



# BFRI

*at a Glance*



Government of the People's Republic of Bangladesh  
**Bangladesh Forest Research Institute**

Chattogram, Bangladesh

[www.bfri.gov.bd](http://www.bfri.gov.bd)

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BFRI Technologies

# BFRI

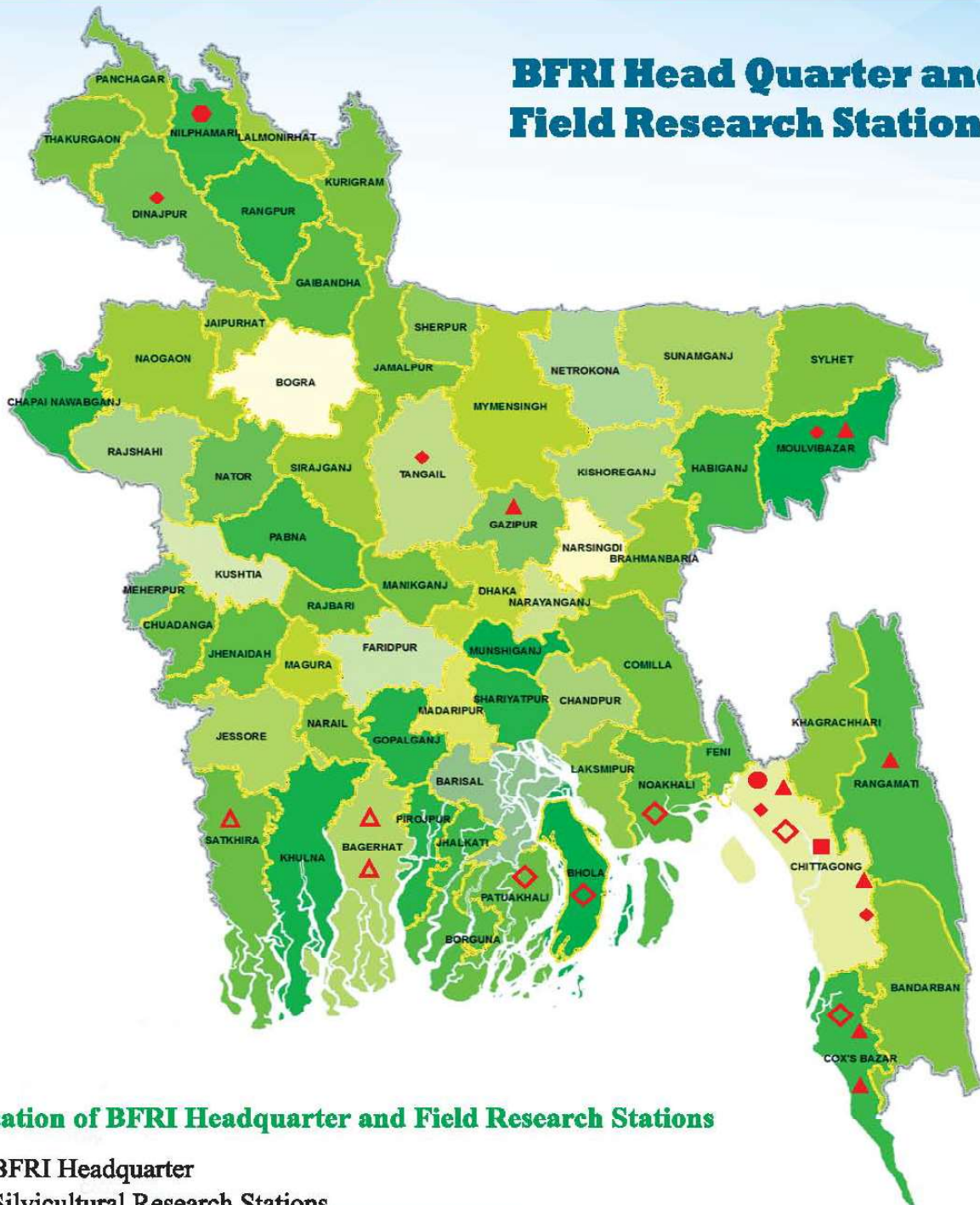
## *at a Glance*

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# Bangladesh Map

## BFRI Head Quarter and Field Research Stations



### Location of BFRI Headquarter and Field Research Stations

- BFRI Headquarter
- ◆ Silvicultural Research Stations
- ▲ Seed Orchard Research Stations
- Minor Forest Research Stations
- △ Mangrove Research Stations
- ◇ Plantation Trial Unit Research Stations
- Regional Bamboo Research & Training Centre (RBRTC)



## Message

It is my pleasure to see the BFRI *at a Glance* has taken a praise-worthy step to compile its strength, role and contributions in the forestry sector both to the readers at home and abroad. It has now been more than half century since the establishment of Bangladesh Forest Research Institute (BFRI)

that it has become the center of excellence spearheading forestry research for increasing the productivity of forest land through improved management of forest resources, forest protection, tree improvement, efficient utilization of forest produces, improving livelihoods of forest dependent people, economic growth and natural resource conservation. The mandate of BFRI is to undertake research in all aspects of forestry aiming sustainable productivity of forest land and forest industries, reduce the demand-supply gap on forest, increasing the benefits derived from trees and forest resources through conservation and sustainable management practices innovation. Our research is focused on the conservation of natural forest ecosystem; identification the sustainable management of plantation forests; species site suitability and managing trees on farms; developing and promoting the quality of forest products and services; providing integrated pest and disease management; tree improvement and germplasm conservation; plant tissue culture, bio-technology and molecular biology. We also address the emerging issues such as climate change and any other field identified by the stakeholders. We strive to share the information and developed technologies among the stakeholders, communities, foresters, scientists and others. We also provide technical advice and technology transfer in partnership, collaboration and cooperation with various government agencies, NGOs and private sectors. The knowledge gained from research conducted at BFRI will continue to enhance socio-economic benefits for forest management practices around the country and aid in forest policy decision-making. BFRI is dedicated to address current forestry issues, while providing the opportunity, under secure conditions, to investigate anticipated forestry issues that have yet to arise.

It's my great privilege to be the Director of BFRI just before the start of centenary celebrations of birth anniversary of the founding Father of Bangladesh. I envision our institute as part of a vital strategy to invest in emerging research field and more devoted to conduct, support and encourage extensive research on forest related application and services. I encourage your presence in our institute which is a mesmerizing gift of nature and inspired by the innovation, ambition and creativity. Hopefully this brochure will be helpful for the readers to get an insight about BFRI in brief.

