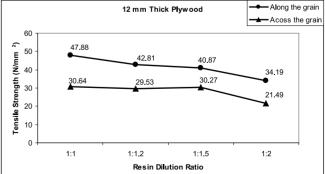


Fig. 7 Variation of Tensile Strength at various resin dilution for 6 mm and 12 mm thick plywood

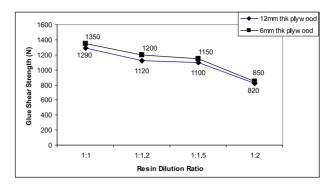


Fig. 8: Variation of Glue Shear Strength at various resin dilution for 6 mm and 12mm thk plywood

CONCLUSION

The adoption of jute felt composites as a substitute for wood in plywood manufacturing represents an optimal solution, especially in light of depleting forest resources. By incorporating renewable materials, the plywood industry can overcome challenges associated with the scarcity of wood veneers, ultimately reducing the overall cost of imported wood materials. This research demonstrates a shift towards utilizing over 60% natural fiber in plywood fabrication, providing a viable alternative to wood and leveraging indigenous technology to bridge the gap between supply and demand. This innovative approach not only contributes to sustainable resource management but also results in significant foreign exchange savings for the country. While the cost of these wood-substituted non-oven jute felt composites may be comparable or slightly higher than traditional plywood, their superior mechanical properties make them a worthwhile investment. This advancement in technology maximizes wood replacement, addressing the demand-supply gap more effectively. From an economic perspective, the study advocates for a resin-to-water dilution ratio of 1:1.5 to achieve improved bond quality and mechanical properties. This recommendation further underscores the viability of this alternative material in plywood manufacturing. In conclusion, the utilization of non-oven jute felt composites presents a sustainable and economically viable option for the industry, promoting both environmental responsibility and enhanced product performance.

References: Contact to author sahoosc@icfre.org

Protocol for the Protection and Preservation of Wooden Artefact in Outdoor Conditions

Narasimhamurthy, Pradeep Kushwaha, Rashmi Ramesh Shanbhag, Mamatha B. S., Mahesh K. Forest Protection Division, ICFRE-Institute of Wood Science and Technology, Malleshwaram, Bengaluru

Email: murthyn@icfre.org

wo Major garden areas in the Bengaluru has the wooden artefacts installed in the exterior condition to serve the garden aesthetics and visitors satisfaction. Over the period, theartefacts that were kept in open will slowly degrade as the weathering and other biotic conditions such as presence of wood boring insects, wood fungi and termite attack. These degraded artefacts can be restored using proper preservative treatments and make them free from degradation and deterioration by following standard maintenance protocols.

Physical Observation of the artefacts to understand the stage of decay, degradation and type of degrading agents is the first step in the restoration and preservation of artefacts kept in exterior condition. In the exterior condition, weathering will exert the major pressure on artefacts by the formation of cracks, slits and wood discoloration. Many cases due to rain and watering the gardens water fall on the artefacts will show the sign of dampening and loss of structural stability as mosses are growing on the surface of the artefacts. Foliage's of trees that are dropped on artefacts will also contribute for decay by serving feeding and breeding ground of foliage feeding insects, ants and spiders. Dropping of bird, nest of squirrels and their excreta were also pose challenges in the wooden artefacts maintenance in public gardens. Where as in terms of biotic decay, fungal damage- characterized by the presence of fungal bodies; Insect attack such as termite as presence of termite galleries mostly in artefact which are in contact with ground; Long horn beetle attack characterised by the presence of pin head shaped holes, carpenter bee attack characterised by the presence of large oval or circular entry holes serves as identifying characters of wooden artefacts degradation.

Even at this stage if garden authorities are willing

to save and safeguard the artefacts considering its economic and historic value solutions can be provided by the institute. Some basic steps involved in the process are cleaning of wooden artefacts, first hand insecticide treatments to drive away the insect residing in them; filling of gaps and infested holes; preservative treatment botanical or chemical based on the public proximity to the artefacts. Post preservative treatment also following protective measures need to be followed to avoid from the natural biodegradation of the wooden artefacts in the exterior condition.

Regular Maintenance and Inspections: -

- Look at subfloor spaces for signs of rot and termite's infestation in the flooring and framing. Presence of soil galleries are proof of termite attack
- 2. In roof spaces, look for evidence of leaks that may promote fungal growth.
- 3. Any sign of cracks or distortion of wooden structures should be taken care by treating with an exterior-grade wood coating both oil- and water-based formulations.
- 4. Check for external paint finishes for splitting or cracking that may lead to water penetration in wood beneath.
- 5. Treatment should be given in the month of March and September with water-repellent preservatives in addition with aTilt (Propiconzole 25%EC) fungicide may also be used.
- 6. Coating of exterior grade polyurethane chemical coat may be given once in a year after sand or pressure-wash the surface as per the conditions of the articles.
- 7. Clarence of leaf litter is required to avoid further

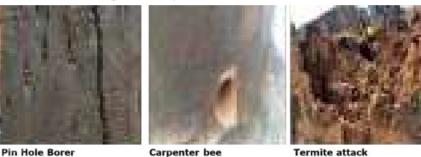
- water logging on the surface of the wooden artefacts. Otherwise which leads fungal growth on the surface.
- 8. When wood is exposed to the sunlight the ultraviolet rays can damage the wood fibers over time, causing the surface to turn gray. The most

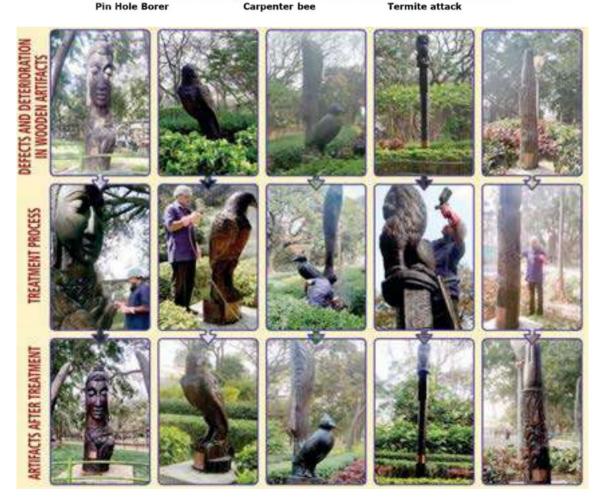
direct way to renew the appearance is to sand or pressure-wash the surface.

With following above mentioned precautions Wooden artefacts also needed regular maintenance and inspect every six months may be helps to take care for longer duration in outdoor conditions.



Arifacts showing cracks, splits and discoloration





References: Contact author at murthyn@icfre.org

Harmonization of Medium Density Fiber Board Standards: A need for Product Application Mamatha B.S., Sujatha D., and M.P. Singh

ICFRE-Institute of Wood Science and Technology,
Malleshwaram, Bengaluru.
Email: sheshagirimb@icfre.org

bstract: Setting up a quality standard for any products plays a critical role to demand for prelam MDF as flooring mate

understand its end-use applications. If standards are not set, the products would not be functional as expected and the quality would be inconsistent and inferior. To better meet the user needs, product manufactured should be designed according to the desired application. Thus any product that are marketed requires harmonization to have better acceptance, and comparable. Medium Density Fiber board (MDF) is the most demandable product in the market having wider application and the CAGR is increasing rapidly every year. IS 12406: Medium density fiber board for general purpose specification is the standard requirement for Medium density fiber board. To comply this standard with international standards a comparison with requirements of Indian Standard (IS), International standard (ISO) and) American national standard Institute (ANSI) for assessing conformity of MDF with respective requirements as per different standards to access the product's suitability and quality is carried out. It is understood that the international standard clearly specifies that based on exposure and service conditions of the products the physical and mechanical properties requirement needs to be complied which gives an opportunity for the customer to decide the right choice of the product for individual product applications like for furniture, sheathing materials, window frames, door linings, flooring, load bearing application etc., Keeping this in view it is very apt to have similar systems implemented by bureau of Indian standard for the MDF manufactured in India.

Introduction: MDF is one of the most rapidly growing composite panel products in the market. The improved standard of living parallel to economic boost in the country has been an increasing local demand for furniture and fitting in addition to use of panel products in housing and structural purposes. There is wide range acceptance of MDF as a

substitute for clear timber and panel. In fact, the demand for prelam MDF as flooring material and furniture component has gone up so much so that the domestic need is to be compensated by import of MDF and the quantity of import is increasing. Market study has indicated that consumption of MDF in India is increasing by 5-10% annually, which means that more and more usable products made of MDF is being used by the consumers in India. manufacturing machines are not made indigenously. However, all the MDF manufacturing units are set up in India by M/s. Diffenbacher and M/s Siemplekamp with ultra-modern machinery. Most are based on continuous presses and incorporate the latest P.L.C control networking and are capable of producing the full range of panel from 2.5mm to 45mm thickness at 300 plus m3 / day.

