DEPARTMENT OF SCIENCE & TECHNOLOGY
FOREST PRODUCTS RESEARCH & DEVELOPMENT INSTITUTE

2021 DOST-FPRDI

ANNUAL REPORT

"Providing R&D and techno-transfer services in the use of wood and non-wood forest products"

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MISSION

Generate, improve and transfer appropriate technologies and information on efficient utilization of forest-based products to make local industries more competitive in the domestic and global markets and to benefit the general public.

VISION

A renowned leader and center of excellence in forest products utilization research, development and technology transfer.

MANDATE

Under section 23 of Executive Order No. 128, FPRDI is mandated to perform the following functions:

- Conduct research and development on wood and non-wood forest products;
- Transfer technologies; and
- Provide technical services and trainings.

Message of the Secretary

I am honored to congratulate the DOST- Forest Products Research and Development Institute (FPRDI) for their accomplishments and the extraordinary opportunities they offered to the forest products industries, communities and stakeholders. Your commitment and resilience propelled our stakeholders to stay strong amid the COVID-19 pandemic.

Your vision to be a globally recognized and world-class leader and center of excellence in forest products innovation, technology transfer and technical services, is evidenced by your efforts to leverage your technologies and services to continually revitalize the country's forestry sector.

For the year 2021, you championed environment-friendly and high-value forest products. You increased the efficiency of abaca fiber for high-end industrial products; improved the processing, durability, aesthetics and sound quality of bamboo musical instruments; developed forest woody vines as handicraft raw materials; explored fragrances and flavors using plant materials for antimicrobial soaps and hand mists; and developed wine barrels from tree plantation species, among others. Aside from this, you focused on technologies with more energy-efficient and environment-friendly sawmilling, drying, machining and wood preservation methods.

To keep micro, small and medium enterprises (MSMEs) afloat amid the challenges brought by the pandemic, you launched the Forest Products Technovation Hub. It composes of three newest facilities: the Forest Products Innovation and Training Center (FPITC), the Bamboo Musical Instruments (BMI) Processing Center, and the Forest Products Technology Business Incubator (FPTBI).

Aside from investing on state-of-the-art machines and processing technologies for your testing laboratories and R&D facilities, you provided MSMEs and technopreneurs start-ups and business development services. This was through your technical expertise on DOST-FPRDI technologies; training and mentoring on feasibility study preparation, product development, business and marketing.

I understand that with the special leadership skills of your researchers and techno-transfer experts, they continually served as mentors and coaches. This helped your clients develop and grow technological skills, business abilities and entrepreneurial talents that will enable them to achieve and be productive at all times.

You pride yourselves with the diverse and highly effective long-term R&D programs such as Bamboo Processing and Industry Development; Flavors and Fragrances from the Forest Technology Program (F3TP); Human Security and Defense R&D Program; Gubat Obra: Forest-Based Creative Products S&T; Forest Products Nanotechnology; Philippine Forest Vines for Handicrafts and other Forest-based Industries; Natural Rubber Exudates and Wood Utilization; and Basic R&D and Services.

I am impressed with the impacts of your programs, activities and projects. You aimed to do more for the forest-based industries and communities you serve with a broader perspective and passion.

Congratulations! Wish you more fruitful years ahead!

FORTUNATO T. DELA PEÑA
DOST Secretary

Message of the Director

The year 2021 has certainly been like no other as the COVID-19 pandemic continuously presented one of the most challenging times. The DOST-FPRDI served as a lifeline to mitigate the economic impacts of the pandemic to our forest-based clients and communities.

We have taken strategies for the forest-based industries to cope with the economic impacts of the global health crisis. We rolled out our technologies and services through our long-term research and development programs. These include Bamboo Processing and Industry Development; Flavors and Fragrances from the Forest Technology Program (F3TP); Human Security and Defense R&D Program; Gubat Obra: Forest-Based Creative Products S&T; Forest Products Nanotechnology; Philippine Forest Vines for Handicrafts and other Forest-based Industries; Natural Rubber Exudates and Wood Utilization; and Basic R&D and Services.

We started to capacitate returning OFWs in setting up their own businesses through the DOST's "TeknoLokal para sa Makabagong Bayani" webinar series to help them establish technology-based enterprises in the Philippines. FPRDI's bamboo processing technologies, engineered bamboo, charcoal briquetting, handmade paper making, skeletonized leaves and bamboo-framed face shield production were among the potential business ventures for the repatriated Filipinos and their families.

We helped technology-based start-up with all the necessary resources/support that the start-up would need to evolve and grow into mature businesses through our Technology Business Incubator (TBI) Program called "Peak Three".Our technical assistances were on wood and non-wood processing technologies; establishing linkages with investors; intellectual property protection; mentoring on business management, marketing and finance; and technology training and testing services.

The true heroes of the pandemic are the small wood and non-wood forest products enterprises. I am extremely grateful to our loyal partners in the private sector, science and technology community and non-government organizations and the camaraderie that exists between us.

I would like to acknowledge our very own Secretary Fortunato "Boy" T. de la Peña and Undersecretary Rowena Cristina L. Guevara, our funding partners - DOST-Philippine Council for Agriculture and Resources Research and Development (PCAARRD), DOST-Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD), the DOST Grants-in-Aid Program - and our entire DOST family for being incredibly supportive and caring and by empowering our agency to continue advocating and promoting science, technology and innovation to the forestry sector and allied industries.

I cannot thank the men and women of DOST-FPRDI enough for their unique impact in the lives of many forest-dependent communities for their livelihood and technological needs. Resilience was the key. Our employees turned the crisis into good by being resourceful and responding positively amid the pandemic.

We certainly learned that when we work together, we are stronger by partnering with industry and stakeholder.

ROMULO T. AGGANGAN
Director

2021 ANNUAL REPORT

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SCIENCE FOR THE PEOPLE

EXECUTIVE SUMMARY

The COVID-19 pandemic and its impacts may result in lasting changes for science, technology and innovation (STI). With uncertain outcomes due to the global health crisis, we strengthened our support to the forest-based industries and communities.

We gained positive changes in the openness and resilience of our researchers through accelerated adoption of digital tools and techniques. We built abilities to respond to challenges that require science-based solutions to the varied needs of our clients.

Working from home allowed for more flexible work engagements. Online conferences provide for larger and more diverse audiences than in-person meetings. Virtual communication and conferencing tools via Zoom & Facebook Live enabled new forms of research collaboration, knowledge exchange and the provision of training during the pandemic.

Bamboo stool developed by FPRDI

RESEARCH & DEVELOPMENT

For 2021, our accomplishments under the New Program and Expenditure Classification (PREXC) were a big improvement after the Coronavirus outbreak in 2020.

We implemented 100 regular-funded projects. Of which, 85 were continuing while 15 new and 19 externally-funded. We performed better this year in terms of our completed projects - 14 versus our target of 12.

Our three technical divisions: Material Science Division (MSD), Technology Innovation Division (TID) and Technical Services Division (TSD) carried out the Institute's functions and activities. Finance and Administrative Division (FAD) and Planning Staff (PS), on the other hand, were the support units of research and development.

In order for the forestry sector to remain vibrant, we rolled out our technologies through the Institute's high-impact R&D and S&T programs/services, namely:

- Bamboo Processing and Industry Development;
- Flavors and Fragrances from the Forest Technology Program (F3TP);
- Human Security and Defense R&D;
- Philippine Forest Vines for Handicrafts and Other Forest-based Industries;
- Gubat Obra: Forest-Based Creative Products S&T;
- Natural Rubber Exudates and Wood Utilization;
- Forest Products Nanotechnology;
- Basic R&D and Services;
- Science and Technology Services;
- Upgrading, Improvement/Expansion of FPRDI Testing Laboratories, and
- Equipment Development Program.

We maximized the use of digital technology to provide new value-producing opportunities to our customers. To better preserve our around 20,000 wood collection gathered from both local and foreign sources, our herbarium and xylarium experts began digitizing each wood sample. We are in the process of converting information into a digital format. The information and photos are uploaded and a QR code is assigned to each specimen for indexing and easy access.

Our customers will soon be able to identify a piece of wood by just using a smartphone, a cell phone that includes additional software functions such as email or an Internet browser. This will be made possible through a mobile application being developed by the DOST-FPRDI and DENR-Forest Management Bureau (DENR-FMB). The joint project aims to quickly and accurately identify selected wood species through a Wood Identification Mobile Phone Application using Android Operating System.

TECHNOLOGY TRANSFER

Under RA 10055 or the Technology Transfer Act of 2009, we transferred 13 technologies. Bamboo framed face shields, steam bending, charcoal briquetting equipment (drum kiln, manual briquettor, charcoal grinder, charcoal mixer), non-wood dryer, eco-dryer for handicraft and bamboo, eco-dryer combining heat treatment facility, finishing spray booth, furnace-type lumber dryer (FTLD), multi-purpose hot press and DIY bamboo shelter were adopted and transferred in Regions III, IV-A, IV-B, V, VII, X and XII.