**Dr. Md. Masudur Rahman**  
Director  
Bangladesh Forest Research Institute

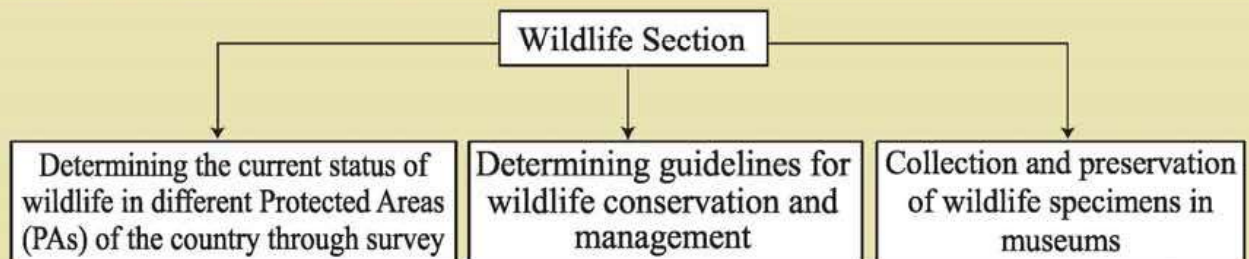


# Wildlife Section



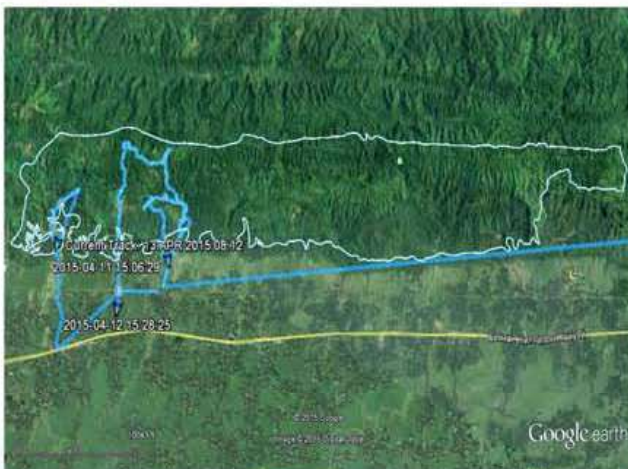
Wildlife is a research section of the Forest Management Wing of Bangladesh Forest Research Institute. It has been conducting research on wildlife conservation and management in Bangladesh since 1978. All the activities of this section are conducted under the direct supervision of the Chief Research Officer, Forest Management Wing. The section conducts wildlife related research in accordance with the needs of different consumer groups (government departments and research agencies, Bangladesh Forest Department, universities, NGOs etc.), their experiences and the advice of relevant specialists.

## Major Research Areas and Activities



## Research in the Wildlife section

Satellite images of google earth software is used with the help of GPS to determine the current status of wildlife in any forest and protected forest in the country and field level data. Transect lines are set up to conduct wildlife surveys through which an overall picture of any wildlife in any place will emerge.







Prepared transect line in Bariyadhala National Park using google earth and GPS

Information is also obtained by seeing wildlife directly, identifying wildlife signs (footprints, stools, tree marks, habitat holes, etc.), showing wildlife pictures to the people of the area and setting up camera traps to survey nocturnal animals.





Different species of wildlife and their sign

## Significant Research Success

### Conservation of Extinct Freshwater Crocodiles (Reptiles)

Freshwater crocodile is an extinct species of crocodile that was once found in most rivers of Bangladesh. Considering the extinction and local/international importance of the species in Bangladesh, the extinct species was collected from Madras Crocodile Bank in 1994 by 4 (4 females and 2 males) freshwater crocodiles with the financial support of Bangladesh Forest Research Institute, Bangladesh Agricultural Research Council and by establishing a crocodile breeding center (CBC) at Chattogram Zoo for breeding, success has come in breeding the species collected in that research center. Therefore, Bangladesh Forest Research Institute has set a shining example in the country and abroad by breeding extinct species of freshwater crocodiles to protect them from extinction, which is a transferable technology.

### Wildlife Museum

This section of the institute has established a wildlife museum which is completely different from the museums set up by different universities in Bangladesh where 60 specimens of rare species of wildlife are preserved. In order to create education, research and public awareness through collection and preservation of wildlife specimens in museums is assisting university researchers and the students of college and school level in wildlife research. All these preserved samples can be used as future reference. Students and teachers of different educational institutions, researchers of the universities, research institutes, NGO representatives are raising awareness about the conservation of various wildlife and its specimens through regular visits.

## Wildlife Survey of Different Protected Areas (PAs) of Bangladesh

A total of 102 species of birds, 27 species of mammals, 20 species of reptiles and 12 species of amphibians have been found in Baraiyadhala National Park (BNP) and 123 species of birds have been compiled at the Hazarikhil Wildlife Sanctuary (HWS) under the survey of that protected areas. Besides an illustrated report was published on 05 April 2018 in Daily Banik Barta under the headline "Birds of Hazarikhil Wildlife Sanctuary" A total of 33 species of mammals have been recorded from the Hazarikhil Wildlife Sanctuary. All this information and data will play an important role in wildlife management in two protected areas.



Pied hornbill at HWS



Hog-Badger at HWS



Small Indian Civet at HWS

## Initiatives for the Conservation of Wildlife and Birds

In order to create opportunities for bird nesting on the BFRI campus and to accelerate breeding success, three types of artificial nests have been set up in different trees and earthen nests and wooden nests have been set up. A total of 300 saplings of various fruit-bearing tree species have been planted on the BFRI campus for the purpose of providing food and shelter to birds and other wildlife. Among them there are different species of fig, civet, jagdumur, kalojam, chalta, gab, kaufal, gutgutia, uriam, chundul, amalki, haritki, bahera, jarul, bakul, palash, chapalish, mandar, notable.



Spotted owl has taken shelter in the clay pots



Set up wooden nests on trees in BFRl campus



Yellow footed green pigeon in BFRl campus



Leopard Cat in BFRl campus



Gardens created by the wildlife section for the conservation of wildlife and birds



## Future Plan

Determination of the current status of wildlife and its diversity in the protected forest areas of Bangladesh. Survey of floristic plant composition to find out the dependency of birds and mammals in the protected forest areas. Organize awareness programs for the conservation of wildlife.