MDF is a wood based composite formed by breaking down of soft wood and hardwood into wood fibres in a defibrator, combining it with wax & resin and forming panels by applying high temperature and pressure in a hot press. typically has a density of 500-900 kg/m3. Smooth and solid edges of MDF can be easily machined and finished. The uniform surface of MDF provides an excellent substrate for painting or applying decorative overlays. The homogeneous edge of MDF allows intricate and precise machining resulting very smooth finish at every corners. It is an excellent substitute for solid wood in many interior and exterior applications such as furniture, cabinets, moulding window and door frames, wall panelling, siding and roof sheathing.

The physical and mechanical properties of MDF are mainly dependent upon the properties of the raw materials (wood, binders, and other additives) and manufacturing parameters (Akbulutet al. 2004). When wood is considered as a raw material, wood fiber properties such as fiber structure & strength, anatomical & chemical properties of fibre and fiber composition (percentages of whole and broken fibers

and fines) are considered to be basic characteristics influencing fibreboard properties due to occupancy of the fibres percentage in larger portion on the total panel volume (Suchsland and Woodson 1991, Maloney 1977, Groom et al. 1999).

In India Medium Density Fiberboard (MDF) panels are manufactured with various physical properties and dimensions, providing the opportunity to design the end product with the specific MDF needed. MDF is manufactured using thermoset adhesives, such as urea-formaldehyde (UF), melamine-urea-formaldehyde (MUF) and to a lesser extent, phenol-formaldehyde (PF) and polymeric methylene-diphenyl-diisocyanate (pMDI). Additives are introduced during manufacturing to impart additional characteristics. The surface is flat, smooth, uniform, dense, free of knots and grain patterns. In India, eucalyptus is the wood species mainly used for the manufacture of MDF with 80% of the panels made are of Urea formaldehyde resin and other resins urea melamine formaldehyde or melamine formaldehyde resins are used depending on the product quality required.

Medium density fiber board is also a hygroscopic material as similar to solid wood and other wood based panels. Linear expansion or contraction in occurring response to increased or decreased moisture content of the materials is one of the most important properties of medium density fiber board. The climatic conditions irrespective of indoor or outdoor usage of MDF products results in the moisture pickup or loss from the panel that leads to high internal stresses offered by fastening such as screws in construction. These stresses may be large enough to cause buckled panels, screw pull out with disintegration of panels. Whilst fibre-boards might appear to be similar to plywood in principle, although the wood components are reoriented. Hygroscopicity, expansion and contraction values of medium density fibre board thus become important design parameters.

The Indian standard on MDF (12406, 2003), describes the requirements of medium density fibre boards for general purposes having density in the range of 600-900 kg/m3. The detailed requirements for physical and mechanical properties for various thickness of boards are recommended for use. Indian standard describes the requirements such as density,

moisture content, water absorption (2h and 24h), Thickness swelling, Modulus of elasticity, modulus of rupture, Internal bond strength (Tensile strength perpendicular to surface in dry, cyclic, accelerated water resistance) and Screw withdrawal strength. Two grades are being categorized as grade-1 and grade-2.MDF is recommended for use in interior dry locations There is a description of Class I refers to Environment with relative humidity less than or equal to 70 percent so that equilibrium moisture content of MDF will not be more than I5 percent. Whereas, Hazard Class 2 refers to Environment with relative humidity more than 70 percent so that equilibrium moisture content (EMC) of MDF will not be more than 20 percent. The Grade - boards can be used in both classes and Grade-2 to be conditionally in Hazard Class-1.

Being a product made of wood fiber, it attracts more water and the product is susceptible to wood destroying organism. One of the study at IPIRTI on hygroscopicity of MDF at various conditions on the behavior of the product at extreme conditions has indicated that the equilibrium moisture content for MDF is lower and less hygroscopic than some of Indian timbers. MDF made of UF resin is unsuitable for use in permanent wet or damp conditions. However, it is suitable for installation in buildings where the moisture content does not exceed 16% for any length of time and does not exceed 20% at any time.MDF is hygroscopic and 1% change in moisture content will decrease the width by 0.42mmper metre. The movement values for the medium density fibre boards exposed between 96%RH and 35% RH were found to be 0.28% in width, 4% in thickness. A 400mm MDF of 15mm thickness will swell by about 1.1mm in width and 0.6mm in thickness in moving from 96% to 35% relative humidity which is equivalent to about 8% increase in moisture content.

Considering the hygroscopicity behaviour of the MDF, the categorization indicated in Indian standards for only two grades may not be appropriate for various end use applications. Hence as adopted in other countries, the MDF categorized in Indian standards shall also be amended based on the end use applications for which the properties require revision in the existing standards. Based on the grades of ANSI, it is observed that the products are

categorized with special reference to the values achieved with respect to each property.

About 8 to 12 percent weight of UF or MUF resin solids per dry weight of wood is applied. In addition, a petroleum-based wax is added (typically 0.5% to 1.5%) to improve resistance to liquid water. Both thermoset adhesives and waxes add some degree of water resistance by reducing the surface energy of the wood fibers. However, the quantity of adhesive and wax is not sufficient to coat the fibers and form a barrier to water absorption into the cell walls. MDF is produced by a hot-pressing process by compressing the panel in thickness direction. Compression is a combined effect of bending randomly oriented fibers and the collapse of cell lumens. Heat and accompanying steam (from evaporated moisture in wood) in the hot-press soften the cell walls to facilitate compression and ultimately allows for adequate fiber-to-fiber contact for adhesive bonding. Fibers are oriented largely perpendicular to the thickness direction and consequently provide significant resistance to swelling in the length and width directions (linear expansion). However, thickness swelling is most significant when water disrupts bonding and fibers recover their shape.

IS 12406- 2003 version recommended thickness swelling(TS) (general) to be 7% for the density of samples 500-900 kg/m³. New amended IS 12406 –

2021 has categorised the TS and internal bond strength after 24h of soaking depending on thickness of panel (Table-2) International standard (ANSI) categorises the water resistance test in terms of general length and width to maximum of 2mm and thickness swelling test to a maximum of 1.5mm after 24h of soaking in cold water for the density of the panels between 500-1000 kg/m³. Resistance to water, in particular, dimensional stability in the presence of changing moisture environment is a desirable characteristic for medium-density fiberboard (MDF). Water resistance is important property for interior products, such as furniture, cabinet and engineered flooring applications. MDF may encounter water by pooling water or high humidity. Liquid water then wets the surface and may be absorbed into MDF by capillary force between fibers or within cell lumens if the panel quality is inferior. At a much slower rate, diffusion of bound water and vapor occurs through the cell walls of fibers. Water vapor enters MDF through interfiber voids or cell lumens, or water vapor may condense and diffuse into cell walls. When water enters the cell wall, swelling occurs as water molecules are attracted to the hydroxyl groups in cellulose, hemicelluloses, and lignin. Secondary molecular bond forces cause the cell wall polymers to separate and accommodate the water molecules. Thus, influencing swelling.

Table 1: Thickness swelling properties after 24 h of MDF in ANSI

	ANSI Less than 15 mm	More than 15 mm	After accelerated aging test Any thickness
Mr110	1.5mm	10%	TS<50% of specified in column1
MR 120	1.5mm	10%	- -
MR130	1.5mm	10%	TS<50% of specified in column1 with atleast attaining 50% of the MOR
MR140	1.5mm	10%	-
MR150	1.5mm	10%	TS<50% of specified in column1 with atleast attaining 50% of the MOR
Mr160	1.5mm	10%	TS<50% of specified in column1 with atleast attaining 50% of the MOR

Table 2: Thickness swelling (TS) and internal bond strength (IB) properties of MDF in BIS 12460-2021(new amended)

	Grade-1 TS (%)	Grade-2 IB (N/mm²)	Cyclic or accelerated water resistance test	TS (%)	IB (N/mm²)
Less than 2.5 mm	35	0.7	0.35/0.2	45	0.65
2.5-4.0 mm	30	0.7	0.35/0.2	35	0.65
4-6.0 mm	18	0.7	0.35/0.2	30	0.65
6.0-9.0	12	0.7	0.3/0.15	17	0.65
9-12.0 mm	10	0.65	0.25/0.15	15	0.6
12.0-19.0 mm	08	0.65	0.2/0.12	12	0.55
19.0-30	7	0.6	0.15/0.12	10	0.55
30-45.0mm	7	0.55	0.1	08	0.5
Greater than 45	6	0.5	0.1	06	0.5

In the United States, moisture-resistant MDF intended for interior applications is graded and marked as "MR" by product standard ANSI A208.2 (American National Standards Institute [ANSI] 2016), where the "MR" designation requires at least a 50 percent improvement of thickness swell compared to other grades covered in the product standard. In general, moisture-resistant MDF intended for interior applications is specified in product standard ANSI 208.2 to have a maximum 5.5 percent thickness swell after 24-hour submersion in water. MDF intended for exterior cladding or trim is tested for weather ability using cyclic exposure to water submersion, drying, and freezing and 24-hour water submersion (ANSI 2020b). Grade 2 MDF by ANSI 208.7 requires maximum residual thickness swell of 10 percent after cyclic wetting, drying, and freezing and a maximum thickness swell of 5 percent after 24-hour water soak.