We provided 470 consultancy/advisory services to 511 customers on bamboo technologies (engineered bamboo, DIY bamboo shelter, bamboo musical instruments, bamboo veneer lathe and bamboo-framed face shields) and charcoal briquetting technologies (charcoal production process, briquette, drum kilns, mixer, grinder and crusher).

We rendered technical assistance to 470 private enterprises/industries, government agencies, cooperatives and foundations.

We provided 399 consultancy/advisory services to our customers. One hundred seventy-eight (44.6%) were from private enterprises/industries, 136 (34.85%) government agencies, 7(1.7%) NGOs/cooperatives/foundations and 75 (18.7%) academic institutions.

A total of 1,357 participants from furniture and handicraft industries, academic institutions, out-of-school youths, people organizations and LGUs participated in 36 skills training-webinars.

As a Professional Regulation Commission (PRC) accredited Continuing Professional Development (CPD) provider, we offered four training courses with CPD units to 207 licensed foresters nationwide, private sector, members of the academe and other organizations on non-wood forest products preservation and treatment and basic finishing techniques. The courses were free of charge.

We filed 12 intellectual property applications. Two were to the Intellectual Property Office of the Philippines (IPOPHIL) through the SciTech Superhighway Program of DOST, namely:

- Lignocellulosic ignition Aid-coated Charcoal Briquettes
- Non-Hold-On Type Decorticating Machine for Abaca

Trademark applications on:

- Bamboo Musical Instruments (BMI)
- Bamboo Musical Instruments Processing Center

We submitted four copyright applications to the National Library of the Philippines. We are also awaiting the Copyright Registration Certificates for:

- Instructional Video on Bamboo Charcoal Hand Soap Making
- Instructional Video on Germicidal Soap Making
- Instructional Video on Tawa-Tawa Hand Mist Making
- K-FAP: Kawayan-Forest-Based Antimicrobial Products

IPOPHIL approved two Utility Model applications on:

- Manual Double Screw-type Mixer for Charcoal Briquetting
- Process of Producing Ballistic Vest from Engineered Woven Bamboo Mats with Metal Plates

Two international patent applications (Patent Cooperation Treaty/National Phase Entry) through DOST-TAPI on:

- Antimicrobial Bamboo Charcoal Hand Soap
- Process of Producing Antimicrobial Bamboo Charcoal Hand Soap

S&T SERVICES

We harnessed our Forest Products Science and Technology Services Program through the upgrading, improvement and expansion of our testing laboratories and services.

Our PNS ISO/IEC 17025: 2005-accredited testing facilities such as Pulp and Paper Testing Laboratory (PPTL), Furniture Testing Laboratory (FTL) and Plywood Testing Laboratory (PTL) acquired and upgraded more sophisticated testing machines to perform other test protocols required by the industry and based on customer demands.

We rendered 1,815 testing and calibration services to 401 customers, generating a total income of PhP 4 million. PPTL had 298 customers and PhP 897,217 income; FTL - 52 customers and PhP 1,836,000 income; and PTL - 54 customers and PhP 1,308,475 income.

Likewise, our other laboratories provided testing services to 165 customers and generated an income of PhP 1,239,164.

The breakdown of these laboratories is as follows: Bio-Energy and Equipment Development - 8 customers and PhP 39,720 income; Engineered Products and Development - 44 customers and PhP 134,165 income; Solid Products Development - 2 customers and PhP 7,056 income, Anatomy and Forest Botany - 17 customers and PhP 209,360 income; Chemistry and Biotechnology - 19 customers and PhP 207,030 income; and Physical and Mechanical - 75 customers and PhP 641,833 income.

To ensure the smooth operations of our programs, we received PhP 198,544,000 from the General Appropriations Act. Likewise, we received PhP 40,892,758.10 worth of grants from external sources. Testing, cooperative and other miscellaneous fees brought forth a total income of PhP 5,033,936.75

FEATURED STORIES

Modular furniture developed by FPRDI

DOST-FPRDI ROLLS OUT TECHNOLOGY THRU INCUBATION PROGRAM

A Laguna-based agro-forest farm learns the process of making antimicrobial soaps and hand mists developed by the DOST-FPRDI.

This, after the DOST-FPRDI partnered with the Laguna State Polytechnic University (LSPU) in providing technical assistance to Adoress Farm.

The initiative is under the National Agri-Aqua Technology Business Incubation Program of the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD).

DOST-FPRDI's technical expert, Dr. Jennifer P. Tamayo, will train Adoress Farm staff in developing the anti-microbial soaps and hand mists using their own plant materials. The Institute will also provide business development services and access to testing laboratories.

The farm will be one of the incubatees of the DOST-FPRDI Technology Business Incubator. Technology Business Incubation (TBI) hopes to accelerate the transfer and commercialization of research-based outputs in the country. TBI is an innovative process where an institution supports start-ups by providing them necessary technical and business development services.

The DOST-FPRDI has its own TBI called the "Peak Three".

Established in 2019 with funding grant from DOST-PCAARRD, Peak Three is intended as a support system for small or starting wood and non-wood forest products enterprises.

Among its services are assistance thru various wood and non-wood processing technologies; linkage with investors; assistance in intellectual property protection; mentoring on business management, marketing and finance; and technology training and testing services.

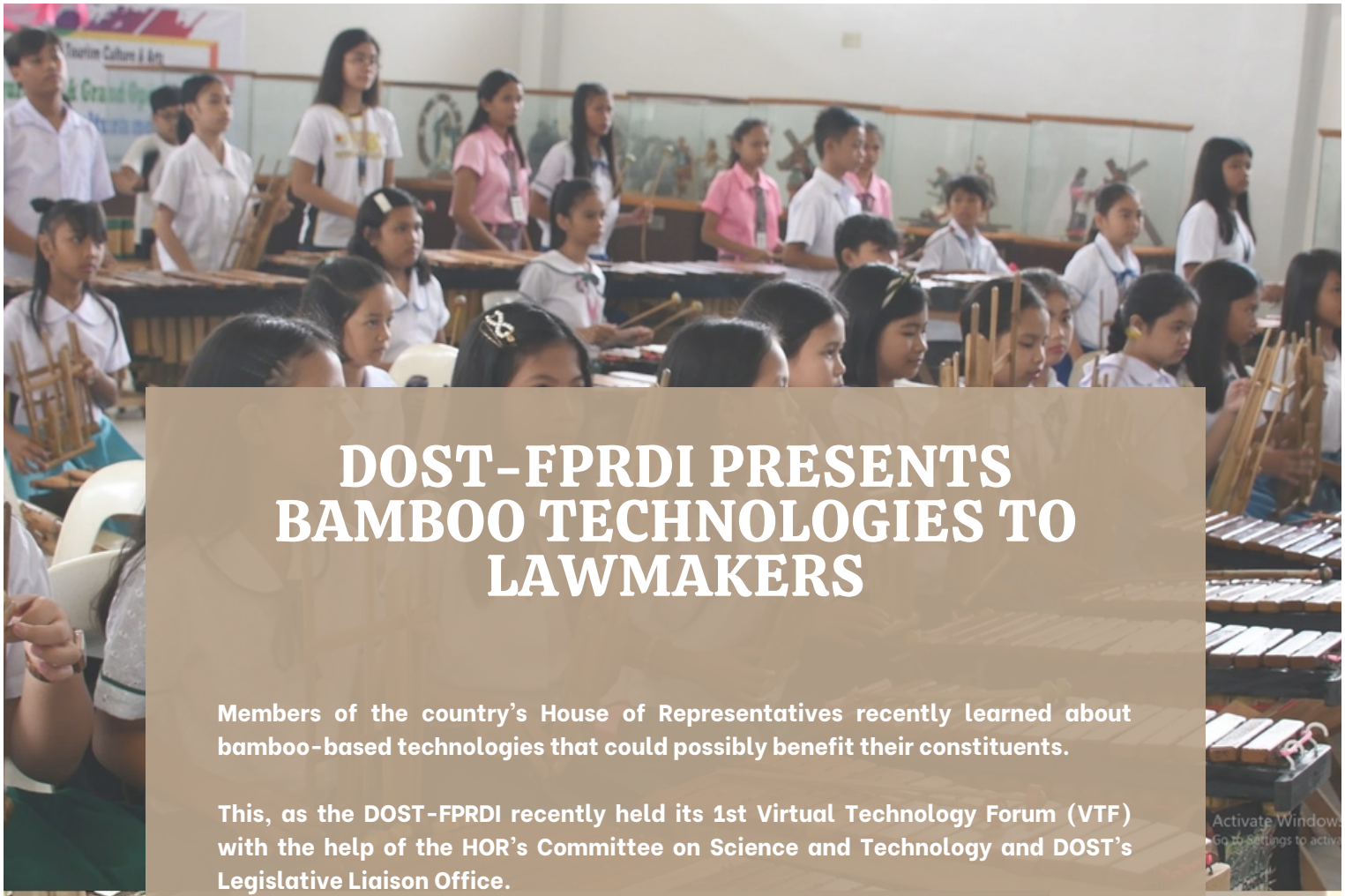
The partnership between two or more TBIs– such as the case between DOST-FPRDI and LSPU – is the first of its kind in the country.