# Forest Products Wing





# Veneer and Composite Wood Products Division



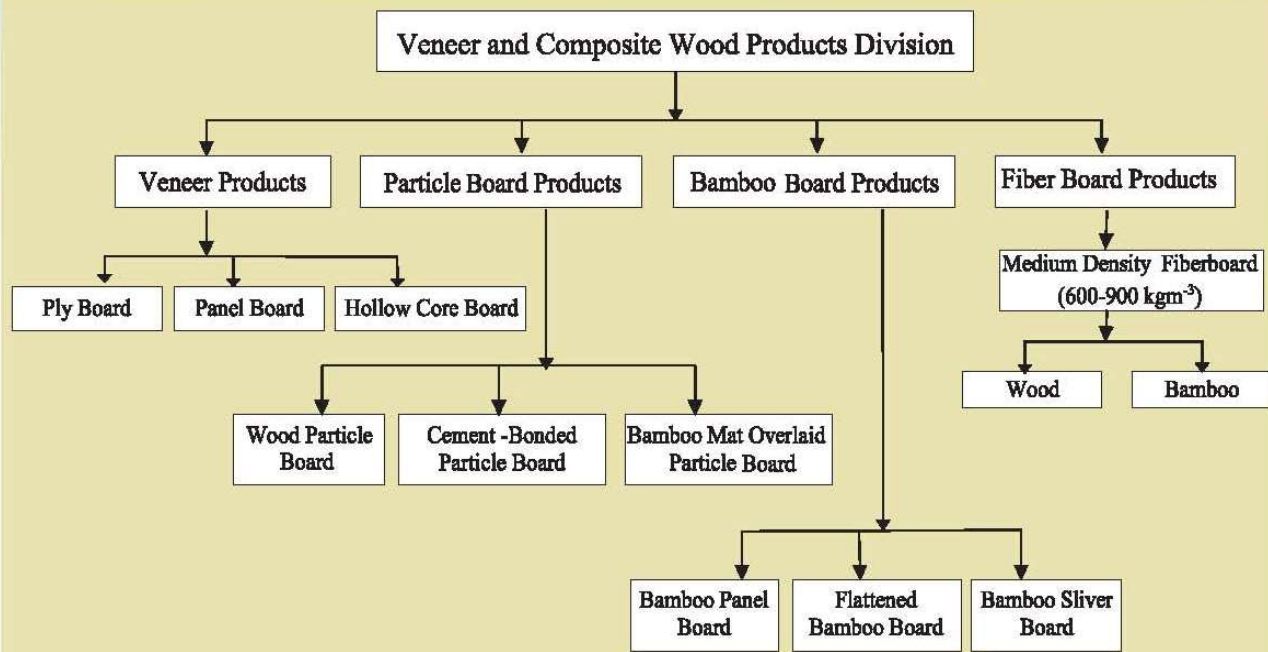
Veneer and Composite Wood Products Division (VCWPD) is one of the research divisions of Bangladesh Forest Research Institute. Its journey started from 1955. The wood resources of Bangladesh are more less than that of its need. One of the main aspects of the balanced and scientific use of this small resource is the use of composite wood products. Composite wood includes plywood, particle board, fiber board, hollow core panel board, cement bonded particle board etc. In addition, the invention of bamboo composite products of this division has been a great success in the field of research. To get a mature tree we have to wait for at least 20-25 years whereas matured bamboo species can be obtained by only 3-4 years. It is possible to transform any species of wood and bamboo through various processes in such a way that the innate quality and energy can be changed. In proportion to the population, the wood resources of Bangladesh are much less than the need. Therefore, in the context of the timber crisis, it is time to say that it is no longer solid wood but the use of composite wood and bamboo in various proposes.



Division and laboratory of Veneer and Composite Wood Products



## Major Research Areas and Activities



## Significant Technologies

- Veneer cutting technology
- Method of using glue on wood
- Plywood making technology
- Particle board making technology
- Hollow-core panel board making technology
- Cement bonded particle board making technology

## Veneer Cutting Technology

Among the other qualities of wood, the main one is that if the weight is taken instead of wood, the wood is harder than steel but light and lovely. This is a very important product. Wood, it also has some flaws. The shape changes with the change of condition around the wood. Solid wood furniture cracks or bends when used. One of the scientific results of efforts to correct these defects is composite wood. Plywood is a composite wood. Veneer is one of the main ingredients in its (plywood) making. Veneer is actually a thin sheet of wood made with the help of veneer lathe machine. When the veneer does not dry well, it becomes infected with bacteria and decays quickly.

## **Method of using Glue on Wood**

Glue (urea formaldehyde/resin binder) is essential for making composite wood. In addition, in the case of use of glue, the instructions of the glue producing factory must be followed properly. Glue is very essential in the manufacture of various types of composite wood such as plywood, laminated wood, hollow-core board, particle board, fiber board, bamboo composite panel and mat over laid particle board.

## **Plywood Making Technology**

Plywood is a high-quality composite wood that is made by gluing a few wood veneers together. An odd number of veneers are usually used in plywood. The experiments of Veneer and Composite Wood Products Division were carried out on the ability of veneer to cut and add glue to nearest 54 wood species. Plywood especially is used in making tea chests, packing boxes, furniture etc. Making plywood will ensure maximum utilization of forest resources and reduce the pressure on forest resources.

## **Particle Board Making Technology**

Particle board, also known as chip board, is an engineered wood product manufactured from wood, bamboo or jute-stick chips and a synthetic resin or other suitable binder, which is pressed with the presence of heat. The suitability of making particle board is tested by mixing nearest 55 different tree species wood chips and three species of bamboo chips. This technology has been used by various particle board making industries including Bangladesh Forest Industry Development Corporation (BFIDC). Manufacturing of particle boards will reduce the pressure on the frequently used timber and ensure maximum utilization of forest resources.

## **Hollow-core Panel Board Making Technology**

The method of making low cost hollow core panel board has been invented by Veneer and Composite Wood Products Division. It saves 30%-50% wood. Door panels, partitions, furniture, etc. made of hollow core board are very light and easy to use. Low quality and discarded wood can also be used in hollow core boards. The technology has been used by Bangladesh Forest Industry Development Corporation (BFIDC) and other furniture manufacturing factories.

## **Cement Bonded Particle Board Making Technology**

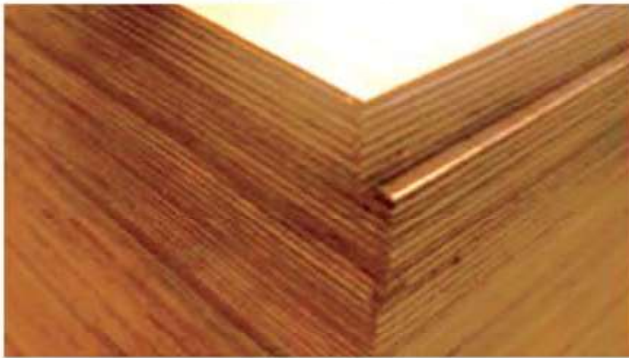
Cement bonded particle board is a type of board similar to particle board made of wood/bamboo chips. The research was carried out by making this board applying pressure and by mixing portland cement with wood or bamboo chips (7:3). It is suitable for use as a building material. These boards can be used to make walls (inside and outside), doors and ceilings. It is durable, its water tolerance level is high and has fire resistance capacity. This board can be easily cut and bore like wood with a saw and nails and threads can be inserted. Ensure maximum utilization of unused forest resources. The establishment of industrial factories will create employment.



Veneer lathe machine



Glue mixture machine



Plywood



Particle board



Hollow core panel board



Cement bonded particle board

## Current Research Focus

### Bamboo Composite Technology Development

Research activities were carried out on making bamboo panel boards from thick-walled chemically preserved borak (*Bambusa balcooa*) and baijja (*Bambusa vulgaris*) bamboos by applying pressure in the presence of heat using urea formaldehyde glue as a binder. The technology of making bamboo mat overlaid particle board was invented by applying pressure in the presence of heat by mixing planer dust. Bamboo panel board and mat overlaid particle board are used to make bamboo composite furniture, which is aesthetic and durable. The production of bamboo products will reduce the pressure on forest resources and ensure maximum utilization of forest resources. The establishment of industrial factories will create huge employment opportunities in this labor-intensive industry.



Bamboo Composite Panel & Particle board and Products

## Fiber Board Making Technique

Fiber board is a type of engineered wood product that is made of wood/bamboo fibers under the influence of pressure in the presence of heat. Types of fiberboard such as Low Density Fiberboard (LDF), Medium Density Fiberboard (MDF) and High Density Fiberboard (HDF). The possibility of making medium density fiber board is tested by mixing glue with fiber. Veneer and Composite Wood Products Division carried out research work on making two species of wood and one species of bamboo fiber for making Medium Density Fiber (MDF) boards. It can be used to make high quality furniture and home interiors. The production of these boards in industrial factories will ensure efficient use of unused forest resources.