Another important factor for MDF is the bond quality assessment is by tensile strength testing, where the sample is pulled apart and the amount of load taken decides the quality of bond. The strength characteristics also helps to evaluate the type of failure occurred whether it is cohesive failure, surface failure, adhesive failure or mixture of both which inturn confirms the interfdacial adhesion between wood & fibre and processing parameters followed for the manufacture of MDF depending on the value of strength taken. Screw holding strength test is most important as it suggests the workability of MDF for carpenters. Thus the ANSI categorises tensile strength and screw holding strength tests into six categories as shown in Table-3 Many of the MDF industries had urged the revision of the indian standard is 12406 -2003 in par with ISO 16895:2016(E) which categorises the product quality requirement w.r.t thickness and density of the products. The mechanical properties of the MDF as per ISO 16895:2016(E) is classified with respective to range of density and again correlating the property requirement based on the thickness of the product. This standard has 3 categories of MDF VIZ., Ultra low density fibrer board (UDF), Low-density fibreboard (LDF), Medium density fibreboard (MDF) and High-density fibreboard (HDF). The classifications are described below. UDF has a nominal density less than 550 kg/m³ .LDF has a nominal density in the range 550 kg/m³ to 650 kg/m³, MDF has a nominal density in the range 650 kg/m³ to 800 kg/m³

and is classified according to Table 3. HDF has a nominal density greater than $800 \, \text{kg/m}^3$.

The revision of standard has been done and the properties requirements as per the thickness has been implemented in IS 12406-2021. However, it has been observed that the present revision of standards has indicated the property requirements based on the two grades of MDF, while the international standards either ANSI 208.2 or ISO 16895:2016(E) described the value requirements based on the end use applications or the properties requirements are listed and the table is annexed for the specific applications. The properties enlisted in the existing standard of MDF cannot be compared with ISO 16895:2016(E) with respect to the test requirement for varying thickness. It has been observed that the value requirement specified for Medium density fiber board for general purpose tropical humid conditions grade 2 the thickness swelling is highest for 2.5 mm thickness which is about 20% after 24 hrs soaking in water and for thickness greater than 45mm the thickness swelling prescribed is 5% while for Grade 1 it is 15% for lowest thickness and 4% for highest thickness. The thickness swelling indicated is decreasing with increase in thickness Whereas in existing BIS standards for grade 2 MDF, the thickness swelling prescribed limit for lowest thickness is 45% and 6% for the highest thickness that is greater than 45mm. The grade1 limitation is 35% for least thickness and 6% for thickness greater than 45mm. The thickness swelling % or internal bond strength indicated shall not serve the purpose of high humid conditions. It has been noticed that the internal bond strength referred for grade 1 is very low especially the value indicated for IB after cyclic test. The value prescribed of the MDF may not find its suitability for load bearing, building structures and also for high humid conditions that are very essential for grade 1. The international standard clearly specifies that based on exposure and service conditions of the products the physical and mechanical properties requirement needs to be complied. This gives an opportunity for the customer to decide the right choice of the product for individual product applications like for furniture, sheathing materials, window frames, door linings, flooring, load bearing application etc.,. Keeping this in view it very apt to have similar systems implemented by bureau of Indian standard for the MDF manufactured in India.

References: Contact author at sheshagirimb@icfre.org

Revision of IS 303 standards (Comparison between old and new IS 303 standards)

In this revision, the following major modifications have been incorporated:

- a) Material clause for timber has been modified,
- b) BWP (Boiling Water Proof) Grades has been added,
- c) The clause on extender has been modified,
- d) Dimension related clause has been modified,
- e) Mycological test is now applicable for all grades,
- f) Modulus of rupture (MOR) and Modulus of elasticity (MOE) requirements have been modified,
- g) Requirements for formaldehyde content for oven dry board and the steady-state formaldehyde emission (optional) have been added,
- h) Marking clause has been modified, and
- I) All amendments to the previous version have been incorporated.

Old 303	New 303
1 SCOPE1.1 This standard covers the requirements of different grades and types of plywood used for general purposes.	1 SCOPE This standard covers the requirements of plywood used for general purposes.
4 GRADES 4.1 Plywood for general purposes shall be of the following two grades, depending upon the bond strength developed by the adhesive used for bonding the veneers: a) Boiling water resistant or BWR Grade, and b) Moisture resistant or MR Grade	4 GRADES AND CLASS 4.1 Plywood for general purposes shall be of the following three grades, depending upon the bond strength developed by the adhesive used for bonding the veneers: a) MR (Moisture Resistant) Grade, b) BWR (Boiling Water Resistant) Grade, and c) BWP (Boiling Water Proof) Grade.
Earlier not there	In terms of formaldehyde class, each grade of plywood shall be further classified in two classes as follows: a) Formaldehyde Class, E_1 b) Formaldehyde Class, E_2
7.2 Assembly 7.2.1 Thickness The thickness of all veneers shall be uniform within a tolerance of ± percent. Corresponding veneers on either side of the central ply and those of face and back veneers shall be of species having similar physical and mechanical properties, such as, density, modulus of electricity, shrinkage, etc, To ensure balanced construction	7.2 assembly 7.2.1 Thickness The thickness of all veneers shall be uniform within a tolerance of ± 5 percent. Corresponding veneers on either side of the central ply and those of face and back veneers shall be of species having similar physical and mechanical properties, such as, density, modulus of elasticity, shrinkage, etc to ensure balanced construction. The examples of balanced construction for odd number of plies are as follows: 3 Ply – XXXX or XYX 5 Ply – XXXXXX or XYYYX or XYZYX Where, X,Y,Z represents species used for top/bottom and centre
6 MATERIALS 6.1 Timber Any species of timber may be used for plywood manufacture. However, a list of species, for the manufacture of plywood is given in Annex B for guidance.	6 MATERIALS 6.1 Timber Any species of timber may be used for manufacturer of plywood. It is recommended to use wood from sources other than natural forests includes, tree outside forest (TOF), rubber, coconut, cashew, walnut, agro forestry, farm forestry, industrial and social forestry plantations, etc and

			shade trees from tea and coffee estates in plywood manufacturing. A list of prevailing tree outside forest species is given in Annex B for guidance purpose. Imported timber may also be used in manufacturing of plywood.				
6.2 Adhe	esive		6.2 Adhe	esive			
The adhe	esive used for bondir	g the veneers in	Any suit	able type of synthetic r	esin adhesive may		
	grades of plywood s			for bonding the veneers			
	nding type of adhesi		of plywo	od comply with requir	ements as per the		
848: 1974	0	1		re grades (see 4.1) of pl			
				of adhesive refer IS 84			
Earlier n	ot there			ny other type of treatm			
				plywood or veneer as p			
				the manufacturer and			
				by the manufacturer.	r		
6.2.1 Evt	enders conforming to	IS 1508 : 1972 may be		enders conforming to I	5 1508 may be used		
	h the synthetic resin			synthetic resin adhesiv			
		esin adhesives (amino		r, synthetic resin adhes	•		
	nen extended by <i>mor</i>			tended by more than D			
	ntain suitable preserv			024 7 12 percent shall o			
	t concentration to sat			tive chemicals in suffic			
	ribed in 11.2.2	isty the mycological		ne mycological test desc			
8.3 Toles				: Tolerances on Dimens			
	owing tolerances on t	ho nominal cizes of	1 able 3		2		
	boards shall be perm			General Purpo (Clause 8.4			
IIIIISHEU	boards shall be perm	iissible.	Sl.	Dimension	Tolerance		
	Dimension	Tolerance	No.	Dimension	10terance		
2)		: + 6 mm		2	3		
a)	Length	- 0 mm	<u>1</u>	L an ath			
l _b)	Width	: + 3 mm	i)	Length	: + 6 mm		
b)	vviatii	- 0 mm	::\	TA7: 1(1.	- 3 mm : + 3 mm		
(م	Thiskness	- 0 111111	ii)	Width			
c)	Thickness	100/		nn · 1	- 1 mm		
	1) Less than 6	: ± 10%	iii)	Thickness	10		
	mm	: ± 5%		a) Less than 6 mm			
	2) 6 mm and			b) 6 mm and abov	e : ± 5 percent		
1)	above	0.20/	. ,	0	0 /4000		
d)	Squareness	: 0.2%	iv)	Squareness, Max	: 2 mm/ 1000		
e)	Edge straightness	: 0.2%			mm or 0.2		
				T1	percent		
				Edge straightness,	: 2 mm/ 1000		
				Max	mm or 0.2		
					percent		
	_ ·	rds shall be reasonably		aces of finished plywoo			
	and face veneers shal	•		oly smooth. Slight sand			
		ding may be given to		ywood boards in ordei	to make them		
	oards in order to mak	5	reasonab	oly smooth.			
smooth.	The squareness and e	edge straightness of the					
board w	hen measured accord	ling to the procedure					