Known as co-incubation, this collaboration is seen to bring "access to a wide range of services, larger pool of technical experts and network of investors and partners; better benefit-sharing of knowledge, facilities and equipment; and higher promotion of technology commercialization."

According to DOST-FPRDI Director Dr. Romulo T. Aggangan, the co-incubation initiative is an "excellent pathway for State Universities and Colleges (SUCs) and Research & Development Institutes to commercialize their technologies and collaborate in research and product development."

"We are encouraging start-ups or small wood and non-wood forest products enterprises to check out DOST-FPRDI's TBI. The Institute will be glad to assist you in moving your business to the next level," he ended.

Interested parties may contact DOST-FPRDI Director Dr. Romulo T. Aggangan at info@fprdi.dost.gov.ph or fprdi@dost.gov.ph.



DOST-FPRDI PRESENTS BAMBOO TECHNOLOGIES TO LAWMAKERS

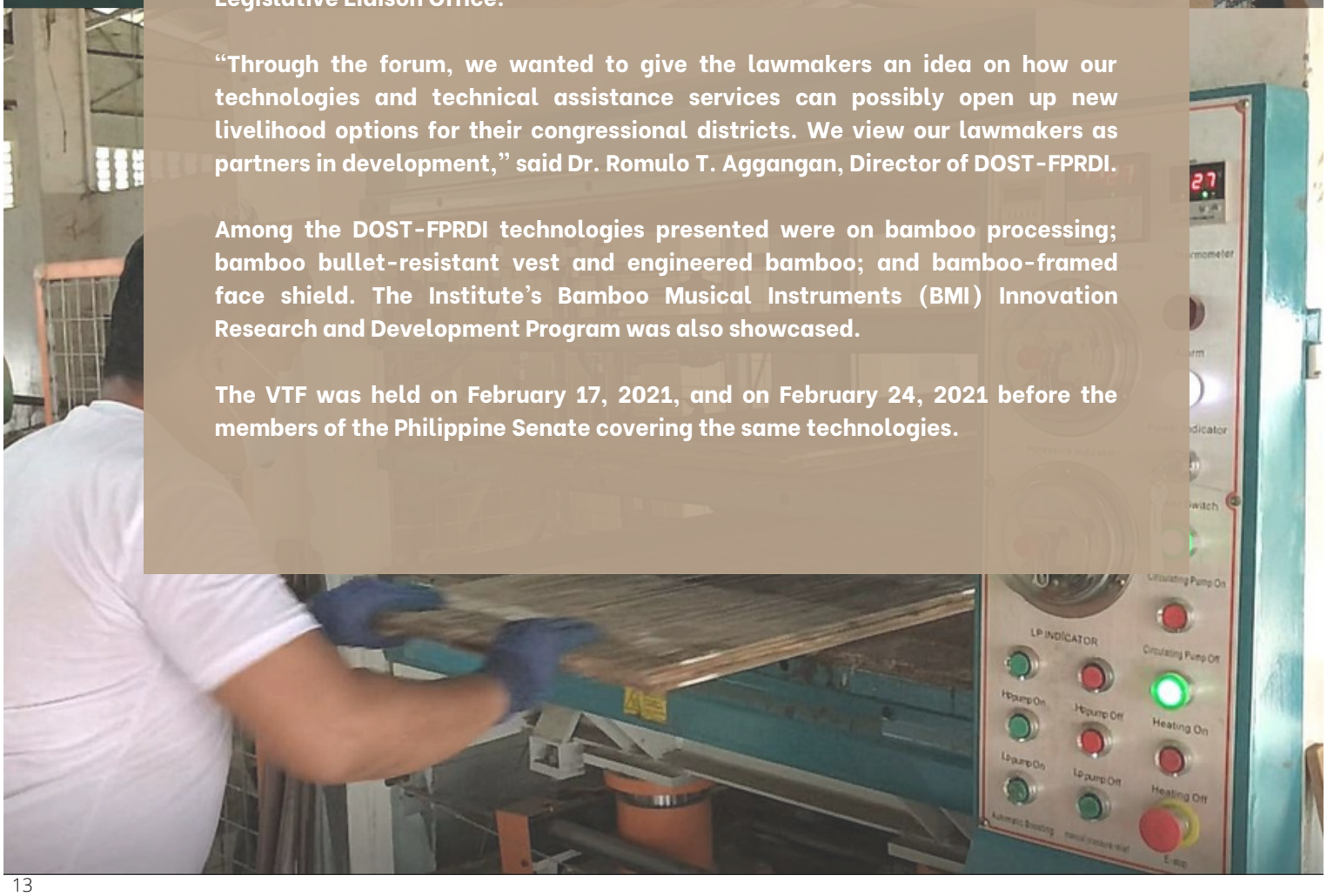
Members of the country's House of Representatives recently learned about bamboo-based technologies that could possibly benefit their constituents.

This, as the DOST-FPRDI recently held its 1st Virtual Technology Forum (VTF) with the help of the HOR's Committee on Science and Technology and DOST's Legislative Liaison Office.

"Through the forum, we wanted to give the lawmakers an idea on how our technologies and technical assistance services can possibly open up new livelihood options for their congressional districts. We view our lawmakers as partners in development," said Dr. Romulo T. Aggangan, Director of DOST-FPRDI.

Among the DOST-FPRDI technologies presented were on bamboo processing; bamboo bullet-resistant vest and engineered bamboo; and bamboo-framed face shield. The Institute's Bamboo Musical Instruments (BMI) Innovation Research and Development Program was also showcased.

The VTF was held on February 17, 2021, and on February 24, 2021 before the members of the Philippine Senate covering the same technologies.



DOST-FPRDI PRESERVES PRICELESS WOOD SAMPLES THRU DIGITIZATION

Treasures come in many forms and sizes.

For the DOST-FPRDI, a "treasure" may be an assortment of wood blocks that for many years now have been contributing to archaeology, the wood-using industries, and the country's anti-illegal logging campaign. The oldest of these blocks is 117 years old.

The DOST-FPRDI's Herbarium and Xylarium (Wood Library) houses around 20,000 wood samples gathered from both local and foreign sources. A go-to place for archaeologists, foresters and students for their wood identification needs, it has the most complete wood collection in the Philippines with more than 4,000 tree species to date, and about 108 contributing countries.

"After the American occupation in the early 1900s, American experts left their collection of wood specimens gathered from their exploration of Philippine forests at the then Bureau of Forestry. During World War II, it was transferred to the Philippine Forest School (now UPLB-College of Forestry and Natural Resources), then to the DOST-FPRDI," recalled Forester Glenn B. Estudillo of the Institute's Material Science Division- Anatomy and Forest Botany Section.

"This is a very rare and valuable collection since some of the collected species no longer exist in the natural forests. We have to protect them because it will be hard to stockpile and impossible to replicate this collection again," he said.

To better preserve the wood collection, DOST-FPRDI experts have began digitizing each sample. The process involves an inventory of the specimens and capturing high-resolution (20x) images using a digital microscope. The information and photos are uploaded and a QR code is assigned to each specimen for indexing and easy access.

"Every time we identify a piece of wood, we cut a thin portion off the sample. Doing this repeatedly will eventually 'shrink' the samples. Digitization will allow us to identify the wood species while preserving the wood blocks," explained Estudillo.

Wood identification is the scientific process of establishing the identity of a wood specimen based on its anatomical, physical and structural properties.

"With the aid of highly-magnified photos, one can identify the species faster and more accurately than simply using the naked eye and a hand lens. Digitization also allows for greater accessibility because anyone with an internet connection and a smart phone will be able to access DOST-FPRDI's digital wood library," he shared.

The Institute's wood identification service had been instrumental in the government's anti-illegal logging campaign as it serves as basis for charges filed against loggers and shipowners that transport illegally-cut timbers.

It also helped archaeologists understand how our ancestors lived by identifying wood specimens recovered from their study sites. Likewise, it is crucial to clients in the construction, furniture and handicraft sectors who need assurance on the identity of their wood materials.

Estudillo concluded "In this digital age, DOST-FPRDI promises to adapt in order to preserve these priceless specimens. We are currently in the process of completing the digitization while also applying for a copyright. We hope to share our digital wood library to the public soon."

DOST-FPRDI CHAMPIONED EARTH-FRIENDLY TECHNOLOGIES

Because of its name, the DOST-FPRDI is sometimes misunderstood as being anti-environment. Some people think that the agency's mandate promotes deforestation, the alleged culprit behind the devastating floods that hit the country in 2020.

This is not true, of course, that the Institute endorses deforestation. While it did study premium timber and catered to the needs of the forest-using industries during its earlier years, it began in the 1980s to study other related natural products. As the country's wood supply began to dwindle due to reckless logging, the agency had to look for substitute raw materials for its clients in the housing, pulp and paper, handicrafts and furniture sectors.

Substitute raw materials

Thus, over the next decades, DOST-FPRDI researchers have probed all kinds of possible replacement to forest timber. These include bamboo; industrial tree plantation species (ITPS); senile coconut wood and rubber wood; abaca; and agricultural residues such as coconut coir, tobacco stalks, tea leaves, corn stalk and rice straw. They have also studied fiber plants, dye plants, forest woody vines, as well as tree gums, resins, oils and exudates, among others.