Medium Density Fiber (MDF) board

## Future Plan

Veneer and Composite Wood Products Division will continue its research work to reduce the import dependence of the country's furniture industry and form self-reliant industries. In this way, just as the industry of bamboo composite furniture and fiber board will be easily developed, the bamboo products will be within the purchasing power of the people. The method of making panel board made of bamboo slices, which is now common in Bangladesh, is quite time consuming and expensive. So, as an alternative to this method, if the technology of making bamboo sliver board can be invented, then high quality bamboo panel board can be made in the country at a low cost.

# Wood Preservation Division



Wood Preservation Division (WPD) is one of the most important research divisions of the Forest Products Wing of Bangladesh Forest Research Institute. The journey of this division started from the establishment of BFRI. This division was established with the aim of ensuring efficient use of forest resources and increasing longevity through application of preservative treatments.



Wood preservation laboratory



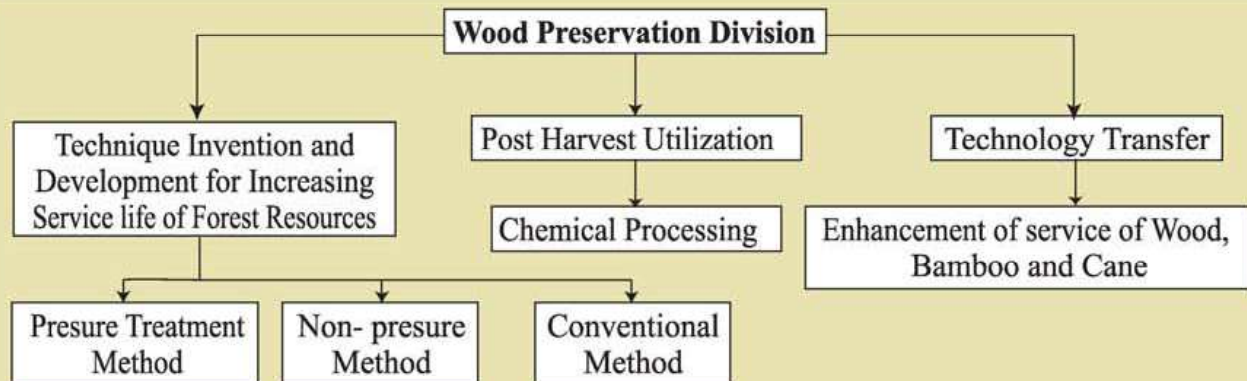
X-ray analyzer



Rotary vacuum evaporator

The major function of this division is to conduct research on the efficient use of forest resources and increase their use through chemical processing. To date, the division has developed preservative techniques for about 100 species of wood, bamboo and cane, increasing the practical life expectancy and working to extend these technologies among the stakeholders.

## Major Research Areas and Activities



## Pressure Treatment Method

Since 1956, preservation of wood, bamboo and cane through chemical treatment using pressure methods has been started and work is underway to determine the use of different chemicals, their application techniques and schedule determination. About 70 (seventy) species of wood, bamboo and cane preservation techniques have been successfully developed and adapted to this method, which have already been extended to different stakeholder groups. In addition, research activities are underway on the application of chemicals to invent and develop more effective methods depending on the quality of the wood used.



Application of chemicals through pressure treatment plant



Bamboo preservation through Boucherie method



Bamboo preservation technique by Sap-displacement method

## Non-Pressure Treatment Method

Since its inception, the division has been conducting research activities to increase the practical life expectancy of wood, bamboo and cane in a non-pressure chemicals applied manner and has been successfully implementing it in conserving forest resources. In this method, preservation techniques of about 30 (thirty) species of wood, bamboo and cane have been developed and extended among different stakeholder groups. As it is cheap and does not depend on machinery, research activities are underway to ensure its successful application and expansion across the country, especially in rural areas.



Various applications of non-pressure chemical methods (preservation of wood, bamboo strips and raw whole bamboo)

## Traditional Treatment Method

From prehistoric times, various preservation methods of wood, bamboo and cane have been in vogue, such as pinet, smoking, brushing, spraying, etc., the successful application of which has ensured the preservation and efficient use of forest resources. In particular, the application of these methods is more observed in rural areas. The division is working on the development and extension of these conventional methods.



Leaching method



Smoking method



Brushing method



Spraying method

## Conservation of Forest Resources

Due to population growth and climate change, the amount of forest and forest resources in Bangladesh is declining like the rest of the world. As a result of application of chemical treatment technology invented/adapted by this division, the practical life span of wood, bamboo, cane, sawdust etc. is increased by about 4-5 times. About 30 (thirty) entrepreneurs have been created in different parts of the country so far to ensure proper use of forest resources.



BFIDC, Sreemangal



Batajor, Barishal



Kalurghat, Chattogram



Palashbari, Gaibandha

Application of treatment technology

### Notable Technologies

- Enhance the service life of wood, bamboo, cane etc. by preservative treatment;
- Increase the service life of bamboo sticks, bamboo poles and sun-grass used in betel leaf farming after preservative treatments;
- Enhance the service life of wood and bamboo furniture's by preservative treatment;
- Railway-sleeper, house and electrical pole protection techniques;
- Rubber wood treatment techniques by pressure method.



Treated bamboo house



Treated rubber wood furniture



Treated bamboo stalks in betel leaf farm



## Training and Advisory Activities

Wood Preservation Division provides technical and advisory services to the Forest Industry Development Corporation (BFIDC), International Organization for Migration (IOM), Mongla Port and other consumer groups on the determination of penetration and retention of chemicals in treated wood and bamboo. The division also provides training, technology transfer, technical assistance and advisory services to various government, private, individual and farmer levels in the country on increasing the practical life span of wood, bamboo, cane, etc. by applying chemicals.



Providing training, technology transfer, technical assistance and consulting services

## Current Research Focus

Various research activities have been undertaken to further enhance the durability of wood and bamboo through better chemical preservation and their application. Among them, research activities on the use of Disodium Octaborate Tetrahydrate (DOT) and Zinc Chloride as preservatives and determination of treatment schedule are ongoing.

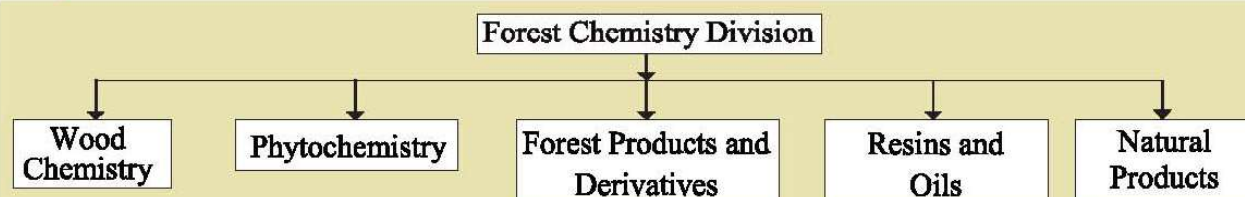
## Future Plan

Research activities are underway to diagnose treatability and natural durability of wood, bamboo, cane, etc. and to increase the number of treated species such as Kalo koroi and Pitali wood. Work is also underway to determine the physical and mechanical properties of chemically treated wood, bamboo, cane etc.