Rupture (MOR) Sl. Grade No.	MOE (N/mm²)		MOR (N/mm²)		Rupture (MOR) SI. Grade MOE No. (N/mm²)		MOR (N/mm²)			
	Average	Min. Ind	Average	Min. Ind			Average	Min. Ind	Average	Min Ind
1 2	3	4	5	6	1	2	3	4	5	6
i) BWR Grade Along (direction parallel to the grain direction of the face	5000	4500	40	36	i)	MR Grade a) Along (direction parallel to the grain direction of the face	3400	3100	26	23
veneer) Across (direction perpendicu lar to the grain direction of the face veneer)	2500	2200	20	18		veneer) b) Across (direction perpendicu lar to the grain direction of the face veneer)	2300	2100	17	15
ii) MR Grade Along (direction parallel to the grain direction of the face veneer)	4000	3600	30	27	ii)	BWR Grade and BWP Grade a) Along (direction parallel to the grain	4300	3800	34	31
Across (direction perpendicu lar to the grain direction of the face veneer)	2000	1800	15	13		direction of the face veneer) b) Across (direction perpendicu lar to the grain direction of the face veneer)	2900	2500	23	21

12 Marking

12.2 Each plywood board shall be legibly and indelibly marked or stamped with the following:

- a) Indication of the source of manufacture
- b) Year of manufacture
- c) Batch No., and
- d) The grade and type as follows: BWR/AA, BWR/AB, BWR/BB, MR/AA, MR/AB, MR/BB

12 Marking

- 12.1 Each plywood shall be legibly and indelibly marked or stamped with the following:
 - a) Manufacture's name and his initials or his recognized trade-mark, if any;
 - b) In word 'Plywood for Shuttering Works';
 - c) Formaldehyde class;
 - d) Nominal Length, Width and Thickness of plywood;
 - e) Month and Year of manufacture;
 - f) Batch No.; and
 - g) Criteria for which the plywood has been labeled as ECO-Mark (if applicable).
- **12.2** Following additional information may be marked on each plywood:
 - a) Number of piles; and
 - b) Trade name of timber species used in manufacturing of plywood.

Major deviation:

Faceless plywood addition (face does not require)

Revision of IS 710 standards (Comparison between old and new IS 710 standards)

- Material clause for timber has been modified.
- Dimension clause has been modified,
- Modulus of rupture (MOR), modulus of elasticity (MOE) and tensile strength requirements have been modified,
- Requirements for formaldehyde content for oven dry board and the steady-state formaldehyde emission (optional) have been added, and
- Marking clause has been modified.

OLD 710 standards NEW 710 standards **4 MATERIALS 4 MATERIALS** 4.1 Timber 4.1 Timber **4.1.1** The species of timbers to be used for the **4.1.1** Any species of timber may be used for manufacture of face veneers, cores and cross manufacturer of plywood. It is recommended to use bands of marine plywood shall be given in wood from sources other than natural forests includes, Tables 1 and 2. tree outside forest (TOF), rubber, coconut, cashew, walnut, agroforestry, farm forestry, industrial and **4.1.1.1** No alternative species of timber shall be social forestry plantations, etc and shade trees from tea used without the prior approval of the and coffee estates in plywood manufacturing. A list of purchaser. prevailing tree outside forest species is given in Annex B for guidance purpose. Imported timber may also be **4.1.2** In selecting the species for the manufacture used in manufacturing of plywood. of plywood, it is recommended that as far as possible a single species of timber shall be used **4.1.2** In selecting the species for the manufacture of and where combinations of different species are plywood, it is recommended that as far as possible a used, care shall be taken to prevent single species of timber shall be used and where incompatibility of the two species. combinations of different species are used, care shall be taken to prevent incompatibility of the two species. 4.1.3 For ECO-Mark, only wood from sources other than natural forests such as wood from industrial and social forestry plantations and shade trees from tea and coffee estates shall be used for the manufacture of veneers. 9.1.4 Tensile Strength 9.6 Tensile Strength The tensile strength when determined by the method described in IS 1734 (Part 9) shall comply with the following values: following values:

- a) Tensile strength shall be not less than 42.0 N/mm² in the direction parallel to grain direction of the face veneers,
- b) Tensile strength shall be not less than 25.0 N/mm² in the direction of right angles to the grain direction of the face veneers, and
- c) Sum of the tensile strength in both directions shall be not less than 84.5 N/mm^2 .

The tensile strength when determined by the method described in IS 1734 (Part 9) shall comply with the

- a) Tensile strength shall be not less than 36.0 N/mm² in the direction parallel to grain direction of the face veneers,
- b) Tensile strength shall be not less than 29.0 N/mm² in the direction of right angles to the grain direction of the face veneers, and
- c) Sum of the tensile strength in both directions shall be not less than 84.5 N/mm².

If the plywood contains scarf joints, half the specimen

If the plywood contains scarf joints, half the specimen subjected to testing shall contain the joint.

subjected to testing shall contain the joint.

Table 3: Minimum Values for MOE and MOR (Clause 9.1.6)

Sl. No.	Requirement	Along the Face Grain	Across the Face Grain
1	2	3	4
i)	MOE, N/mm ² a) Average		
	, ,	7500	4000
	b) Minimum individual	6700	3600
ii)	MOR, N/mm ² a) Average		
		50	30
	b) Minimum individual	45	27

Table 2: Minimum Values for MOE and MOR (Clause 9.8)

Sl. No.	Requirement	Along the Face Grain	Across the Face Grain
1	2	3	4
i)	MOE, N/mm² a) Average b) Minimum individual	6400 5700	4600
ii)	MOR, N/mm ²		
	a) Average	43	35
	b) Minimum individual	38	31

Table 4: Minimum Values for MOE and MOR (Wet Bending Strength) (Clause 9.1.7)

Sl. No.	Requirement	Along the Face	Across the Face
140.		Grain	Grain
1	2	3	4
i)	MOE, N/mm ²		
	a) Average	3750	2000
	b) Minimum	3400	1800
	Individual		
ii)	MOR, N/mm ²		
	a) Average	25	15
	b) Minimum	22	13
	Individual		

Table 3: Minimum Values for MOE and MOR (Wet Bending Strength)
(Clause 9.8)

Sl.	Requirement	Along the	Across the
No.		Face	Face
		Grain	Grain
1	2	3	4
i)	MOE, N/mm ²		
	a) Average	3200	2300
	b) Minimum	2900	2100
	individual		
ii)	MOR, N/mm ²		
	a) Average	21	17
	b) Minimum	19	15
	individual		

Earlier not there

9.11 Formaldehyde Content Test

Test of free formaldehyde content in the sample shall be done by perforator method as per IS 13745 and test results are drawn sample shall meet the requirements of formaldehyde content as follows:

Formaldehyde Class, $E_1 \le 8 \text{mg} / 100 \text{ g}$ of oven dry sample

Formaldehyde Class, $E_2 > 8$ mg/ 100 g of oven dry sample and ≤ 30 mg/ 100 g of oven dry sample

9.12 Steady-State Formaldehyde Emission test (Optional Test)

Manufacturer will offer a stack of plywood made under a batch (not less than 50 pieces) bearing the batch no. and date of manufacture along with details of plywood that is grade, size and thickness, adhesive used and any other (the manufacture wish to inform). After sampling, the sample will immediately cover in airtight polythene with date of sampling on the plywood.

Sample must be taken for test within 24 h of opening the airtight cover and within one month from the date of sampling and test shall ben done by the test method as given in IS/ISO 12460 (Part 1). The test results are drawn sample shall meet the requirements of formaldehyde emission value as follows:

Formaldehyde Class, $E_1 \le 0.124 \text{ mg/m}^3$ Formaldehyde Class, $E_2 > 0.124 \text{ mg/m}^3$

11 MARKING

11.1 Each plywood board shall be legibly and indelibly marked or stamped with the following particulars along with such other marks as the purchaser may stipulate at the time of placing order:

- a) Manufacture's name, initials or recognized trade-mark, if any;
- b) Year of manufacture;
- Abbreviations indicating the species of timber used in each ply, as indicated in col 4 of Tables 1 and 2;
- d) Batch number; and
- e) Criteria for which the plywood has been labeled as ECO-Mark.

11 MARKING

11.1 Each plywood board shall be legibly and indelibly marked or stamped with the following:

- a) Manufacturer's name and his initials or his recognized trade-mark, if any;
- b) In words 'MARINE PLYWOOD';
- c) Formaldehyde class;
- d) Nominal Length, Width and Thickness of plywood;
- e) Month and Year of manufacture;
- f) Batch No.; and
- g) Criteria for which the plywood has been labeled as ECO-Mark (if applicable).

11.2 Following additional information may be marked n each plywood:

- a) Number of piles; and
- b) Trade name of timber species used in manufacturing of plywood.

5.2.2.1 In the case of 3-ply boards, the thickness of the centre veneer (core) shall be at least equal to that of one of the face veneers; bust shall not exceed the combined thickness of the two face veneers. In the case of multi-ply boards the thickness of any veneer shall not exceed twice the thickness of any other veneer in the same board.

5.2.2.1 In the case of 3 ply boards, the thickness of the centre veneer (core) shall be equal to that of one of the face veneer, but shall not exceed the combined thickness of surface veneers.