"Because of our name, our work has sometimes been misunderstood by the public, and even by policy makers," says Institute Director Romulo T. Aggangan. "During Senate Budget Hearings, some lawmakers would ask about the relevance of what we do, considering that the country has very little forest cover left, and these have already been made off-limits to all kinds of logging. We then have to explain to them what we do and what we have done so far."

Tree plantation species, lumber dryer, moisture meter

Over the years, DOST-FPRDI wood anatomists, chemists, and forest products engineers have studied the properties and uses of 15 kinds of industrial tree plantation species (ITPS), such as falcata and gmelina. Because of this, many managers in the wood-based industries now understand how to saw, machine, dry, finish, and treat these non-forest raw materials. Fast-cycle trees grown in plantations are good substitutes to forest timber for construction and many other industrial uses.

Another contribution is the furnace-type lumber dryer (FTLD). Explains Aggangan, "This is like a big oven which can dry natural raw materials fast and right, resulting in quality wooden furniture which don't shrink or crack, and handicrafts which are not attacked by molds.

In 2018, Connor Group, one of the world's top merchandise-sourcing firms hailed the Institute for its role in raising the quality of Philippine handicraft exports thru the FTLD.

"Another helpful technology is the low-cost wood moisture meter which helps our clients know how much water a piece wood contains. This is important to ensure the quality finished product," says Aggangan.

Recent accomplishments

In recent years, the Institute has trained countless aspiring business people on handmade papermaking, innovated wine barrels from tree plantation species, and developed machines for making engineered bamboo, one of the promising materials in the country today with many applications. It has also set up a state-of-the-art processing plant for converting old and unproductive rubberwood into quality furniture – a big help to rubber farmers in Zamboanga Sibugay.

At present, it is studying how to optimize the abaca fiber for making high-end industrial products, how to upgrade our bamboo musical instruments, how to make the most of forest woody vines as handicraft raw materials, among others, and how to develop fragrances and flavors from forest products.

DOST-FPRDI likewise runs world class testing laboratories for furniture, plywood, pulp and paper, and also conducts wood identification, physical and mechanical properties, and biomass energy tests on forest-based and related products.

Pro-environment

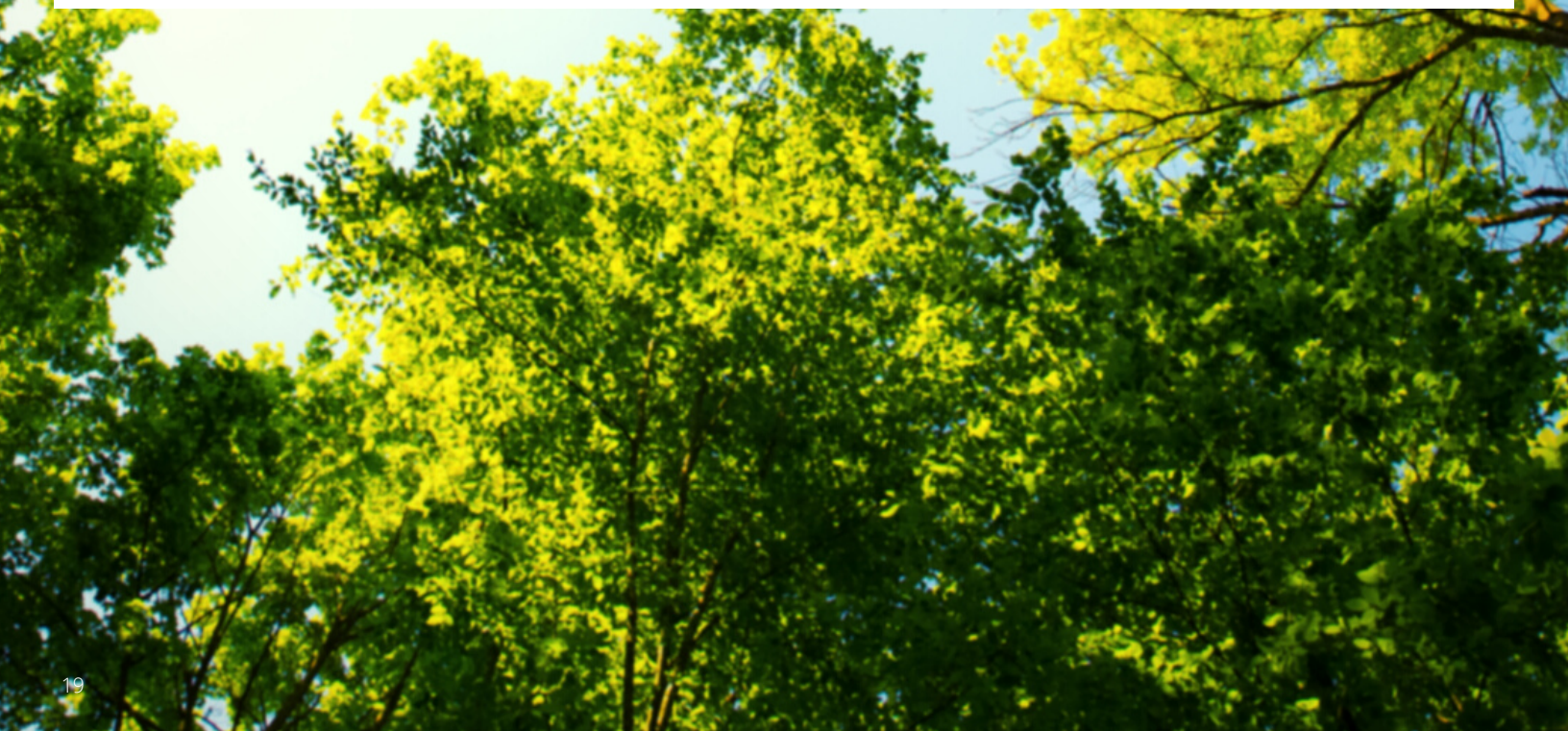
“Come to think of it, our name is a misnomer,” says Aggangan. “It doesn’t exactly reflect who we are, because we do so much more than study ‘forest products’. We do not study forest timber, our priority is to look for ways to wisely use many native plants and related natural materials to meet our clients’ needs. Much of what we do shows our aim to help protect – and not destroy – the planet.”

For example, he explains, in its bamboo projects, the Institute not only supports the bamboo-based industry, it also promotes bamboo farming. Putting up more plantations worldwide can help stabilize the earth’s climate by limiting the effects of global warming. More than any other plant, it can absorb massive amounts of carbon from the atmosphere which is a major cause of global warming.

“The same is true with tree plantation species,” he adds. “As we do more studies on them, we promote the setting up of more tree farms and the use of products harvested from them, which are known to be effective carbon absorbers.”

In their current projects, Aggangan adds, DOST-FPRDI researchers are looking for more earth-friendly ways of doing things – for example, more energy-efficient sawmilling, drying and machining methods, and less toxic methods of preserving wood.

“In the coming years,” ends Aggangan, “we will continue to work towards the competitiveness of our client industries while promoting sustainability. These two things – competitiveness and sustainability – should always go together. No matter how fantastic, scientific innovations will mean nothing if they damage the environment.”



RUBBERWOOD FURNITURE COULD BE THE NEXT BIG THING

In the province of Zamboanga Sibugay, rubber farmers are now reaping the fruits of the rubberwood initiative led by the DOST-FPRDI.

Members of the Tambanan Agrarian Reform Beneficiaries Multi-Purpose Cooperative (TARBEMCO) have started producing and selling furniture pieces made from old and unproductive rubberwood trees. With clients coming initially from their province, the farmers have so far produced cabinets, chairs, tables and other home pieces.

"Zamboanga Sibugay locals are accustomed to using senile rubberwood trees for low-value products such as fuelwood, pallets and crates. Thru the DOST-FPRDI project, they learned to make high-value products which could sell for a competitive price," explained Engr. Victor G. Revilleza, Project Leader.

"Rubberwood has good qualities suitable for making furniture, and other wooden products. It has white to pale cream color, which when dried becomes light brown. Its reasonably good strength properties make it a durable material for furniture," he added.

In the last three years, DOST-FPRDI has conducted a series of trainings for TARBEMCO members. These include trainings on harvesting and sawmilling, rubberwood preservation and treatment, kiln drying, woodworking machine operation and maintenance, furniture making and basic finishing. The Institute also established a Rubberwood Processing Center in Naga, Zamboanga Sibugay with a complete line of processing facilities from sawmilling to finishing.

Interested furniture buyers may contact Mr. Jonard Ansoc, TARBEMCO Manager, at 0965 0586690.

DOST-FPRDI AND DENR-FMB DEVELOPS MOBILE APP FOR AUTOMATED WOOD ID

Curious about what tree species your wooden furniture is made of?

Soon, you will be able to identify a piece of wood by just using your smartphone. This will be made possible through a mobile app being developed by the DOST-FPRDI and DENR-Forest Management Bureau (DENR-FMB). The two agencies' joint project aims to quickly and accurately identify selected wood species thru a Wood Identification Mobile Phone Application using Android OS.

