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PRESENT STATUS AND CHALLENGES OF WOOD SCIENCE AND TECHNOLOGY EDUCATION IN INDIA

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Abstract- **This article summarizes the present status and challenges of academic programmes in the field of Wood Science and Technology (WST) in Indian universities and other institutions, with special emphasis to post graduate education. Though the WST education has been running since several decades in India, there is very slow improvement in terms of the number of institutions offering this programme, when compared to many other professional courses. Now there are only 8 institutions in the country for the wood technology programmes including diploma, post graduate diploma and post graduate courses. There is scope for more institutions to enter into this field. Institutions having expertise and facilities for training activities on improved, better and efficient utilization of wood and other lignocellulosic materials, may be encouraged to start suitable academic programmes in WST. Timely update of the current curricula followed at present by the institutions should be done with rigorous discussions with industries, government authorities and academics in order to improve the quality of wood technology professionals. The curriculum should be at par with those of developed nations so that the graduates could be familiar with the global trends. The government should support the organizations engaged in novel and practical methods of collaborative academic programmes with the objective of improving the quality of education in the field like the one being practiced in Dual Mode recently in Kerala. Regarding the job opportunities, the wood-based industries including the furniture units should facilitate the recruitment of wood technologists, considerably reducing the number of candidates employed from non-technical professions for managing their manufacturing and quality control facilities. In order to ease many of the aforementioned challenges, efforts are needed to prod the Central Government for the establishment of a statutory body under the Ministry of Science & Technology, with more authority to coordinate/monitor and promote all institutions and industries associated with the research and training activities in the field of wood science and technology.**

Keywords: **Status, challenges, wood science and technology, higher education, India**

I. INTRODUCTION

The field of study which consists of the physical, biological, and chemical makeup of wood is called wood science and it covers the underlying principles of wood preservation and wood processing. The application of various scientific disciplines inclusive of forestry, physics, chemistry, biology, engineering, etc. to the wood preservation, processing, etc. is the wood technology. It also includes biotechnology, quality control and waste management too.

Wood science and technology course in India promotes interactive learning methods. During the post graduation, students get chances to broaden their knowledge and explore their possibilities. The course includes local field visits, industrial tour, and in-plant (industrial) training, aside from routine theory and practical classes. Local field visits increase interests and create more positive feelings toward that topic. Industrial tour across the country and industrial trainings provide opportunities to learn practically through interaction. During the in-plant training period, the students visit the industry and get insights regarding the working environment. The training which lasts from more than a month improves their entrepreneurial ability, helps to come across real problems, and to find proper solutions. The industrial exposure to the students helps them to develop their career in high-tech industrial requirements. Toward the end of the study period, each student is required to do a project work independently. This will help to deepen and extend the knowledge of the chosen topic, helps to solve problems with confidence, and strengthens the student for large and complex research projects.

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II. HISTORY, OBJECTIVES AND PRESENT STATUS

The history of Wood Science in India could be traced back to the teaching of the subject to the trainee Forest Officers at Forest Research Institute, Dehradun under the British administration and the field was then referred to as Forest Science [1]. However, the starting point of a formal Wood Technology education was the diploma level course initiated in 1982 by the Government Polytechnic College, Kannur under the patronage of Sri Kaderkutty Sahib, the Founder Managing Director of The Western India Plywoods Ltd, with the objective of producing technical manpower in the field suitable for working in plywood and other wood-based industries in the country. Later in 1991, the course was renamed and restructured as Diploma in Wood and Paper Technology. In 1996, the first Post graduate programme in Wood Technology was introduced under the aegis of FRI, Dehradun with the following objectives:

1. To develop technically qualified wood technology professionals with sufficient knowledge and skills
2. To provide true industrial training exposure to the youth and there by pave the way for greater employability in wood-based industries
3. To prepare the human resources which enable and encourage the young professionals to take up 'start-up' wood-based enterprises
4. To equip the professionals with new innovative research and technology to extend high quality technical services to the industries

Though the WST education has been running since several decades in India, there is very slow improvement in terms of the number of institutions offering this programme, when compared to many other professional courses. Now there are only 8 institutions in the country for the wood technology programmes including diploma, post graduate diploma and post graduate courses (Table.1). As stated above, a career in wood science and technology in India begins with the diploma level course. Matriculates with science and mathematics background are eligible for this 3 years course. Graduates with physics, chemistry, biology, mathematics and engineering subjects are eligible for the post graduate programmes. Further, there are several specialization subjects like wood waste utilization, plywood, fibreboards, etc. However, access to wood science and technology education at all levels has widened significantly over the last two decades. Hence, human resource development (HRD) in wood science and technology sector has become so important for better understanding and management of forest and agricultural resources. It is also necessary to introduce the wood technology subject at all levels in village schools and colleges

Table.1: Institutions/Universities offering Wood Science &Technology courses in India.