Revision of IS 4990 standards (Comparison between old and new IS 4990 standards)

In this revision, the following major modification have been incorporated:

- a) Material clause for timber has been modified,
- b) Dimension clause has been modified,
- c) Modulus of rupture (MOR), modulus of elasticity (MOE) and tensile strength requirements have been modified,
- d) Requirements for formaldehyde content for oven dry board and the steady-state formaldehyde emission (optional) have been added, and
- e) Marking clause has been modified

OLD 4990 standards				NEW 4990 standards							
Table 2: Average and Minimum Individual Values of Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) in Static Bending Strength (Clause 10.1.7)				of Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) in Static Bending Strength							
Sl. Grain MOE MOR Sl. Grain MOE M			MOR (N/mm²)								
		Average	Min. Ind.	Average	Min. Ind			Average	Min. Ind.	Average	Min. Ind
1	2	3	4	5	6	1	2	3	4	5	6
i)	Along (parallel) to the grain direction of the face veneer)	7500	6700	50	45	i)	Along (parallel) to the grain direction of the face veneer)	6400	5700	43	38
ii)	Across (perpendic ular to the grain direction of the face veneer)	4000	3600	30	27	ii)	Across (perpendic ular to the grain direction of the face veneer)	4600	4100	35	41

Table 3 Minimum Average and Minimum Individual Values of Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) for Wet Bending Strength

Sl. No.	Property	Along the Face Grain	Across the Face Grain
1	2	3	4
i)	MOE, N/mm ²		
•	a) Average	3750	2000
	b) Minimum	3400	1800
	individual		
ii)	MOR, N/mm ²		
Í	a) Average	25	15
	b) Minimum individual	22	13

Table 4 Minimum Average and Minimum Individual Values of Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) for Wet Bending Strength (Clause 10.10)

Sl. No.	Requirement	Along the Face Grain	Across the Face Grain
1	2	3	4
i)	MOE, N/mm ²		
	a) Average	3200	2300
	b) Minimum	2900	2100
	individual		
ii)	MOR, N/mm ²		
	a) Average	21	17
	b) Minimum	19	15
	individual		

10.1.6 Tensile Strength

The tensile strength when determined by the method described in IS 1734 (Part 9) shall comply with the following values:

- a) Tensile strength shall be not less than 32.5 N/mm² in the direction parallel to grain direction of the face veneers,
- b) Tensile strength shall be not less than 22.5 N/mm² in the direction of right angles to the grain direction of the face veneers, and
- c) Sum of the tensile strength in both directions shall be not less than 60.0 N/mm².

10.8 Tensile Strength

The tensile strength when determined by the method described in IS 1734 (Part 9) shall comply with the following values:

- Tensile strength shall be not less than 28 N/mm² in the direction parallel to grain direction of the face veneers,
- b) Tensile strength shall be not less than 26 N/mm² in the direction of right angles to the grain direction of the face veneers, and
- c) Sum of the tensile strength in both directions shall be not less than 60.0 N/mm^2 .

12 MARKING

12.1 Each plywood board shall be legibly and indelibly marked or stamped with the following particulars:

- a) Manufacture's mark of identification;
- b) Year of manufacture;
- c) Type of plywood (see 4), and
- d) The criteria for which the plywood has been labeled as ECO-Mark.

12 MARKING

12.1 Each plywood board shall be legibly and indelibly marked or stamped with the following:

- a) Manufacture's name and his initials or his recognized trade-mark, if any;
- b) In words 'Plywood for Shuttering Works';
- c) Formaldehyde class;
- d) Nominal Length, Width and Thickness of plywood;
- e) Month and Year of manufacture;
- f) Batch No.; and
- g) Criteria for which the plywood has been labeled as ECO-Mark (if applicable).

12.2 Following additional information may be marked on each plywood:

a) Number of piles; and

5 MATERIALS

- **5.1** Timber Any species of timber may be used for manufacture of plywood for concrete shuttering works. However a list of species given in Annex B may be used for selection of species. For ECO-Mark only species of wood from sources other than natural forests such as wood from rubber, coconut, cashew, industrial and social forestry plantations, etc, shade trees from tea and coffee estates shall be used for the manufacture of plywood
- **5.2** Adhesives for Bonding of Veneers The adhesive used for bonding shall be of the *hot press synthetic resin* (*phenol formaldehyde*) *type* and shall conform to BWP type specified in IS 848. Extenders shall not be added to the adhesive. Addition of a dye to the adhesive to check that all the parts of the veneer are completely covered by adhesive shall be permissible. Addition of a filler not exceeding 5 percent shall be permissible provided the filler does not detract from the water resistance of the adhesive

- b) Trade name of timber species used in manufacturing of plywood.
- **5.1** Timber Any species of timber may be used for manufacturer of plywood. It is commended to use wood from sources other than natural forests includes, tree outside forest (TOF), rubber, coconut, cashew, walnut, agro forestry, farm forestry, industrial and social forestry plantations, etc and shade trees from tea and coffee estatesin plywood manufacturing. A list of prevailing tree outside forest species is given in Annex B for guidance purpose. Imported timber may also be used in manufacturing of plywood.
- 5.2 Adhesives for Bonding of Veneers The adhesives used for bonding the veneers shall be based on any suitable synthetic resin conforming to BWP Type of IS 848. Extender shall not be added to the adhesive by the plywood manufacturer. Extenders shall not be added to the adhesive. Addition of a dye to the adhesive to check that all the parts of the veneer are completely covered by adhesive shall be permissible. Addition of a filler not exceeding 5 percent shall be permissible provided the filler does not detract from the water resistance of the adhesive.

DATA POINT:

Timber Import Statistics in India: Wood in Rough (HS code-4403), Sawn Wood (HS code-4407) and Veneer Sheets (HS code-4408)

V.K. Upadhyay, ICFRE-Institute of Wood Science and technology, Bengaluru E-mail: upadhyayvk@icfre.org

India has imported around 1,82,150 crore rupees and an average of 9,107 crore rupees in total timber during the last 20 years (2003-04 to 2022-23). Over the last two decades, the most common types of imported timber have been 76% rough wood (HS code: 4403), 15% sawn wood (HS code: 4407), and 9% veneer sheets (HS code: 4408). The major suppliers were Malaysia, Myanmar, New Zealand, Ecuador, Ghana, Papua N GNA, and Costa Rica and accounting for 70% of total imports with HS code 4403; Germany, Malaysia, Indonesia, the United States, Myanmar, Brazil, and Tanzania sharing 61% of all imports of HS code 4407; and The veneer sheets (HS code-4408) mainly coming from China, Vietnam, Gabon, Myanmar, and Indonesia, accounting for 70% of total Indian veneer imports.

India's economy has grown remarkably, and this has increased demand for wood and wood products. Wood based industries (WBIs) in India is an "unorganized" sector and include furniture, handicrafts, composite wood, plywood, paper, packaging and printing material and toys. The timber used for manufacturing of wood products for domestic consumption etc. A large number of WBIs are sourcing the wood raw material largely from the trees outside forestsfrom the farmers and imported timber from different countries. This study provides brief information of thelast two decades (2003-04 to 2022-23) on HS codes 4403, 4407, and 4408 of timber import statistics, trend behaviour, and significant timber supplier countries to India.

During these two decades, India has imported 95.85 million CBM of rough wood worth ₹1,39,089 crores, 15.60million CBM of sawn wood worth ₹27,488 crores, and 2.95 million tonnes of veneers worth ₹15,573 crores. An average of 4.79 million CBM of wood logsvalued at ₹6,954 crores, 0.78 million CBM of Sawn wood valued at ₹1,374 crores and 0.15 million tons of veneer sheets valued at ₹779

crores were imported per year from different countries. (Table 1). The import pattern of lumber during the last 20 years is depicted in Fig. 1.

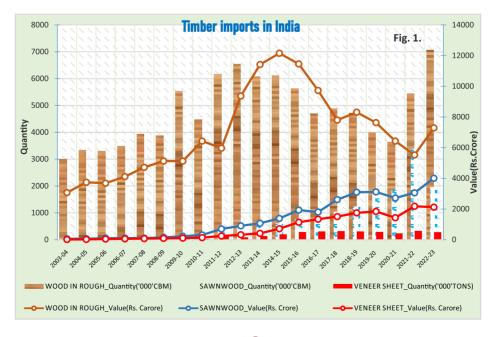
Country-wise Timber Imports in India:

The import of timber products from top ten countries accounting for 76% of total imports of wood logs, 71% of total imports of sawn wood, and 92% of total imports of veneer sheets. Malaysia, Myanmar, New Zealand, Ecuador, Ghana, Papua N GNA, and Costa Rica were the major suppliers of HS code 4403 and represented in both decades (2003-04 to 2022-23). The top 10 supplier of HS code-4407 wereGermany, Malaysia, Indonesia, the United States, Myanmar, Brazil, and Tanzania. Most veneers (HS code: 4408) are imported from Gabon, Myanmar, China, Vietnam, and Indonesia (Fig.2). Table 2 (a&b), Table 3 (a&b), and Table 4 (a&b) displayed the annual trend and variation in the timber import behaviour of wood in rough (HS code: 4403), sawn wood (HS code: 4407), and veneer sheets (HS code: 4408).