According to DOST-FPRDI's For. Mario DR. Ramos, the project will use XyloTron, a machine-vision-based wood identification system developed by the U.S. Forest Service's Forest Products Laboratory. XyloTron uses image analysis, statistical processing software and the wood imaging device Xyloscope in capturing and analyzing the wood's cross section.

"The project goal is to make sure all locally traded timber and timber products are correctly identified. Thru the mobile app, a person can verify whether a piece of lumber is legally sourced or not," explained Ramos.

"The app will identify initially 30 commercially traded wood species in the Philippines, which include endemic, exotic and imported trees. As it can be used offline, the app is reliable even if the user is off-the-grid," he added.

For decades now, DOST-FPRDI's wood identification service has been an important part of the government's campaign against unlawful logging. Executive Order No. 23 strictly prohibits logging in all natural and second-growth forests, but allows the harvesting of trees grown in industrial plantations.

Upon DENR's request, the Institute's experts conduct on-site and off-site identification of confiscated wood, and submit reports which serve as legal evidence against the violators.

The mobile app project is funded by the Food and Agriculture Organization of the United Nations under its EU-FLEGT Programme.

DOST-FPRDI SIGNS PACT WITH TECHNOLOGY ADOPTER

The DOST-FPRDI is now a step closer towards fully commercializing one of its developed technologies.

The Institute has recently signed a Technology Licensing Agreement (TLA) for the FPRDI Bamboo Flattening Machine with the Laguna-based LAMBS Agri-Mechanicals company.

Among other obligations, the TLA requires DOST-FPRDI as the creator and owner of the flattening machine to grant LAMBS a non-exclusive and non-transferable license to use, produce and/or commercialize the machine in the Philippines within 5 years from the company's start of fabrication.

The TLA is DOST-FPRDI's output for HIRANG, an internship program that aims to level up DOST technology transfer officers' skills, network and industry competence. HIRANG stands for Honing Innovations, Research, Agreements and Negotiations of Government-funded technologies and is spearheaded by DOST-Technology Application and Promotion Institute (TAPI).

Compared to the very tedious traditional manual method using an adze or bolo, the FPRDI Bamboo Flattening Machine is an efficient and profitable way of producing flattened bamboo.

The resulting material can be converted into engineered bamboo components for high-value furniture, handicrafts and building materials.

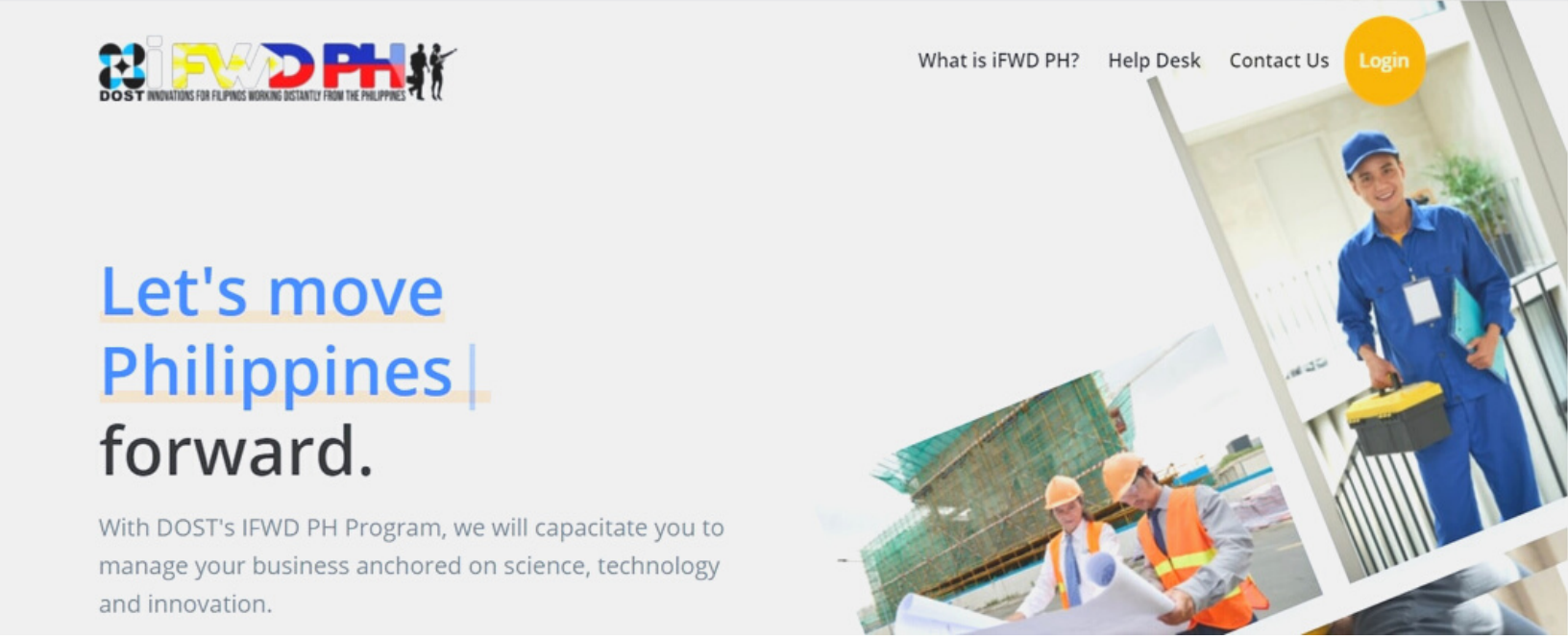
With an output of 200 square meters of flattened bamboo a day and a fabrication cost of Php 1.2 million, the machine is expected to boost the growth of the local engineered bamboo industry.

Flattened bamboo may also be used in making non-woven bamboo textiles, face masks and filter, and school chairs and desks. The government requires the use of bamboo for at least 25% of desks and other furniture requirements of public elementary and secondary schools, and prioritizes its use in the furniture, fixtures and other construction requirements of public facilities.

To meet the industry's raw material needs, bamboo plantations are now being established nationwide with support from the both government and the private sectors.

In 2018, DOST-Philippine Council for Agriculture, Forestry, Aquatic and Natural Resources Research and Development (PCAARRD) reported that the country has 39,200 to 52,700 hectares of bamboo plantation. Of these, 58 percent are in forest lands; 5 percent in government plantations; 7 percent in private plantations; and 30 percent in natural stands in private lands.

Given the right plantation management and processing innovations, the country's bamboo industry can play a key role in improving farmers' lives. In some parts of China, a farmer with a one-hectare bamboo plantation is said to earn as much as USD30,000 or about PHP 1.5 million a year."



DOST-FPRDI PRESENTS TECHNOLOGIES TO OFWS THRU TEKNOLOKAL WEBINAR

The DOST-FPRDI recently pitched its technologies and services to Overseas Filipino Workers (OFWs) thru DOST's "TeknoLokal para sa Makabagong Bayani" webinar series.

The Institute was tapped by the DOST-National Capital Region, DOST Region X and DOST Region I last April 16, 30 and May 14 respectively, to discuss its technologies that can be potential business ventures for returning Filipino workers.

Among those presented were FPRDI's bamboo processing technologies, engineered bamboo, charcoal briquetting, handmade paper making, skeletonized leaves and bamboo-framed face shield production. Apart from the technologies, the corresponding investment costs and return of investment were also discussed during the webinars.

"We are happy to be part of this initiative that aims to capacitate returning OFWs in setting up their own businesses. The Institute's technologies are fit for those who want to venture into furniture production, and gifts and handicrafts businesses," said DOST-FPRDI Director Romulo T. Aggangan.

The TeknoLokal webinar series showcases DOST-developed technologies that are "100% made by our Filipino scientists and researchers" and therefore responsive to the needs of the Filipino people.

It is part of the DOST's iFWD PH Program that assists repatriated Filipinos and their families establish technology-based enterprises in the Philippines. iFWD PH stands for Innovations for Filipinos Working Distantly from the Philippines.

The program has two phases: (1) Capacity building thru product and business concept development, and advisory sessions with technology-based enterprise advisors; and (2) Innovation funding thru technical training, market testing, laboratory testing and equipment acquisition.

DOST-FPRDI is committed to work towards the competitiveness of its industry partners while promoting sustainability. As the country's wood supply began to diminish due to reckless logging. The Institute continues to look for ways to wisely use native plants, tree plantation species, and related natural materials to address the needs of its clients.

DOST-FPRDI RENEWED ITS COMMITMENT TO SERVE THE FOREST-BASED INDUSTRY, MSMES DURING ITS 64TH ANNIVERSARY

The DOST-FPRDI marked another milestone during its 64th Anniversary celebration last July 5 to 9, 2021.

With the theme "Pagbangon at Pag-asa sa Panahon ng Pandemya", this year's celebration centers on the Institute's continued R&D initiatives and technical services amid the ongoing pandemic.

"We are more than a year into this global health crisis, yet most of us are still finding ways to manage its impacts," said DOST-FPRDI Director Dr. Romulo T. Aggangan.