No.	Course	Institution/University	Address
1	M.Sc.Degree in Wood Science &Technology (2 years)	Forest Research Institute Deemed University(FRIDU)	Dehradun, Uttarakhand
2	M.Sc.Degree in Wood Science &Technology (2 years)	Dr.Yashwanth Singh Parmar University of Horticulture and Forestry	Solan, Himachal Pradesh
3	M.Sc.Degree in Wood Science &Technology (2 years)	Kannur University(KU)	Kannur,Kerala
4	M.Sc.Degree in Forestry (Wood Science) (2 years)	Kerala Agricultural University (KAU)	Thrissur, Kerala
5	P.G.Diploma in Wood and Panel Products (1 year)	Indian Plywood Industries Research & Training Institute (IPIRTI)	Bangaluru, Karnataka
6	a. Diploma in Advanced Woodworking (1 year) b. Certificate course in Wood Product Designing and Development	Institute of Wood Science & Technology(IWST)	Bangaluru, Karnataka
7	Diploma in Wood and Paper Technology(3 years)	Government Polytechnic College	Thottada, Kannur, Kerala
8	Diploma in Wood Technology (3 years)	Kashmir Government Polytechnic College	Gogji Bagh, Srinagar, Jammu& Kashmir

because they produce a good quality education from childhood.

1. Diploma and post graduate diploma courses: In India, the Government Polytechnic College, Kannur is conducting a three-year diploma course in the field of Wood and Paper Technology with the objective of imparting professional training to the students with regard to processing technologies for efficient utilization of wood. The subjects covered by this course include: forest and forestry, raw materials for wood and paper industries, wood seasoning and preservation, saw milling, veneering, manufacture of wood products like particle board, MDF, value added products like mouldings, cornices, skirtings, deckings, etc; plywoods, blockboard, flushdoor, synthetic resin manufacturing, pulp and paper manufacturing, specialty papers and boards, interior design engineering, etc. The job opportunities are in interior fields, estimation, interior design and drawing, particle board and MDF industries. There is great demand for the diploma holders in Wood and Paper Technology and all the students are placed through campus interview arranged by placement cell.

The Government Polytechnic College, Srinagar has recently introduced the second diploma course in Wood Technology in the country under the World Bank Technical Education Project-III to impart technical education to the students. A special workshop is under construction for conducting the practical sessions where all modern machinery required in wood based industry will be installed with the financial assistance of World Bank.

The Bangaluru-based Institute of Wood Science and Technology (IWST) is conducting two programmes: a Diploma course in advanced woodworking and a certificate training course in Wood Product Designing and Development for individuals, students, carpenters, persons working in wood-based industries. The training programmes address the skill development in the area of woodworking to attain global competitiveness by using state of the art machineries and on completion of the courses; the trainees will be able to handle advanced woodworking machines for product development.

Another Bangaluru-based institute i.e., Indian Plywood Industries Research and Training Institute (IPIRTI) is conducting a Post Graduate Diploma course in Wood and Panel Products Technology for young science and engineering graduates who are selected on all India merit basis. The major part of this one-year training programme involves the actual transfer of skills through hands on experience at the pilot plant of the Institute simulating the factory conditions. Trainees are also exposed to actual industrial environment through study tours. To develop communication skills amongst the trainees, seminar presentation and project works are also organized. The main objective of the course is to prepare the trainees to shoulder various responsibilities in the wood based industries. The course also aims at imparting professional knowledge and skills with regard to processing technologies for efficient utilization of wood through conversion into engineered wood and a variety of panel materials/products viz. plywood, particle/fibreboard, block board, flush door. It includes processing technology on bamboo-mat based panel products and adhesive technology. Standardization aspects with respect to quality management and BIS certification are dealt with in details. Working knowledge on use of computers and internet is also imparted. Emphasis is given not only to theoretical background of various technologies but also acquaintance with wood panel processing machinery and training imparted on operation of machinery in laboratory and pilot plant scale.