Table 1: Timber imports in India during the years 2003-04 to 2022-23

		n Rough de-4403)		od (HSCode- 107)		ets(HSCode- 08)
Year	Value (₹ Crore)	Quantity ('000'CBM)	Value (₹ Crore)	Quantity ('000'CBM)	Value (₹ Crore)	Quantity ('000' TONS)
2003-04	3,068.15	2,992.31	56.60	102.7	16.56	4.99
2004-05	3,737.10	3,331.49	60.82	69.5	22.62	7.27
2005-06	3,681.75	3,298.70	92.41	59.81	49.24	13.31
2006-07	4,113.99	3,491.85	103.29	62.81	64.25	11.35
2007-08	4,712.43	3,931.39	102.48	59.9	74.33	14.24
2008-09	5,126.42	3,875.32	144.96	85.35	92.46	18.75
2009-10	5,126.42	5,527.24	220.50	173.11	103.56	21.72
2010-11	6,427.55	4,464.29	308.26	192.21	133.54	27.77
2011-12	5,968.25	6,167.56	696.75	495.24	245.02	14.42
2012-13	9,370.82	6,536.30	900.37	499.50	323.60	90.73
2013-14	11,423.94	6,078.65	1,070.21	524.79	417.05	138.47
2014-15	12,156.68	6,112.09	1,383.64	605.46	714.67	204.41
2015-16	11,462.59	5,622.14	1,933.05	764.60	1,140.85	289.52
2016-17	9,730.35	4,703.27	1,805.55	708.83	1,338.16	312.19
2017-18	7,801.00	4,877.53	2,615.18	1,044.69	1,510.35	325.56
2018-19	8,314.77	4,707.93	3,092.05	1,238.40	1,749.37	312.02
2019-20	7,631.48	3,991.21	3,120.87	1,716.16	1,843.12	292.16
2020-21	6,426.69	3,628.46	2,716.69	1,845.44	1,432.62	237.4
2021-22	5,520.37	5,443.28	3,054.55	3,389.85	2,180.41	332.38
2022-23	7,288.85	7,066.29	4,009.78	1,962.86	2,121.32	285.33
2003-04 to 2022-23	1,39,089.57	95,847.30	27,488.00	15,601.21	15,573.09	2,953.99
Average	6,954.48	4,792.37	1,374.40	780.06	778.65	147.70
C.V.	40%	22%	90%	114%	99%	86%

Source: Compiled by author based on Data Bank of Ministry of Commerce and Industry, Govt. of India



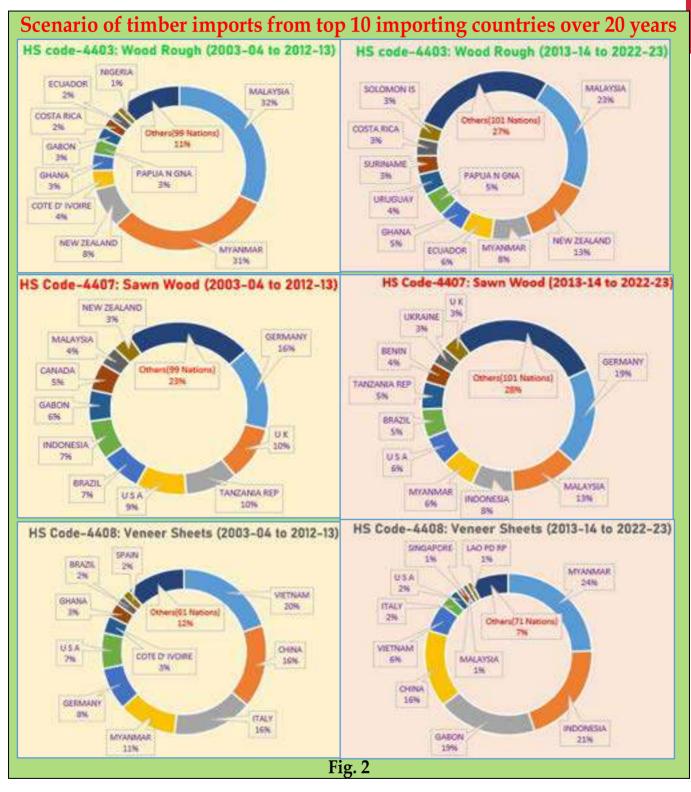
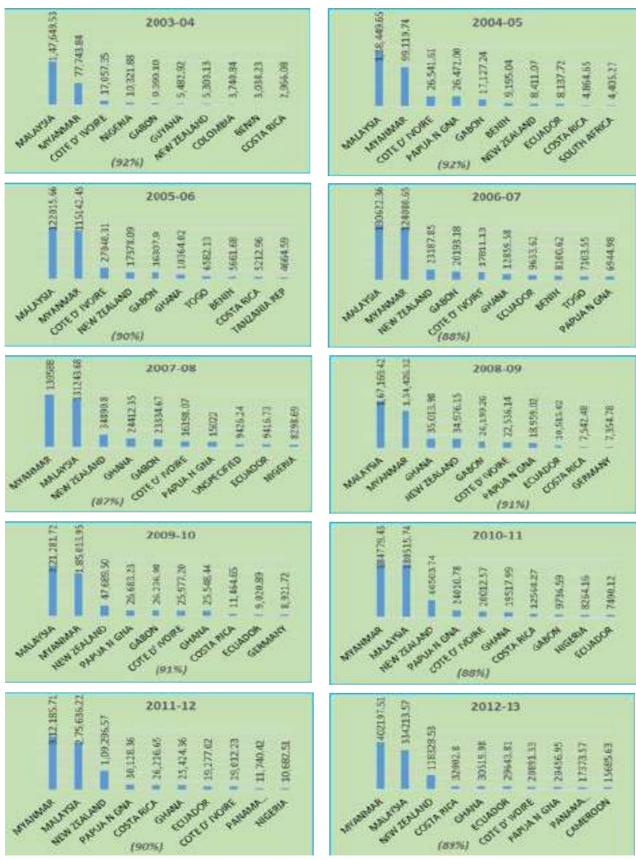


Table 2 (a): Wood in rough etc.(HS Code-4403) import from top 10 Countries in India during the year 2003-04 to 2012-13

Value in (Rs. Lakh)



(90%):

(89%)

Table 2 (b):
Wood in rough etc. (HS Code-4403) import from top 10 Countries in India during the year 2013-14 to 2022-23

Value in (Rs. Lakh)

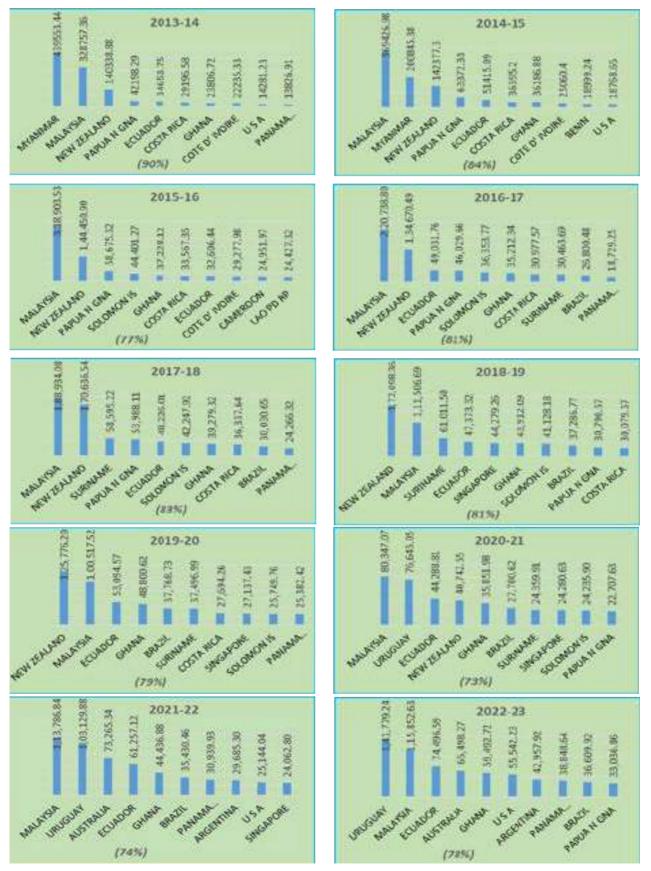


Table 3 (a): Sawn wood (HS Code-4407) import from top 10 Countries in India during the year 2003-04 to 2012-13 Value in (Rs. Lakh)



Table 3 (b): Sawn wood (HS Code-4407) import from top 10 Countries in India during the year 2013-14 to 2022-Value in (Rs. Lakh)



Table 4(a):
Veneer sheets (HS Code-4408) import from top 10 Countries in India during the year 2003-04 to 2012-13

Value in (Rs. Lakh)