"The Institute continues to support micro, small and medium enterprises (MSMEs) as they are among the most hard-hit sectors. Through the agency's technologies and upgraded technical services, DOST-FPRDI helps keep local small businesses afloat amid the challenges brought by the pandemic," he added.

One of the highlights of the Anniversary celebration was the launch of the DOST-FPRDI Technovation Hub last July 5, 2021. The Technovation Hub features three of the Institute's newest facilities: The Forest Products Innovation and Training Center, the Bamboo Musical Instruments Processing Center, and the Forest Products Technology Business Incubator.

"The Hub houses state-of-the-art facilities that can be accessed by businesses venturing into furniture, handicraft, housing and bamboo musical instruments production, among others. We believe that with innovation and R&D support, small enterprises can sustain their growth and be more competitive here and abroad," explained Aggangan.

"We also ensure that sufficient technical and marketing support are given to wood and non-wood forest-based industries thru our TBI. By providing business development services to our clients, we increase their chances of sustainably adopting our technologies," he said.

Aside from the Technovation Hub inauguration, DOST-FPRDI also conducted a consultative dialogue with the forest-based sector last July 7, 2021 as a way of making its services and technologies more responsive to the needs of industry partners.

A free training-webinar on furniture making was held on July 8, 2021. The agency had been conducting virtual technology trainings since last year to provide livelihood opportunities for the public.

"With the economy in recession because of the COVID pandemic, it is important that MSMEs get all the support they need to survive. Our commitment to better serve our clients has not faltered, and has even become stronger as we all work together to help mitigate the effects of this global crisis," ended Aggangan.

DOST-FPRDI CAN NOW HELP MSMES RECOVER THRU FOREST PRODUCTS TECHNOVATION HUB

The DOST-FPRDI has launched three new facilities meant to boost the productivity of local micro, small and medium enterprises (MSMEs).

Collectively called the DOST-FPRDI Technovation Hub, the facilities aim to provide upgraded services and technologies to serve MSMEs in the local forest-based and related industries.

“MSMEs have taken the brunt in the economic downturn resulting from the COVID-19 pandemic. According to a United Nations Development Program report, majority of these enterprises have either ‘shuttered for good, closed temporarily, or reduced their workforce or capacity because of COVID-19 and its restrictions,’” explained DOST-FPRDI Director Romulo T. Aggangan.

"At this crucial time, the Institute would like to help small businesses bounce back thru our technical expertise and new facilities. Technovation – which blends 'technology' and 'innovation' – is exactly how we envision to support the MSMEs in the forest-based and allied sectors. We believe that with innovation and technological support, small businesses can boost their productivity and become stronger players locally and even globally," he added.

The DOST-FPRDI Technovation Hub includes the Forest Products Innovation and Training Center (FPITC), Bamboo Musical Instruments (BMI) Processing Center, and Forest Products Technology Business Incubation (FPTBI).

The FPITC has state-of-the-art precision machines, such as CNC machine and laser engraver, to create high-end furniture, gifts, toys and housing components. It likewise houses processing technologies, such as the the bamboo veneering and flattening machines, UV curing equipment for high quality finishes, and the dual heated hot press for higher efficiency in engineered bamboo manufacture.

The BMI Processing Center, on the other hand, is for businesses that wish to adopt the Institute's technologies for improving the processing, durability, aesthetics and sound quality of select bamboo musical instruments.

The third facility, FPTBI, is where start-ups are hosted and business development services are provided. MSMEs can access the following support services thru the FPTBI: testing laboratories; technical expertise on DOST-FPRDI technologies; training and mentoring on feasibility study preparation, product development, business and marketing, and office space and facilities.

"To all the MSMEs, technopreneurs and innovators in the forest-based and related industries, we are earnestly inviting you to check how our new facilities can help expand your businesses," Aggangan ended.

FPRDI WINS IN NATIONAL TECHNO-TRANSFER CONTEST

The DOST-FPRDI emerged as a major winner in the 2021 Gawad KINTAL: Kwentong Itinatangi Ng Taon sa Agham, Industriya, at Lipunan.

The Institute won the 2nd Best Commercialization Story for how its green charcoal technology has benefitted a private company in Negros Occidental. The recognition was given by the DOST-Technology Application and Promotion Institute (TAPI) in a virtual awarding ceremony last July 31.

With the DOST-FPRDI's help, Mackay Green Energy, Inc., is now able to turn huge amounts of agricultural wastes into quality charcoal briquettes. "The MacKay Green Energy, Inc. owns large plantations of bana grass all over the country. The plants' leaves are used as biomass fuel, leaving behind plenty of stalks unused. This prompted the company to seek our assistance to turn their grass stalks into briquettes," explained DOST-FPRDI's Carolyn Marie C. Garcia.

A charcoal briquette is a compacted mass of fuel material made from a mix of charcoal fines and a binder, and molded under pressure. Compared to plain charcoal, briquettes are easier to handle because they are compact and uniform in size. Mackay Green Energy, Inc. acquired 30 manual briquettors, 30 drum kilns, 6 binder-mixers and 6 charcoal crushers from DOST-FPRDI in 2016.

MacKay has not only secured an average income of more than Php 100,000 per month, it has also employed at least eight (8) workers as bana grass harvesters and laborers for the charcoal briquette production. According to their official website, its bana grass charcoal is now being supplied to Landmark, Robinsons, Shell Select and Ihaw Juan, among others.

Charcoal briquettes are among the Institute's eco-friendly technologies. They are easy to ignite, burn slowly, give more intense heat per unit volume and are almost smokeless when burning. Promoting the use of charcoal briquettes from agro-forest wastes is one way we can help protect the environment. In recent decades, the excessive use of wood charcoal by the 'lechon' industry has been blamed for the destruction of our mangrove forests," said DOST-FPRDI Director Dr. Romulo T. Aggangan.

"The Institute has long advocated the sustainable use of forest products, carefully exploring other native plants and related natural materials to meet its clients' needs. Much of what we do shows our aim to help protect – and not destroy – the planet," Aggangan added.

The Gawad KINTAL is DOST-TAPI's way of giving "spotlight to commercialization stories that have made the most mark or impression in science, industry, and society."

RESEARCHERS STUDY SAFETY OF WINES AGED IN DOST-FPRDI WINE BARRELS

DOST-FPRDI researchers recently started a research project that would study the safety of fruit wines aged in locally made wine barrels.

The project is an off-shoot of the Institute's efforts at pilot-testing its own wine barrels made from tree plantation species like big-leafed mahogany (*Swietenia macrophylla*), mangium (*Acacia mangium*), and river red gum (*Eucalyptus camaldulensis*), and a fruit tree - santol (*Sandoricum koetjape*). The wine barrels were developed to find substitutes to white oak (*Quercus alba*), known worldwide as the best material for ageing wines.

"We want to assure our future technology adopters and the public of the quality of the wines produced using our barrels," explained Project Leader Kim Wilmer M. Balagot. "To do this, we will test the toxicity and antioxidant activity of bignay and mango fruit wines fermented for three months. We will also check if our wine barrels contain compounds that can enrich the wines' aroma and flavor."

"Most local fruit wine makers use plastic and glass to age their wines," shared DOST-FPRDI's Engr. Caezar A. Cuaresma. "With our wine barrel technology, they have a quality yet affordable option. It's almost like they're using imported barrels, but about three times cheaper."

The Institute is partnering with the Laguna-based Angeles Woodworks Co. for the fabrication of the wine barrels, and with Dielle's Apiary and Meadery Inc. for the fruit wines.

Funded by the DOST-PCAARRD, the project will run from June 2021 to February 2022.

DOST-FPRDI DISTRIBUTES BAMBOO-ABACA ALCOHOL DISPENSER AND FOOT BATH

The DOST-FPRDI distributed bamboo-abaca hands-free disinfectant dispensers and foot baths to several establishments and government offices in Los Baños, Laguna.