2. Post graduate courses: The Master in Wood Science and Technology programmes of FRI Deemed University (FRIDU), Kerala Agricultural University (KAU), Dr.Y.S.Parmar University of Horticulture and Forestry and Kannur University aim to provide opportunity to the students wishing to pursue professional careers in science and technology of wood as natural resource and to make themselves aware about the problems related to wood as basic material to manufacture various useful products. The programme is designed to provide the students with specialized knowledge and skills in the properties, manufacture and utilization of wood and related biomaterial products and also to improve the qualitative, quantitative and futuristic aspects of students. The structure of the curriculum is developed to synthesize multi-disciplinary knowledge in the biological and physical science of wood and its industrial application. Emphasis is also given to provide a fundamental education in the properties of wood basics of wood anatomy, chemistry, physics, mechanics, as well as processing knowledge and techniques to manufacture solid and composite wood products. The students are also expected to improve their capacities as leaders and managers through study tour, industrial attachment and excursions and other opportunities. Human Resource Management and Marketing and Enterprise Development are also the part of syllabus to build their entrepreneurial skills and aptitude.

III. CHALLENGES AND FUTURE PROSPECTS

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1. Syllabus, Teaching methodologies and Lab facilities: To begin with, the need of amendments in syllabus has been the greatest challenge. Since four decades, the world wood science has changed a lot and we are still in the same course designed in the1990s. Current curricula of post graduate courses should be amended to meet new challenges for educating the future students in wood science. The curriculum should be at par with those of developed nations so that graduates could be familiar with the global trends. Timely update of the curriculum should be done with rigorous discussions with industry experts, government authorities, and academics. Through the revisiting of the courses being offered and revamping the course structure in order to shape the curriculum to be consistent with changing industry needs and to stay relevant with the advances in the technology, the demand for the graduates will be very high [2]. A core understanding of wood science, building technology, business, and emerging technologies such as engineered wood products contribute to their career success [3].

Some institutions are operating without proper and complete set of faculties, classroom, and laboratories and the teaching methodologies are of the spoon-fed type. Students totally rely on lecture notes. There should be regular monitoring of academic institutions to check if the operation of pilot plants, laboratories, and faculties are in place. Students should develop the habit of consulting different reliable sources to deepen their knowledge. Teaching faculties should encourage the use of student journals, motivate students for writing-to-learn assignments, practice cooperative and collaborative learning techniques, accommodation of varying learning styles, and methods to enhance problem-solving abilities and critical-thinking skills.

2. Research Culture: Institutions should have separate research units with qualified manpower and well-structured laboratories and should encourage the faculties to participate in research and publication process. Research can be carried out in a collaborative manner too. After completing preliminary studies, the sample may be micro-analyzed in sophisticated laboratories of foreign universities. This will help to upgrade the research status of both the institutions. It is also necessary to have a close cooperation with specialists from related branches of science and engineering in order to increase the potential of wood as a material and also to develop the scientific, technical skills and knowledge of the student community [4][5].

3. Industry tie-up: Lack of cooperation among academia and industries makes it difficult when it comes to conducting in-plant trainings and internships. This might be due to the flooding of interns from all academic backgrounds, be it science based or others. Lack of uniformity in pay scale motivates the mobility of fresh graduates from industries. This turnover has been a headache for industrialists.

4. Inter-teaching: Inter-teaching has been found as a novel approach to facilitate students of wood science. It is a 20- to 30-min student-to-student discussion which includes reciprocal peer tutoring, cooperative learning, and problem-based learning. Lectures should be accompanied by hands-on or visual explanations. More emphasis should be given to practical demonstrations and that may be performed in wood industries itself. But there must be mutual understanding among them.

5. Interaction with industrialists: All institutions should arrange regular interactive sessions with industrialists or wood technologists from leading industries as practiced by FRI University, Dehradun, for the benefit of the students in deepening their understanding of the present industrial scenario. Fig.1 shows one of the interactive programmes organized by FRI University on 23rd August, 2018 for the students of M.Sc. WST. During this one-day session, Mr.Subhash Jolly, President of the Wood Technologists Association offered various tips to the students for succeeding and excelling in wood-based industries from his experience in the field of wood technology, especially from his association with various plywood manufacturing units in India.

6. Placement Cell: To help the students in finding suitable employments in their chosen field, there should be regular placement cells in institutions consisting of a placement officer and representatives of students from respective programmes. The functioning of the placement cell of FRI Deemed University as summarized below is an excellent model for adopting by other institutions.