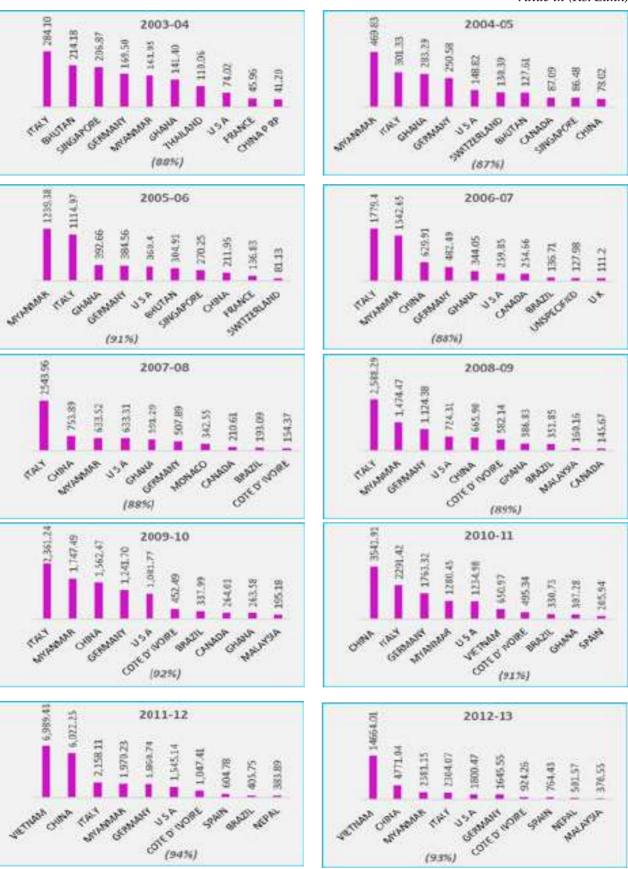


Table 4 (b): Veneer sheets (HS Code-4408) import from top 10 Countries in India during the year 2003-04 to 2012-13 Value in (Rs. Lakh)





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 20years 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)

FOR REGISTRATION



काष्ठ विज्ञान एवं प्रौद्यौगिकी संस्थान INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY

(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्) (Indian Council of Forestry Research and Education) (पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार, की एक स्वायत्त निकाय) (An Autonomous Body of Ministry of Environment, Forest and Climate Change, Govt. of India) पी.ओ. मल्लेश्वरम/P.O. Malleswaram, बँगलुरु/Bengaluru — 560 003



ICFRE – Wood Industries Committee of India (ICFRE-WINCOIN)

(formed vide Notification No. F.No. 36-5/2022-ICFRE dated 23rd Dec., 2022.)

WINCOIN MEMBERSHIP APPLICATION FORM

Name of the Organization to on Membership Certificate			ocaranata			
Address to be printed on M Certificate	embership					
Correspondence Address, if from 2. above.	different					
4. GST No. of the Organization	at 1. above					
5. Name of Head of Organizat	on					
6. Contact details: Land	line with STD:				Fax No	
Mobile No.:		Email:				
7. Details of erstwhile IPIRTI	Membership,	Year of	Membership:			
if any.(Please enclose copy Membership certificate)	of earlier	Membership Type: Associate/SSI/MSI/LSI/Life Member				
8. Membership Required, Plea	se choose one	Associate/SSI/MSI/LSI/Life Member				
For the financial year:		If Renewal, then year of commencement :				
9. Structure of Organization: F	Public Ltd./Private Ltd/Partnership/Proprietary Concern					
10. Registered as (Enclose co Registration Certificate)	Large/Medium/Small Scale Industry or any other					
11. Products Manufactured *						
12. Installed Capacity*						
13, Annual Production*						
14. Whether BIS Licensee*				_		
15. Total no. of employees	2997		echnical Persons	-		
16. Details of application fee p	aid	D.D.No.	/Transaction Id:			
Issuing Bank/Branch	Amount	*	Date	8		
(DD to be drawn in Please see overleaf fo			VST CORPUS FUND, p details and fee struc			
17. Any other details						
18. For further Information ple	Secretariat ICFRE-WINCOIN, Institute of Wood Science & Technology P.O. Malleshwaram, Bengaluru- 560 003 (India) Email: dir_lwst@icre.org; icfre_wincoin@icfre.org, Tel +91-80-22190103; +91-80-30534050, +91-80-30534021				e.org,	

दूरभाष/Phones:कार्यालय/Office: 080-23341731, 080-22190100, 200(सामान्य/General) 080-30534021 (नमूना कक्ष / Sample Cell)

फॅक्स/FAX: 0091-80-23340529, ईमेल-/e-mail: icfre_wincoin@icfre.org, येवसाईट/Website: http://iwst.icfre.gov.in

As per Government of India, Ministry of Environment, Forest and Climate Change, Order No. F.No. 16-1/2022-RT dated 22.10.2022, Indian Plywood Industries Research and Training Institute (IPIRTI), has been merged with Institute of Wood Science and Technology (TWST), Bengaluru

Details of Membership Type (Category) and Membership fees are as under:

Membership Category	Membership Fee
(i) Life Membership SSI:	(i) Rs.1,20,000/- + 18% GST (In one lumpsum or in 4 instalments of Rs.30,000+18%GST payable half-yearly)
(ii) Life Membership MSI/LSI:	(ii) Rs.2,40,000/- + 18% GST (In one lumpsum or in 4 instalments of Rs.60000+18%GST payable half-yearly)
(iii) Annual Member SSI	(iii) Rs.12,000 + 18% GST for Small Scale Industries / units
(iv) Annual Member MSI/LSI:	(iii) Rs.24,000 + 18% GST for 1" year and thereafter for
Manufacturers of panels from wood and	renewal Rs.18,000+ 18% GST every year for Medium/
other lignocellulosic materials and	Large Scale Industries / Units
associated industries like machinery, resins, chemicals, etc	
Associate Member:	Rs, 6000/- per year +18% GST
For Associations & Individuals	SEMACH RESUME SERGERAL RESCOUNTS AND DESCRIPTION OF THE PROPERTY OF THE PROPER

Benefits for industrial members of "ICFRE-WINCOIN":

- a) Technical support services related to processing and production of wood & wood-based products.
- Provide solutions to common problems of the industries and their needs through regional workshops/meetings.
- c) Arranging Training and Education for the candidates sponsored by the industries through regular short term vocational courses as well as specially conducted courses as per the request of sponsors.
- d) Preference in providing well educated and trained production workforce to the wood & wood based industries.
- e) Focus will be given to problems and needs of the industries in R&D projects.
- f) Undertaking sponsored projects given by the industry for their process and product development.
- g) Enlighten the members as well as non-members for the Wood and Wood based Industries regarding the significant achievements and other important events conducted in the Institute.
- Formulation of specifications for the new products developed by the industry and issue of draft amendments to existing standards.
- Undertaking sponsored projects given by the factory for their process and product development.

The membership fees may be paid through Demand Draft/Online to the following account:-

The Director, 'IWST-Corpus Fund' A/c No. 64013600791 State Bank of India (03295)-Yeshwanthpur (Bengaluru) Tumkuru Road, Near APMC Yard, Yeshwantpur, Bengaluru-560 022, Karnataka IFSC Code: SBIN0003297



With Best compliments from

FEDERATION OF ALL INDIA TIMBER MERCHANTS, SAW MILLERS AND ALLIED INDUSTRIES

(Registered under Companies Act)

White Pearl, Flat No. 201, 1st Floor, # 269/1-1, Kasturiba Nagar,
Opp. Union Bank of India, Mysore Main Road, Bengaluru- 560026. Karnataka State.
E-mail: faitmsmai@gmail.com

Regn. No.: CIN-U51909WB2008NPL131579 - Dtd. 30-12-2008

PRESIDENT



ARJUN HIRJI PATEL

Mandya - Bangalore

94482 73375 / 82170 99809

E-mail : arjunhirjipatel@gmail.com

VICE PRESIDENT



PRABHUDAS K. PATEL Nagpur 97658 57857

VICE PRESIDENT



CHAKILAM RAMANAIYA
Hyderabad
93910 13985

GEN. SECRETARY



MANSUKH K. PATEL
Nadiad - Gujarat
98255 62847
E-mail : shardavsm@yahoo.com

SECRETARY



KANTILAL D. PATEL
Delhi
98112 51020

JOINT SECRETARY



LAXMAN G. PATEL Kolhapur 94230 40457

TREASURER



VISHRAM L. CHHABHAIYA
Bangalore
98440 35112

JOINT TREASURER



JIVRAJ V. PATEL Bangarpet, Kolar 94480 77032

- HON. ADVISORS -



NAVAL KEDIA Kolkata 98302 00497



DWARA RAMAKRISHNA Rajamundry 94401 76081



CA RAMNIKLAL M. VAGADIA Bangalore 98453 75577



HIMMATBHAI R. PATEL Mumbai 98211 19116



CA BHAVANBHAI H. PATEL Mumbai 98200 82969

KYOOD IS GOOD





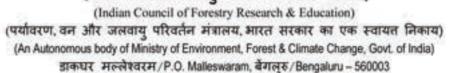








ICFRE - INSTITUTE OF WOOD SCIENCE & TECHNOLOGY (भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद)





दिनाक/Dated: 17.01.2024

和/No:16-214/2023-24/IWST/EXTN/Incubation Centre/436(a)

GUIDELINES FOR REGISTRATION AT INCUBATION CENTRE OF ICFRE-IWST

About ICFRE-Institute of Wood Science and Technology (IWST), Bengaluru

ICFRE-IWST is a premier research Institute under Indian Council of Forestry Research and Education (ICFRE) with specialized mandate to work on the research aspects of wood science and technology. In order to promote innovation and entrepreneurship among students, faculty and stakeholders, ICFRE-IWST has established Incubation Centre for wood products under the guidance of expert scientists of ICFRE-IWST.