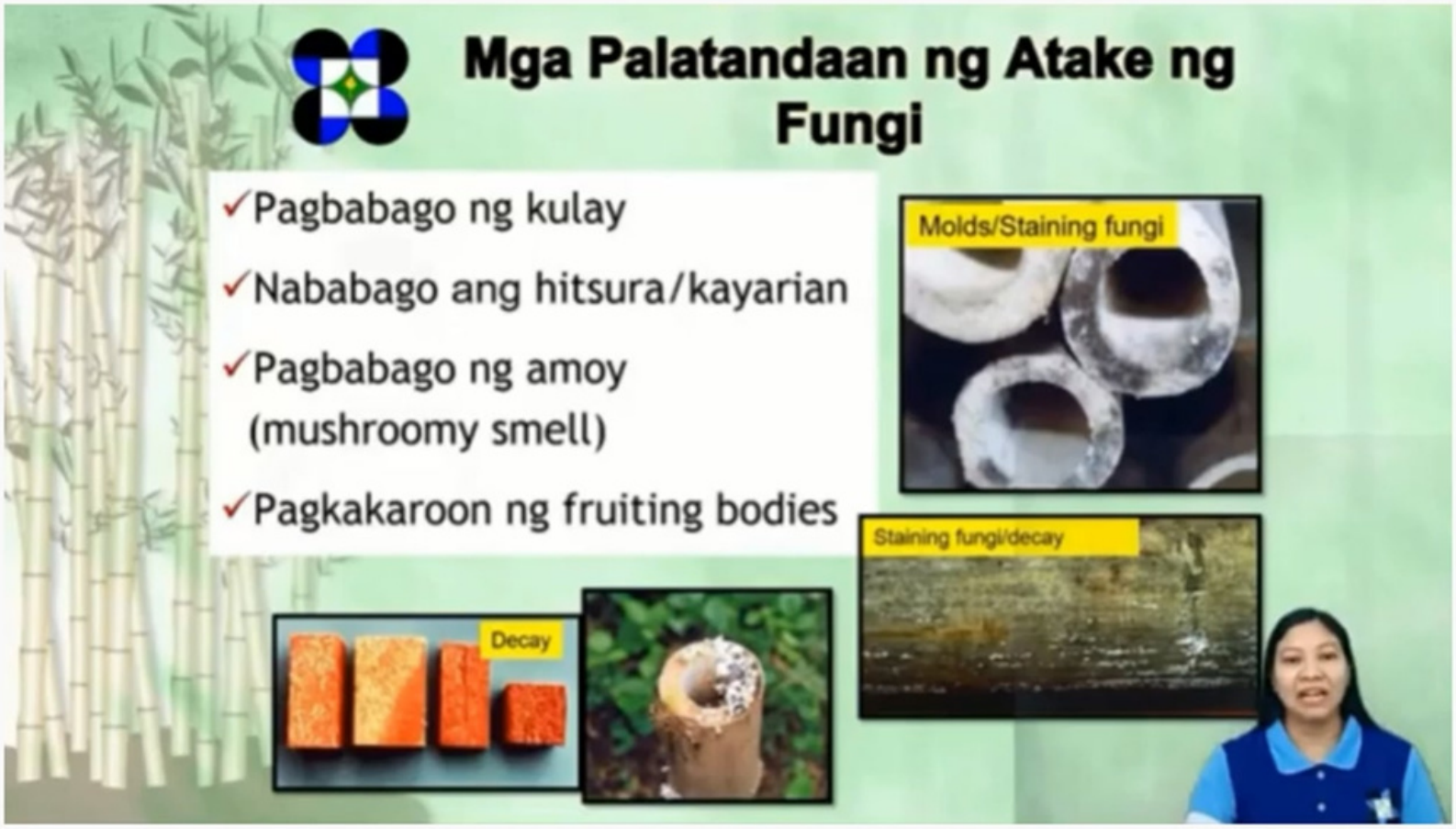
The bamboo dispenser releases alcohol when someone steps on the connected foot bath while the abaca acts as a sponge that disinfects the pressing footwear. The device was developed by the Institute in 2020 in response to the COVID-19 outbreak.

A total of 10 prototypes were provided to the University of the Philippines Los Baños (UPLB); DOST-PCAARRD; DOST-CALABARZON; Los Baños Municipal Office; Los Baños Doctors Hospital; Los Baños Municipal Health Office; the vaccination hub in Brgy. Batong Malake; Centro Mall, Diocesan Shrine of St. Therese of the Child Jesus; and Brgy. Hall of Batong Malake.

The distribution was also geared at prototype testing, to evaluate the dispenser's usability and acceptability.

According to Project Leader Florena B. Samiano, "DOST-FPRDI advocates the sustainable use of local forest resources to help protect the public against COVID-19 infection. The use of natural products such as bamboo and abaca is very promising as these are two of the most economically important, widely available resources in the country. They are also eco-friendly because they are biodegradable."

The distribution was held last 06 July 2021 as part of the Institute's 64th anniversary celebration.



FORESTERS EARNED CPD UNITS FROM DOST-FPRDI'S FREE TRAINING-WEBINARS

The DOST-FFPRDI is offering Continuing Professional Development (CPD) courses for licensed foresters.

The free 2021 CPD training-webinars on July 22 and 29 were on Non-wood Forest Products Preservation and Treatment and for August 19 and 26 on Basic Finishing Techniques. These were participated in by licensed foresters from FPRDI, other government agencies, private sector and members of the academe. The four webinars benefited 207 foresters from all over the country.

The CPD training-webinars are among the Institute's many offerings to continuously provide technical services and technology know-hows to the forest-based and allied sectors. "DOST-FPRDI believes that the requirement of physical distancing we are currently experiencing should not hinder learning. Thus, the Institute is adapting to changes to unceasingly support and serve our clients," said Dr. Maria Cielito G. Siladan, Chief of the Technical Services Division.

DOST-FPRDI, PRIVATE FIRM MAKE FURNITURE FROM THERMALLY-MODIFIED BAMBOO

Furniture makers and designers may soon be able to take advantage of promising color patterns created from thermally modified (TM) and hot oil-treated (HOT) bamboo.

The DOST-FPRDI and the Rizal-based Focolare Carpentry recently developed several furniture models made from TM and HOT kauayan-tinik and giant bamboo. The prototypes included a dining set, TV stand with drawers, console table, construction items (stair tread and riser), and small handicrafts like tablet & cell phone stand with sound amplifier.

"Subjecting bamboo to thermal modification and hot oil treatment can produce poles of varying shades – from light yellow-brown to almost black– which can accentuate furniture pieces. This color change cannot be done when chemical preservatives are used," explained Dr. Juanito P. Jimenez, Jr., DOST-FPRDI Assistant Scientist.

Thermal modification or heat treatment is the process of subjecting natural materials like wood and bamboo to high temperatures to make them more stable and durable.

"TM uses high heat to alter the chemicals present in a piece of wood or bamboo, and eliminate the food supply of destructive insects and fungi. With the correct combination of heat and time of exposure, the right chemical changes take place. These make the material more dimensionally stable (more weather-proof, less prone to swelling and shrinking) and less appetizing to powder- post beetles and termites," said Jimenez.

According to him, the bamboo poles were heat-treated using spent cooking oil at 175˚C and 200˚C both for 30 minutes. These were then processed into slats before gluing to form engineered bamboo boards.

The downside of TM, however, is that extremely high heat can affect the material's strength and give it a darker color. "The trick is to find the mix of temperature and treatment time that will not substantially affect the strength of wood or bamboo. The color change, however, can be a good thing as it imparts on light-toned wood or bamboo the dark look of premium wood species such as narra, dao and rain tree," Jimenez added.

Funded by the DOST-PCAARRD's, the prototyping is part of a project that aims to determine TM and HOT bamboo's workability in a factory setting.

PALLET BUSINESS GROUP THANKED DOST-FPRDI

The President of the Pallet Business Association of the Philippines (PBAP) recently acknowledged the DOST-FPRDI for its strong technical support to the members of her organization.

Ms. Xenia A. Gabayan expressed her appreciation during an episode of the TV show "DOSTv" where she was a featured guest. "For many years now, the Institute has been there to help meet our most important technical needs," she said. "They have assisted us with their testing services, wood moisture meter, lumber dryer, and heat treatment facility."

"Thru testing, we can know the strength and durability of our products, while thru the wood moisture meter, we can check how much water is present in our materials. Strength and moisture are critical factors to consider for any producer who wants to make quality pallets."

A pallet is a platform device used for supporting goods while they are transported in warehouses, manufacturing plants, or vehicles. Usually made of wood, pallets are an indispensable tool for the efficient movement of goods worldwide.

According to Gabayan, "The PBAP is made up of 12 private companies which are involved in the pallet industry either as pallet makers, traders or service-providers. Aside from availing of the DOST-FPRDI's testing services and the moisture meter, several PBAP's members have also adopted the Institute's lumber dryer, while others are now using its pallet heat treatment facility.

"The goal of our organization is to produce globally competitive Philippine-made pallets and we are happy that with FPRDI's consistent technical help, we are one step closer to our goal."

DOST-FPRDI, DOST-NCR TEAM UP TO IMPROVE BJMP PAROL

The Christmas season promises to become a brighter time in the coming years for Persons Deprived of Liberty (PDLs) in San Juan City. This, as the city's Bureau of Jail Management and Penology (BJMP) participated in a Virtual Consultative Dialogue with DOST-FPRDI last 20 August 2021.

According to City Jail Warden Mr. Jose Marie D. Sabeniano, the parol-making project is a source of livelihood for the PDLs and their families.