# Forest Chemistry Division

*F*orest Chemistry Division (FCD) is one of the leading research divisions affiliated to the Forest Products Wing of Bangladesh Forest Research Institute. This division was established in 1955 when BFRI started its journey as Forest Product Laboratory. It has a well-equipped research laboratory enriched with FT-IR, GC, Spectrophotometer, rotary vacuum evaporator, orbital shaker, magnetic stirrer, flame photometer, furnace, clevenger, etc. The division has been working successfully ensuring the best utilization of forest resources by analyzing their structural compositions and disseminating the developed technologies among the stakeholders.

## Major Research Areas and Activities



The research activities of FCD includes (a) Structural analysis of different trees to ensure their optimal utilization; (b) Based on wood chemical composition, provide information on their preservation techniques; (c) Providing information on pulp production depending on the presence of cellulose, hemicellulose and lignin; (d) To develop simple extraction techniques for resin/oily substances from forest trees; (e) To make various chemical derivatives of forest products; (f) Research on artificial agar resin generation and quality improvement of crop plants through application of nanotechnology.

## Research on Different Species of Trees and Bamboos

The most important function of this division is to analyze the structural compositions of different species of trees and bamboos to ensure their better utilization. Provide information on the various uses of wood and bamboo based on the amount (%) of cellulose, hemicellulose, starch and lignin present.

For example, (a) if the amount of lignin or starch is high or the amount of cellulose and hemicellulose is low, it is not good for pulp production; (b) the higher the amount of cellulose and hemicellulose including lignin, the more suitable it is for external use; (c) provide information about the chemicals used in preservative treatment based on the



Schematic diagram for analysis of wood and bamboo

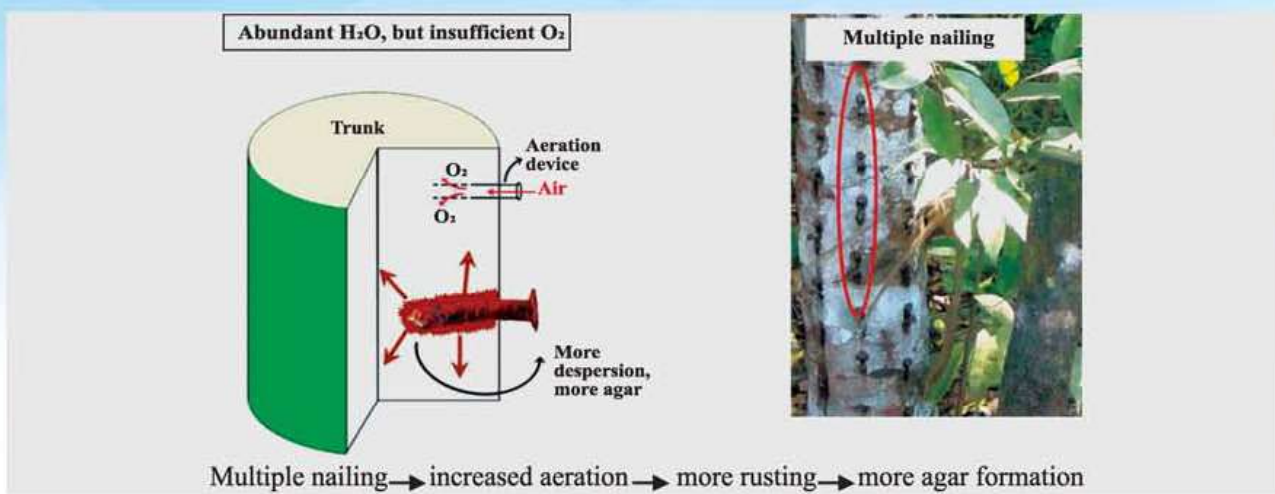
quantity and type of extractives and starch present in the sample/specimen. The division has so far analyzed the structural composition, durability, physical and chemical properties of 11 (eleven) species of trees and 07 (seven) species of bamboo to ensure their better utilization. Moreover, work is underway to analyze the chemical composition of 4 (four) more species of bamboo.

### Research on Medicinal Plants

To gain knowledge and suggest the possible uses of medicinal plants by analyzing their chemical constituents. To date, phytochemical analysis of a total of 7 (seven) medicinal plants and their anti-oxidant efficacy have been confirmed in this division, the number of which is gradually increasing.

### Research on Agarwood

Naturally and habitually, a small number of trees produce small amounts of agar resin (according to the data of natural forests, agar resin is produced into 5-6% of plants in 50-year-old gardens and into 8-10% of plants in 60-year-old gardens). The most common artificial method used in Bangladesh for agar resin formation is iron nailing that produces very little and low quality resin. In this regard, an artificial technique/technology has been developed that produces high quality resin into the whole tree by applying different types of chemicals. Moreover, an advanced nanotechnology based technique has been developed that led to the formation of agar resin in just 6 months, which is waiting to be studied on a pilot scale. Additionally, the quantity and quality of oil extraction from agar-wood has been improved, with extraction increased by about 50% and extraction period reduced from 15-20 days to 8-10 days. To increase the production of resin, strategies have been developed by putting the double nail and the same nail step by step without interring it at once.



Formation of 2-3 times higher agar-resin than conventional iron nailing method by multiple-iron nailing method



High quality agar-resin formation is possible within just six months through nanotechnology

### Production of Acetic Acid from Golpata Juice

Although delicious molasses and fermented ethanol are produced from the golpata juice, the production of acetic acid directly from the juice is one of the major achievements of this division, where the yield was 15-17%. The vinegar produced from this acetic acid is completely natural and has a distinct taste and flavor.

### Poultry-Feed Production from Rubber Seed Kernel (RSK)

Although there are many rubber plantations in Bangladesh at present, there is no commercial use of rubber seeds or oil produced from these rubber plantations. This division, in a joint study with Bangladesh Council for Scientific and Industrial Research (BCSIR), confirmed the use of rubber seed kernels as an alternative to conventional poultry feed up to 5% diet ration. Consumption of more than 5% increases the mortality rate of chickens due to digestive problems. Moreover, there are future plans for research work on grease, soap and lubricant production from the obtained rubber oil.

### Production of Food Coloring from the Seeds of Vermilion Tree

Food-color production techniques have been developed from the seeds of the vermilion tree. There are no health risks as it is natural.



### Tannin Production Technique

Generally, tannery uses a lot of inorganic chemicals containing heavy metals that are very harmful to the environment. In contrast, naturally occurring chemicals (tannins) used in skin tanning are not harmful to the environment. Tannins production techniques have been developed from the bark of various mangrove species such as- goran, kankra, poshur, etc.

### Technology Innovation, Development, Extension and Advisory Works

Many technologies invented/ developed by Forest Chemistry Division have become popular among stakeholders. Of them (a) improvement of oil extraction system from agar-wood where the extraction efficiency has been increased by about 50% and extraction period has been decreased from 15-20 days to 8-10 days; and (b) improvement of the traditional iron nailing method for agar-resin production in Bangladesh so that the production can be increased up to 2-3 times. Without these, the division in collaboration with the Training and Technology Transfer Unit (TTTU) of BFRI works to extend the invented/developed technologies to the field. Moreover, to extend technologies to the mass people through social media, various posts are created from this division.