Vision

To nurture the culture of invention and entrepreneurship in the wood products among students, faculty, stakeholders and community inventors.

Mission

- To focus on invention by identifying problems and providing solutions that would be commercialized into venture development.
- ii. Product development would be prime focus by normalizing resources.

Objectives

- Identifying areas, proof of concepts to prototype modules and translating them into product development.
- Conducting hackathons and wood camps to engage and develop interest among students, faculty, stakeholders and community inventors.
- To inculcate generation of Intellectual Property Rights (IPRs) among students, faculty, stakeholders and community inventors.

Incubation Space

ICFRE-IWST has full-fledged Incubation Centre with 250 sq.mt. work space with modern wood working machineries to assist the inventors and entrepreneurs. Institute also host IT Cell and library to access the knowledge in the field of wood science and technology. ICFRE-IWST host Wood Properties and Processing (WPP) Division and Plywood and Panel Product Technology Division with experienced wood scientists and technical officers to guide and assist students, faculty, stakeholders and community inventors on their invention ideas into business model.

Fields of incubation

- i. Wood and bamboo based products
- ii. Engineered wood
- iii. Wood polymer composites
- iv. Wood modification
- v. Wood and lignocellulose panel products
- vi. Forest Protection
- vii. Tissue Culture
- viii. Forest management and certification

Process of Registration and Operationalization

Interested students, faculty, stakeholders, community inventors and entrepreneurs who like to work in the Incubation Centre of ICFRE-IWST on wood products shall register by submitting duly filled necessary data in Registration Form enclosed. The applicants shall pay ₹10,000/- (Rupees Ten Thousand only) as a deposit amount to ICFRE-IWST.

The incubation after registration has to sign a Memorandum of Association with IWST and bear cost of material required for developing prototypes, charges for machine usage and meet any other financial obligations as agreed in the Memorandum of Association.



REGISTRATION FORM TO WORK IN ICFRE-IWST INCUBATION CENTRE

PHOTOGRAPH	

PERSO	NAL INFORMATION	
1.	Name:	
2,	Contact Number:	
3.	E-mail Id: ⊠	
4.	Postal address:	
BUSIN	ESS INFORMATION	
1.	Name of the business:	
2.	Which topic is most aligned with your idea?	
3.	How long you have been working in your business idea?	
4.	Any progress so far made?	
5.	Any prototype model developed (if applicable)?	
6.	How would your business idea contribute to improve life using business as a force for good things?	

Institute of Wood Science and Technology, Bangalore Publications for Sale

IWST PUBLICATIONS FOR SALE BOOKS

SI. No.	Name of the Books	Language	Rate
1.	Gem of Peninsular India Sandalwood	English	1,500
2.	Endemic Possession of Eastern Ghats: Red sanders	English	150
3.	Biodeterioration of Timber and its Prevention in		
	Indian Coastal Waters - 3rd Progress Report (1982-2005)	English	250
4.	Anatomy and Properties of Lesser Known Timbers of		
	North-East with particular reference to Nagaland	English	175

PROCEEDINGS / ABSTRACTS

SI. No.	Name of the Books	Language	Rate
1.	Forestry, Forest Products and Coastal Population	English	200
2.	Wood Preservation in India: Challenges, Opportunities		
	and strategies	English	250
3.	Conservation, Restoration and Sustainable Management of		
	Mangrove Forests in India	English	250
4.	Intellectual Property in Forestry issues	English	250
5.	Bamboo Reserve Management & Advances in		
	Utilization Options	English	200
6.	Indian Sandal wood. Compendium Abstracts of		
	Research carried out English	400	
7.	Abstracts of the Published Research Papers (1998-2007)	English	Free

TECHNICAL BULLETINS / BROCHURES

SI. No.	Name of the Technical Bulletin	Language	Rate
1.	Sandalwood	English/Kannada	100
2.	Sandalwood Tree (Pests, Diseases and their Management)	English	80
3.	A Guide to some important timbers in South Indian markets	English	150
4.	Arbuscular Mycorrhizal (AM) fungi as biofertilizer in forestry	English	30
5.	Teak Heartwood Borer. AlcterogystiaCadambae (moore) and		
	its management	English	50
6.	Whitefly pests in Forestry and their management	English	30
7.	Wood Polymer Composite: New age Material	English	50
8.	Protection of Wood from Weathering	English	80
9.	Flower Gall Inducer of PongamiaPinnata and its management	English	60
10.	Cultivation prospects of edible bamboo shoots in South India	English	100
11.	Ficus Tree in Semi-arid. Agro Ecosystem of Karnataka	English	150
12.	Bamboos of India	English	200
13.	GuaduaanguistifoliaKunth: A Vegetable Steel Bamboo Species	English	150
14.	Dendorocalamusstocksii (Munro): A Potential Multipurpose Species		
	for Peninsular India	English	150
15.	DendorocalamusBrandisii (Munro): An ideal Bamboo Species for		
	Domestication in Humid Tropics	English	150
16.	Micro propagation of Bamboo Species	English	150
17	Disease Alert on Eruption of Sandal Spike Disease in Conservation and		
	Cultivation of Indian Sandalwood	English	100
18	Important Insect Pests in Mangroves of Maharashtra and their Management	English	100
19	Genuine Mahagony – Cultivation, Management and Uses	English	100
20	Meliadubia Malabar Neem	English	100
21	Phytoplasma: Thrust for developing effective management strategies	English	100
22	Sandal oil: Adulteration and detection techniques	English	100
23	Bamboo Lumber: A sustainable alternative to solid wood	English	100
24	Utilization Potential of Palmyra Palm Wood (Borassusflabellifer L.)	English	100



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

Тα			
100			

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.

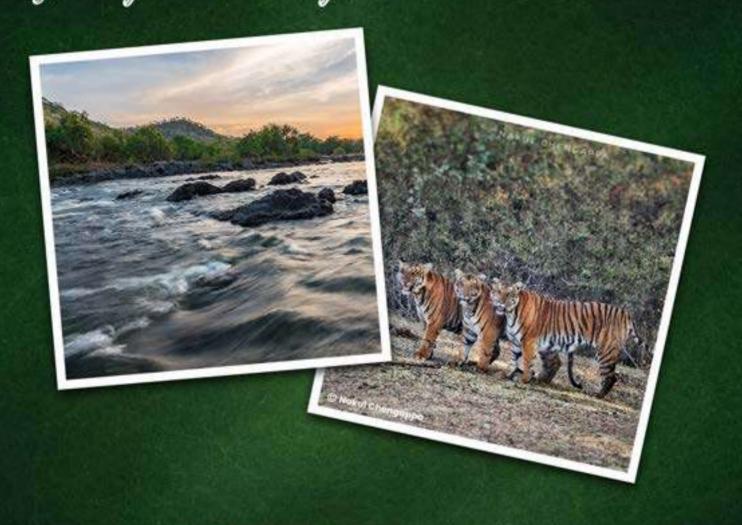
Plac		(Signature of the Applicant)
Date	:	
1.	Name of applicant in full (in block capitals)	
2.	(a) Date of Birth, (b) Age (in case of individuals only)	
3.	Academic and professional qualifications (in case of individuals only)	
4.	Present employment/how engaged and brief history of previous career in 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. 5,000
Foreign:		
Corporate	N. A.	US \$ 2,500
Institutional	US \$ 50	N.A.
Individual	US \$ 20	US \$ 200

Enjoy a safe and blissful stay amidst the wilderness at

Jungle Lodges and Resorts





Book your stay today.





www.junglelodges.com
info@junglelodges.com



(+91 80 4055 4055







The very 1st Laminate Flooring manufacturing facility in India "MADE IN INDIA, FOR INDIA". Action TESA Flooring is manufacture by Direct Pressure Laminated (DPL) flooring process where in the anti-abrasive aluminium oxide overlay along with the melamine impregnated decorative film is Directly Fused with the core substrate & the balancing film at the back. Action TESA is the 1st flooring manufacturer in India by forward integrating HDF from its own Plant.





























Customer Care Service: 1800 3090 707 customerservices@actiontesa.com

www.actiontesa.com





FOR ENDURING SAFETY AND PEACE OF MIND





Published by:

Institute of Wood Science and Technology

Indian Council of Forestry Research & Education

(An Autonomous body under Ministry of Environment, Forest & Climate Change) P.O. Malleshwaram, Bengaluru - 560 003, Karnataka, India E-mail: dir_iwst@icfre.org | Website: https://iwst.icfre.gov.in

Designed by: Samvida Communications (OPC) Pvt. Ltd. Contact: Meghana S Belavadi, meghana@samvida.biz, +91 9886201993