Fig.1: M.Sc. WST students of FRI Deemed University interacting with Mr.Subhash Jolly, President of the Wood Technologists Association, India

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● FRIDU will prepare students profile cum placement brochure every year and will send invitation to various companies/organizations for placement.
●After confirmation from companies/organizations, suitable date for placement/ interview is decided as per mutual convenience. The companies/organizations can ask for the resumes of students and has the liberty to shortlist them. The list of shortlisted students is to be mailed to the placement cell of FRIDU by the companies/organizations at least 7 days prior to the campus selection date.
●The companies/organizations are required to also keep an extended shortlist prior to visiting the campus for interviews as some students shortlisted by them may already get placed before the campus selection date assigned to the company.
●The final results of campus selection/ interviews should be submitted to placement cell FRIDU within 7 days along with a waiting list. After declaration of the results, companies/organizations need to send offer letter/ joining letter to selected student through placement cell FRIDU within 2 weeks.

IV. NOVEL RESTRUCTURING ATTEMPTS

During the last decade, in order to meet the recent challenges for educating the students, the institutions offering the wood technology courses in India have attempted to restructure the academic programmes to help unlock the potential of the students by focussing on quality teaching on the lines followed by the institutions abroad(Table.2). Realizing that Industry-Academic partnership is a strategic necessity in today's challenging global knowledge economy, one of the institutions has entered into a collaborative academic programme of 'Dual Mode' as practiced in Germany and other European countries. The alliance to this effect was signed with Kannur University and announced in the year 2015. This 'Dual Mode' is a joint programme consists of theoretical classes for six months in the Kannur University and six months of in-plant training at the WIP in an academic year. As part of this

Table 2: Major restructuring of Wood Science & Technology programmes in India

No.	Institution/University	Attempts to restructure the programmes
1	FRIDU	Separated wood technology from the original PG degree programme on Forestry in 1996
2	IPIRTI	Major restructuring of the course is in progress in 2020
3	Institute of Wood Science & Technology(IWST)	Course started in 2018 and later added short-term courses of 4 month duration
4	Dr.Y.S.Parmar University of Horticulture and Forestry	Renamed and restructured degree
5	Kannur University	Course started in 2008 and later entered into a collaborative academic programme of 'Dual Mode' with a leading Wood-based Industry in 2015
6	Kerala Agricultural University	Under ICAR, it has a full-fledged Forestry College and in 2010 started a Dept. of Wood Science.
7	Govt. Polytechnic College, Kannur	Course started in 1982 as Diploma in Wood Technology and Renamed and restructured in 1991 as Wood and Paper Technology
8	Govt. Polytechnic College, Srinagar	New course funded by a World Bank Technical Education Project

unique initiative, the students get substantial practical exposure through hands-on experience on various processes employed in the wood processing units of The Western India Plywoods Ltd. Following are some of the highlights of this programme:
Certificate from Industry: Students get the M.Sc. degree in Wood Science &Technology from the University and a certificate by The Western India Plywoods Ltd, after the completion of 2 years.
Scholarship: WIP pays scholarships of Rs 5000/- per month to each of the 24 students of the first year and 24 students in the second year (a total of 48 students in an academic year).
Field study tour: Field visits to the captive plantation sites of the industry and nearby forest areas are arranged to learn to identify trees with the help of field guides, use of crosscut saws and other logging tools and plantation management techniques, continuous assessment of students' performance during the training sessions by qualified R&D team and end semester project and dissertation works under the guidance of technical experts (Fig.2).

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Training session by experts: As part of the training programme, interactive sessions between the the students and the experts in the field who visit the company for technical or business purposes are also arranged by WIP. For instance, a special session with Dr.R.N.Kumar, former Head of R&D and renowned wood polymer technologist was organized for the 2018-20 batch was conducted on 4th July, 2019 (Fig.3). In a very lively and interesting way, Dr.Kumar shared his experience in the field of wood technology with the students. He also discussed various ongoing research activities the world over in the field of wood and lignocellulosic composites both in industries and academic institutions. He also shared the memories and reminiscences of his experience in the field of wood drying and wood adhesion with the world renowned wood scientist, Prof.Kollmann in the Institute for Wood Research and Wood Technology, University of Munich, Germany. The narration of his interactions with the Malaysian students in the Department of Wood Paper and Coatings, Universiti Sains Malaysia, Penang, Malaysia was useful. During his talk, he also offered useful tips to the students for excelling in their studies as well as their professional life in future. There was an enthusiastic response from the students who asked a number of questions.