### Current Research Focus

At present, an experiment is underway to extract high quality aromatic agar-oil through steam-distillation which will enable agar-planters, new entrepreneurs and beneficiaries to extract high quality aromatic agar-oil in a short time and at low cost. Another study is underway to increase the durability and beauty of wood with the help of super-hydrophobic coatings and enable self-cleaning. Under the RBRTC project, work is underway- (a) chemical characterization of four bamboo species; bhudum (*Dendrocalamus giganteus*), kata (*Bambusa bambos*), muli (*Melocanna baccifera*), tolla (*Bambusa longispiculata*) and (b) study to determine the minerals, mycotoxins and vitamins present in edible bamboo shoots of them.

### Future Plan

On behalf of this division, a research project titled "Development of high quality agar-resin formation technology in whole-trees" is in the approval stage, which if implemented, will greatly increase the research capacity of this division along with the institute. Additionally, a study titled "Super Absorbent Polymers (SAP): A Modern Approach to Forestry and Agriculture in Drought Area" is under process.

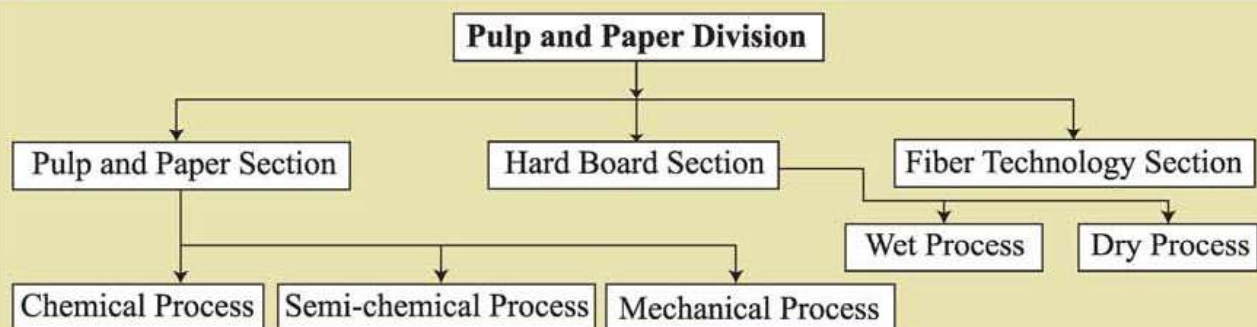
# Pulp and Paper Division

*P*ulp and Paper Division is one of the leading research divisions under the Forest Products Wing of Bangladesh Forest Research Institute. Although BFRI started its journey in 1955 under the name of “Forest Products Laboratory” with the aim of inventing technology for the efficient use of forest resources, the research activities of this department started from 1959. There is no single pulp producing species which meets the demand for pulp, paper and board mills in Bangladesh. The aims and objectives of the establishment of this division were (a) to determine the suitability of making pulp, paper and board from native wood, bamboo and grass species and (b) to innovate and develop strategies to increase pulp production rate and improve quality.



Laboratory of Pulp & Paper Division

## Major Research Areas and Activities



Significant research activities conducted by this division are (1) to determine the suitability of rural tree species, jute, bamboo, sugarcane bagasse, grass and fast growing indigenous tree species for pulping and bleaching process; (2) development and improvement of chemical pulping and bleaching process at optimum condition using

catalyst. To date, more than sixty (60) research studies on pulp and paper have been completed in this division. In these studies, fourteen (14) species of wood, six (6) bamboos and six (6) grass species have been tested for quality pulp and paper production. For the purpose of making hardboard, pulping techniques of twenty (20) species of hardwood and grass species have been developed. In addition, fibers of forty eight (48) woods, seventeen (17) bamboos and sixteen (16) grasses have been prepared and analyzed.



Schematic diagram of paper/board preparation

Pulp and Paper Division has a total of three sections. Since its inception, the division has been conducting research activities in the paper technology section and hardboard section, but later in 1976, the fiber technology section was included in the division.

### Paper Technology Section

The function of the paper technology section is to make and analyze high quality pulp for making paper suitable for writing and printing. Chemical pulping techniques have been applied to produce high quality pulp from kadam, civit, shimul, dhaincha, gamar and siris. The obtained pulps from these species were suitable for making printing, writing and wrapping paper in our domestic paper industry. The paper produced from dhaincha with neutral sulfite semi-chemical method (NS-AQ) had glossy properties. However, its surface is rough and hard. As a result, more research is needed on its commercial production. Three grass species of Sylhet region viz., Acre, Null and Reed were mixed in 1:1:1 to make high quality pulp by Kraft method. The obtained pulp was suitable for making writing, printing and wrapping paper. For making quality paper based on pulp strength, fourteen (14) woods, six (6) bamboos and six (6) grasses species had been explored in this section and the quality of paper had been verified in this section. Moreover, different types of paper were produced with different proportions of hardwood and their subsequent properties have been determined.

## Hardboard Section

Hardwood pulp was made from native wood and bamboo species by mechanical pulping process and its usefulness were determined. The suitability of hardboard making pulp from a total twenty (20) hardwoods and grass species were determined. Hence, their hardboards were made and tested. Suitable hardboard can be produced from mechanically produced pulp from champa, chapalish, civit, gamar, gewa, gorjan, sundari, shimul, white siries and malacana, koroi. In addition, it has been possible to make high quality insulation boards from rice straw and five (5) grass species such as Blue-panic, ratz, *Themda arudinacea*, ridley and sacram.

## Fiber Technology Section

This section deals with fiber quality analysis to get a preliminary idea of the pulp suitability of different species for making pulp. Fibers of forty eight (48) timber, seventeen (17) bamboo and sixteen (16) grass species had been prepared and analyzed under this section. The results of the studies showed that out of them thirty eight (38) wood, fifteen (15) bamboo and nine (9) grass species are quite suitable for making pulp.

## Innovation and Expansion of Technology

Although there are more than a hundred paper and board mills in Bangladesh, the only pulp producing paper mill is Karnafuli Paper Mills Limited (KPML), Kaptai, Rangamati. The Department of Forests (FD) produces and supplies the required raw materials on the requirement of KPML and recommendation of the Pulp and Paper Division, BFRI. Accordingly, the Kaptai Pulpwood Division of the FD has planted gamar, kadam, sada koroi, kala koroi, raj koroi, chakuya koroi, chatial, vadi, chapalish and jam etc. on 15,692 hectares of land to supply raw materials to KPML.

## Developed Technologies

- Increase the yield and quality of pulp produced from native trees species.
- Evaluate the effect of age differences of kadam trees on pulping by Kraft method and determine their yield.
- Preparation of high quality pulp in a mixture of one or more species, e.g., pulping of *Albizia richardiana* with a mixture of *Bambusa vulgaris*.
- Making pulp from the stems and branches of rubber trees and determining their characteristics.
- Developed a process for producing high quality pulp from low grade jute.
- Evaluate the effect of Magnesium (Magnesium Sulphate) salt on hydrogen peroxide bleaching of pulp.



Determining the usefulness of keora wood in making hardboard.

Determining the suitability of 21 months old muli bamboo for producing pulp and the characteristics of the paper produced from it.

Determination of suitability of 4, 6, 8, 10 and 12 years old gamar and akashmoni for producing quality pulp.

Effect of molecular oxygen for the delignification of pulp produced from rubber trees.

### **Current Research Focus**

Pulp and Paper Division is conducting research to ensure the proper use of waste paper and reduce production costs in order to protect the environment and address the effects of climate change. In addition, to reduce the environmental pollution some research activities have been taken to process optimization of pulping and bleaching.

In addition, research activities are underway to determine the effects of appropriate chemical doses to determine the most favorable environment for pulping and bleaching to reduce environmental pollution.

### **Future Plan**

To alleviate the shortage of raw material, conduct research on making pulp and paper in a mixture of tree and bamboo.

Accomplish the bleaching process by environment friendly chemicals such as peroxide and ozone.

Enzymatic treatment of waste paper instead of heavy metals containing inorganic chemicals.

Invent and develop pulp making techniques based on mathematical modules.

Modernizing the waste management in the pulp and paper industries.

Production and characterization of nano-composites and nano-papers from nano-cellulose.

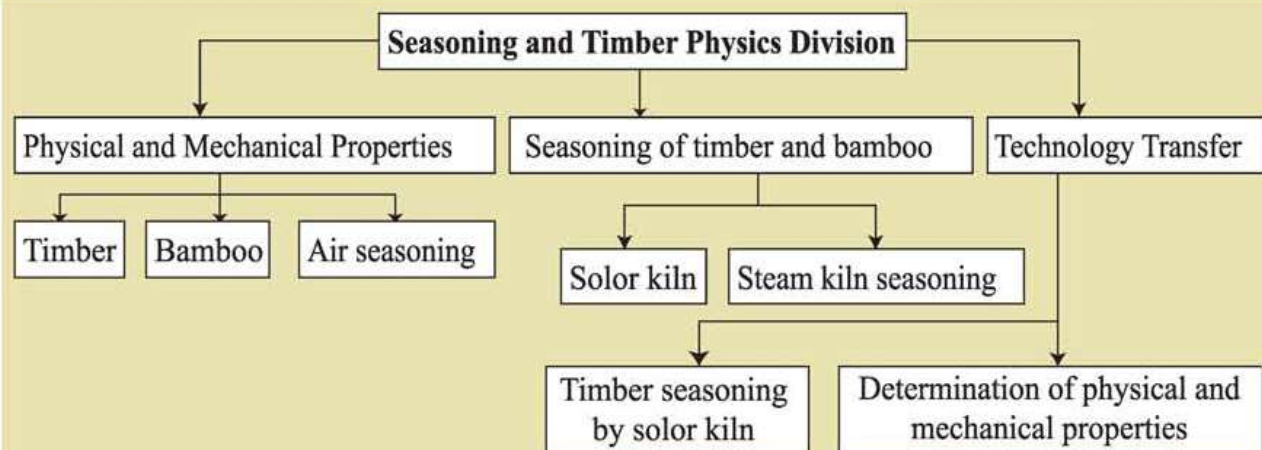
# Seasoning and Timber Physics Division

Seasoning and Timber Physics Division (STP) is an important research division of Forest Products Wing of Bangladesh Forest Research Institute. It started its journey since 1955. This division was established with a view to the service life improvement and proper utilization of forest resources through seasoning methods. Since then it has been conducting research on postharvest utilization and physical process of forest resources. Technologies have been developed for increasing the service life of forest resources through conventional methods as well modern systems such as solar kiln and steam kiln method and disseminating the technology among the stakeholders.



Universal testing machine and other machines of laboratory

## Major Research Areas and Activities



## Wood Quality Improvement through Seasoning

Seasoning method was started at Seasoning and Timber Physics Division of BFRI in 1957. It is stated that seasoning techniques have been developed around 70 important timber forest species and published as in different publications. Research on seasoning process of wood and bamboo species has been continued till today under this division to increase the service life of forest resources and conserve the forest.



Solar kiln



Seasoning of wood

## Determination of Physical and Mechanical Properties of Wood

It was conducting research on determination of physical and mechanical properties of forest wood from very beginning. It is stated that physical and mechanical properties have been determined around 30 important timber and non-timber species and published as in different publications.



Determination of physical and mechanical properties of wood

## Conservation of Forest Resources

Bangladesh's forests have decreased significantly in terms of both area and qualitative status over the last few decades. The annual deforestation rate is estimated to be around 3.3% due to lack of proper utilization of forest resources. If adopted seasoning technology, the service life of wood, bamboos etc. will be increased 4-5 times. As a result, the misuse of house building materials is decrease and increase the forest and forest resources. Till today, around 25 entrepreneurs have been developed by this division and the directly applied seasoning technology to increase the service life of forest products and conserve the forest.

## Some Notable Technologies

Enhancing the service life of wood, bamboo, cane etc. house building materials and produced furniture by solar and other seasoning methods.

Seasoning method of railway sleeper, housing and electric pole.

Seasoning technique of rubber wood.

## Advisory Works

Determination of physical and mechanical properties are given to different stakeholders.

Training, technology transfer, technological support etc. are given to stakeholders.



Some advisory works

## Training Activities

Training programme on seasoning of wood and bamboo through Solar Kiln.



Training on seasoning of wood and bamboo

## Current Research Focus

Current research programmes are focused on determination of physical and mechanical properties of wood by heat treatment and also for different bamboos species.

## Future Plan

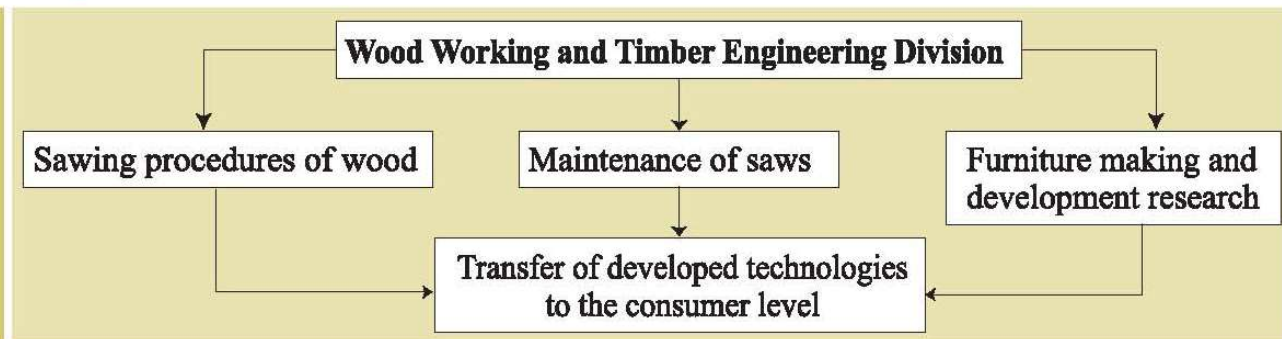
Bangladesh has a rich heritage of biological diversity in natural forests. Some of the opportunity areas in conservation of forest resources include forest resource management, post harvest utilization and chemical processing by application of modern treatment technology. In this regard, we have a plan to design of our future research to develop improved seasoning schedule for wood and bamboo seasoning.