The R&D Division plays an active role both in coordinating the activities with the industrial units as well as extending all the facilities of the in-house Unit for practical training. The syllabus for the course was so designed by the R&D team under the expert guidance of Dr.R.N.Kumar that the students will have expertise in

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Fig.2: M.Sc. WST students of Kannur University during a field study trip to Periya, Wayanad, a training session in the Plywood factory and a special session on Quality Management Systems at WIP

Fig.3: M.Sc. WST students of Kannur University interacting with Dr.R.N.Kumar, renowned wood polymer technologist

saw milling operations, plywood and compreg manufacturing, synthetic resin manufacturing, manufacturing of fiberboards (softboard, hardboard and pre-compressed press board) and block boards and flush doors. During this training period, the students also get exposure in management, accountancy, marketing, materials procurement, safety, standardization, etc. and are therefore ideally suited for employment in the wood-based industries both in our country and abroad. They also become resourceful with entrepreneurship potential to take up 'start-up' programmes in the production of wood-based panel products and furniture.

V. CONCLUSIONS AND RECOMMENDATIONS

In the U.S, Wood Science and Technology education in what has traditionally been called wood science or forest products has been plagued by low enrolments for decades [6][7]. But the problem faced by India is the very slow progress in terms of the number of institutions offering this programme, when compared to many other professional courses. At present, there are only 8 institutions in the country for the wood technology programmes including diploma, post graduate diploma and post graduate courses. There is scope for more institutions to start the WST course. State Agricultural Universities, Government Polytechnic Colleges and Institutions like IWST, Bangaluru; KFRI, Thrissur, etc. having expertise and facilities for training activities on improved, better and efficient utilization of wood and other lignocellulosic materials, may be encouraged to start suitable academic (degree/post graduate degree) programmes in WST. Urgent changes in the academic curricula of on-going wood technology courses are imperative in order to provide a profound technology education to the students, which has to create the intellectual backbone of tomorrow's forest-based industries and a knowledge-based society as well and it should be done with rigorous discussions with industries, government authorities and academics to improve the quality as well as the employability of the wood technology professionals [8].

Some ideas and suggestions arose during the above discussion are listed here in no particular order of significance, as recommendations for the overall improvements of the WST programmes in the country:

1. Introduce the subject at graduation levels (B.Sc.WST degree course) and at lower classes, under the crown umbrella of ICFRE at FRIDU, Dehradun and/or at different educational institutions and colleges. According to Stables, introducing technology into the curriculum of young learners is important because of the propensity of this age group to engage in technological activity with an enthusiasm, curiosity and lack of inhibition that creates an optimum opportunity for development [9]. The teaching of science in the early education levels also helps us to prepare scientists and technologists needed for the development of research and innovation in future as a foundation for economic prosperity and welfare of emerging economies [10].
2. Encourage novel attempts by institutions and extend Government support to the efforts to collaborate with other institutions or industries within the country. The collaborative programme of this kind was found to be successful in the field of higher technical education, when Indian Institutes of Technology (IITs), National Institutes of Technology (NITs) and some private engineering institutes implemented an unique and innovative industry-linked engineering education and training system, as per the guidelines of All India Council for Technical Education (AICTE) [11].

Similarly, international cooperation among the wood technology institutions in South Asian countries may be started based on bilateral agreements, covering the exchange of teachers for shorter or longer stays and students for summer practices. This type of cooperation as one of the possible ways to improve the forestry educational system was financially supported by the parties of agreement and has been working well in central and eastern European countries. The bilateral contacts led not only to the development and improvement of educational systems, but they resulted in good international cooperation in research programs, and common publication of scientific papers and textbooks [12]. The international partnerships also facilitate institutional development, foster research and innovation, enhance quality of education and create opportunities of resources exchange, including but not limited to information and knowledge [13].

3. Fill various teaching posts in universities to empower the education and encourage extending short duration Adjunct faculty positions for industry experts with proper relaxation in their age or educational backgrounds
4. Professionals associated with Wood Technologists Association, India should work together with others- industry members of IPIRTI Society, research institutions and those in the regulatory and public policy communities for better training and employment for young wood technologists. Regarding the job opportunities, the wood-based industries including the furniture units should facilitate the recruitment of wood technologists, considerably reducing the number of candidates employed from non-technical professions for managing their manufacturing and quality control facilities.
5. Efforts are needed to prod the Central Government for the establishment of a statutory body under the Ministry of Science &Technology, with more authority to coordinate/monitor and promote all institutions and industries associated with the research and training activities in the field of wood science and technology.

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