# Wood Working and Timber Engineering Division



Wood working and Timber Engineering division is one of the research divisions of Forest Products Wing of Bangladesh Forest Research Institute. The journey of this division started from its inception. Research activities on wood sawing methods, saw maintenance, furniture making and development are conducted in this division. This division has also developed a simple technology to make attractive materials by attaching different colored wood together using glues. The technology of making furniture from rubber and chambal wood is one of the significant innovations of this division. In addition, relentless efforts are being made in this division to make durable, attractive and environment friendly furniture with different species of wood with the help of modern technology keeping pace with the present age.

## Major Research Areas and Activities



## Practical uses of Different Machineries

**Saw Mill:** Tree species collected from the forest are cut as raw material as required initially.

**Cross-cut Saw:** Sliced the wood vertically.

**Jointer Machine:** Smoothing the oblong pieces of wood on one side or on both sides.

**Circular Saw:** Large pieces of wood into oblong pieces and cut them to size.

**Thickness Planner:** Make pieces of wood to the required thickness.

**Mortise Machine:** Fittings fitted to the pieces of wood by making rectangular/square holes of required size.

**Moulder Machine:** Curves the edges of small pieces of wood.

**Drill Machine:** Makes round holes in different parts of the furniture as per the required size.

**Sander Machine:** Smooth the pieces of wood by rubbing them with sandpaper just before making the furniture.

**Jig Saw:** The various designs required to enhance the beauty of furniture are made through this machine.

**Wood Turning Lathe Machine:** Rotates the pieces of wood into cylindrical and funnel shaped. The pieces of wood are also cut and perforated evenly at both ends.

**Grinding Machine:** Reshape or sharpening various equipment.

**Hand Cross-cut Saw:** It is a hand-held tool by which pieces of wood are cut at different angles or in curved directions.

**Band Saw:** This saw is used to cut small tree into pieces.

**Band Sharpener:** Sharpening in order to increase the cutting efficiency of the saw.



Sander machine



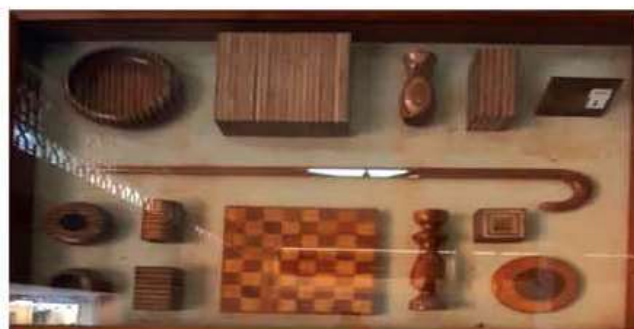
Mortise machine

## Preservation of Wood Specimens of Different Species

The Division of Wood Working and Timber Engineering has preserved some samples of the results of research on different species of wood at different times for making furniture.



Specimen of different wood species



Fancy materials made with wood pairs of different colors

## Innovation and Expansion of Technology

Some popular technologies have been developed by the division of Wood Working and Timber Engineering. Innovative techniques for proper preservation and effective use of different types of saws used in making furniture have also been expanded at various times through presentation, exchange of views and training at various conferences at the national level. Durable and eco-friendly furniture and tiles made of rubber wood are significant innovations of this division.



Samples of wood made furniture



Fancy stuffs



Wood made tiles

### Current Research Focus

At present, least conventional wood species are being studied, except for the most common conventional furniture making, and we continue our relentless efforts to create sustainable and environment friendly furniture by increasing their durability through strength determination, conservation and chemical treatment at various stages. Also the boring, planing and finishing properties of relatively less strong wood species such as Toon and Tetuya koroi are being monitored excuted.

### Future Plan

The natural forests of Bangladesh are rich in various plant species. The use of forest resources in making fancy furniture for our personal or commercial needs is very common. The tendency to make furniture with some species of wood is mainly due to its natural strength. As a result, only certain species, such as teak, mahogany, champa, gamma, garjan, kathal, am, raintree, etc., are declining in number due to their increasing dependence as wood. In this case, it is planned to bring the research results to the consumer level by researching on naturally less strong wood species and increasing their durability through strength testing, conservation and chemical treatment at various stages to make them sustainable and environment friendly furniture.

# Way Forward

**B**angladesh is endowed with diverse flora, fauna, micro-organism and beautiful landscape that harbors a mosaic of life forms. However the forests, woodlands, shrub lands, grass land and their habitats have been subjected to over exploitation and destruction for the increasing need of large population. Pollution has become one of the devastating threats to human life, the environment and biodiversity. Globally, the issues of deforestation, pollution and climate change have been recognized as serious threats to human wellbeing and the environment in general. To reverse and halt such potential threats research and production of convenient packages of information and technology as plausible solutions. Bangladesh Forest Research Institute under the administrative controlled of the Ministry of Environment, Forest and Climate Change (MoEFCC) conducts research to develop management practices to increase the productivity of natural forest and to convert wastelands and marginal lands, conserve or restore environmental balances through increased stocking densities of forests.

Most forest issues today are global and it makes a lot of scope to connect, cooperate and share knowledge and experiences on a global scale. We will establish a effective channel to participate public and private universities and other research institutions, as well as the private sector, to facilitate the design, development and implementation of research programs that are responsive to the country's development requirements, as well as to those of sustainable forest management and resource conservation. In establishing those connections, forest research will increasingly encompass the investigation of emerging forestry, biodiversity, and climate change related issues. Bangladesh Forest Research Institute (BFRI) has published its renowned journal Bangladesh Journal of Forest Science (BJFS) every half yearly. Bangladesh has a rich heritage of biological diversity in natural forests. Forest genetic research is crucial for future forest health, adaptation, conservation and sustainable forest management. Conservation of forest genetic diversity, including dynamic *in situ* and *ex situ* conservation and forest genetic monitoring are all major forest management tools for future. In this regard, we have a plan to design our future research to develop improved protocols for plant regeneration and genetic transformation of important forest crops.



There will be paradigm shifts in silviculture and forest management to maximize productivity and resilience of forest ecosystems. If we are able to conduct more relevant and responsive research work on the concept of climate change resilient forest, then our country will have to play a major part to mitigate climate change successfully. The awareness about the need to communicate about the forests and forest research is raising in the scientific community. Connecting people with forest science needs innovative approaches and we are keen to take such initiatives. Urban forestry is more and more important for future of forests with rising urbanization and large population of our country. We can take initiatives to extend forest education and pedagogic activities to make popular urban forestry among mass people. We can initiate research work in collaboration with urban planners. Forestry and wood processing industry will play a major part in the bio-economy. Already many technical advances are being put to good use by industry, but the bio based nanomaterial's offer a positive outlook and research for the future. Wood mobilization will play a key role in supplying the bio economy with sufficient resources. The social, health and psychological roles of forests are increasing in importance as well, but there is a lot of potential for research in these fields as we need more concrete conclusions and data and manage for them in a better, more informed way. Also, forest tourism can mean a lot economic benefits.

Hence, the mandates of BFRI can be updated with the, growing demands of time where research development and training on conservation can be added in addition to existing charter of duties. To play effective role as a national level research organization, its mandates and charter of duties need to be overhauled by a group of experts. Fruitful applied research at BFRI must be ensured by initiating a new mechanism of Key Performance Index (KPI) of working scientists there.