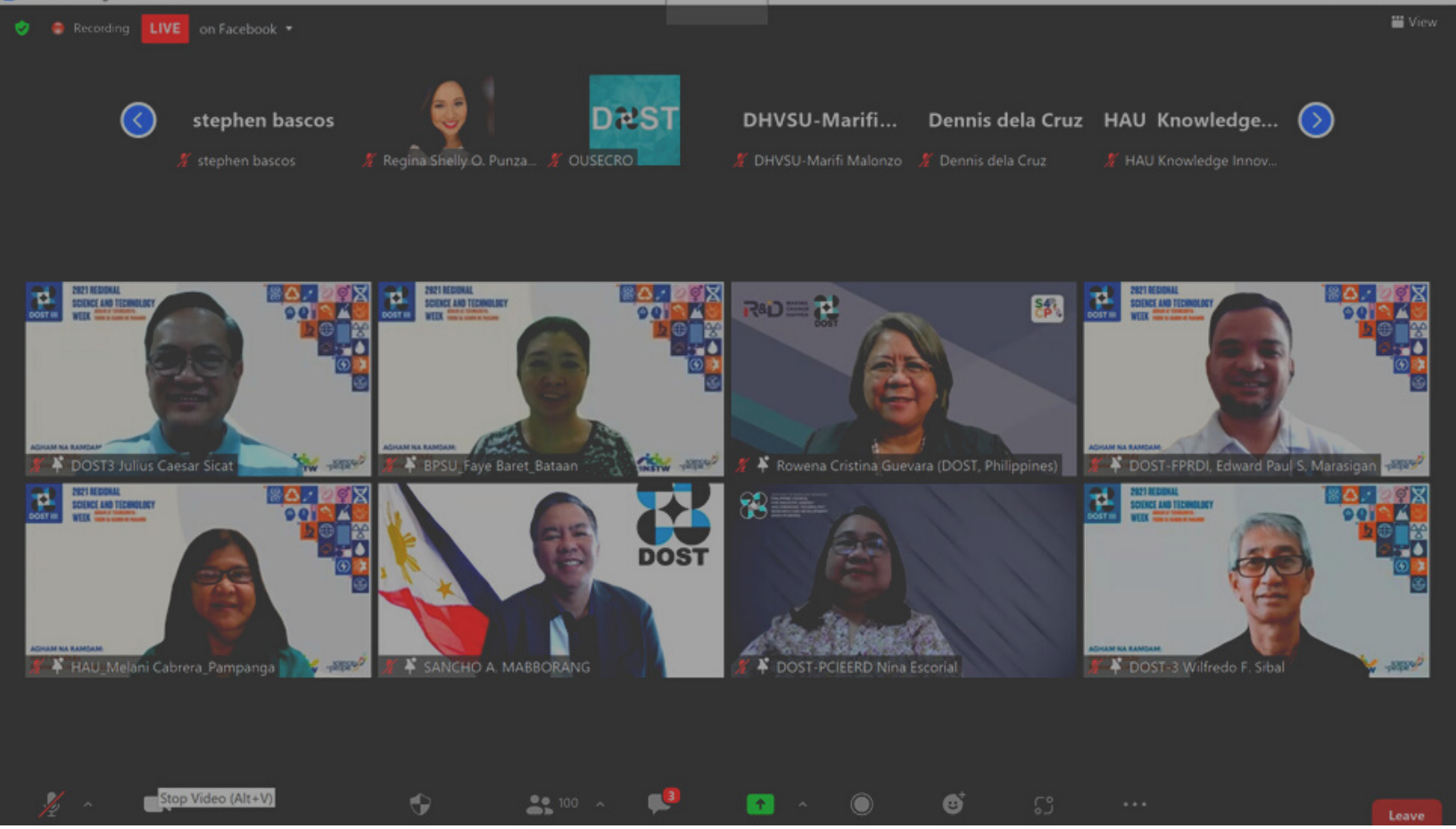
Among San Juan City-BJMP's concerns were the tools or equipment needed to speed-up production; preservative treatment to improve lantern durability and quality; skills upgrading; and possible sources of bamboo.

Meanwhile, for next year, DOST-FPRDI's possible interventions may include trainings on the following topics for the San Juan City PDLs: Handmade Paper Making; Treatment and Preservation of Bamboo and other Raw Materials; Bamboo Furniture/Handicrafts Processing Technology; and the Operation of Wood/Bamboo Processing Equipment.

"We are excited to share our technologies with the BJMP," said Dr. Maria Cielito G. Siladan, Chief of the Technical Services Division.

"Hopefully, thru these capacity building activities, the Institute could help develop higher-value products and handicrafts, and introduce other livelihood ideas to PDLs. They will also be invited to several FPRDI training webinars this month."

The consultative dialogue was initiated by the DOST-National Capital Region, which will also prepare the Memorandum of Agreement for the upcoming technical assistance services.



DOST-FPRDI DEVELOPED WASTEWATER TREATMENT EQUIPMENT

The DOST-FPRDI recently installed its wastewater treatment equipment to a Pampanga-based furniture and handicraft company.

The equipment was developed to help RSU Manufacturing Corporation properly dispose of the used water coming from their finishing spray booths (FSBs). RSU produces furniture and handicrafts from wood, rattan and other non-wood forest products, and currently operates nine wet-type FSBs.

"This equipment addresses the improper discharge of wastewater that usually contains toxic chemicals from the finishing overspray. It takes into account the wastewater's characteristics and the best treatment method for it," explained project leader Engr. Edward S. Marasigan.

The spray booth is an enclosure that controls the spread of excess varnish or paint during the finishing operation. It was developed by the Institute to provide a safer working area and better quality products.

DOST-FPRDI researcher For. Aralyn Quintos added, "The current practice of disposing wastewater thru drainage or directly to bodies of water contributes to environmental pollution. Wastewater from the FSBs contains aromatics, benzene derivatives, alcohol, siloxanes, propanoic and pentanoic acid which are harmful to aquatic plants and animals. It can also cause the excessive growth of a bad kind of algae."

The turn-over ceremony for the equipment was attended by staff from DOST-FPRDI, DOST Region 3 and RSU last 05 October. Aside from the installation, the Institute will also provide training on equipment operation.

Marasigan also presented the technology during the "AGHAM NA RAMDAM: DOST CRADLEs Businesses in Central Luzon" webinar last 22 October 2021. The event is one of the highlights during the Regional Science and Technology Week celebration in Region 3.

The project runs from May 2020 to December 2021 and is funded by DOST's Collaborative Research and Development to Leverage Philippine Economy (CRADLE) Program.

DOST-FPRDI RESEARCHERS WIN MAJOR AWARDS IN REGIONAL SYMPOSIUM

Researchers of the DOST-FPRDI bagged major awards in the recently concluded 34th Regional Symposium on Research, Development and Extension Highlights.

Engr. Shirley A. Pelayo, For. Sheryll C. Micosa, Kennethjer G. Alejo, Alaine G. Pagatpatan and For. Carmina F. Lasap won the Best Research Poster Award for their paper titled "Efficacy of CNSL Formulations against Molds and Decay Fungi as Applied to Commercial Forest Woody Vines".

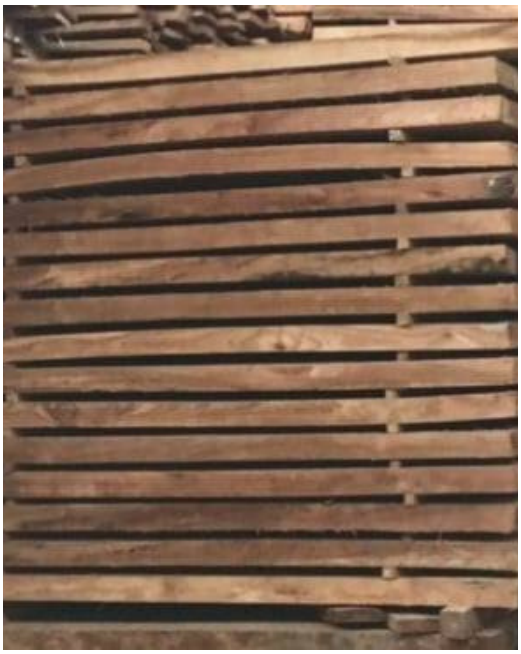
The paper was part of a completed project funded by the DOST-PCAARRD. The study developed cashew nut shell liquid (CNSL) formulations and tested them against molds (Aspergillus niger and Penicillium sp.) and decay fungi (Gloephylum sepiarum and Polyporus sanguineus) under laboratory condition.

"CNSL formulations had slight inhibitory effect against molds, but were moderately to highly effective against decay fungi. Three times brushing of CNSL formulations at higher concentration gave higher retention value. Indoor exposure test of treated vines showed that among the three CNSL formulations, the CNSL + copper chloride was comparable with the standard preservatives in preventing fungal attack," explained Pelayo.

Meanwhile, placing third in the Best Extension Paper category were Engr. Cesar O. Austria, For. Jovito Elec, Froilan B. Samiano, Audel Mosteiro, Noel Medrano and Val Valderama for their entry titled "The Adversity That Leads to Innovation: DOST-FPRDI Bamboo-Framed Face Shield".

The bamboo-framed face shield is one of DOST-FPRDI's initiatives in response to the COVID-19 outbreak. It utilizes bamboo - a perennial, woody-stemmed grass that is known for its many uses and is widely used in making handicrafts and furniture in the country.

Bannering the theme "Science and Technology: Enhancing the Sustainability and Resiliency of the Agriculture, Aquatic and Natural Resources Sector", the regional symposium was organized by the Southern Tagalog Agriculture, Aquatic and Resources Research, Development and Extension Consortium (STAARRDEC). The awarding was held last 20 October 2021 via Zoom & Facebook Live.



RUBBERWOOD PROCESSING PLANT GETS ENVIRONMENTAL CLEARANCE

The DOST-FPRDI Rubberwood Processing Plant in Zamboanga Sibugay recently received its Environmental Compliance Certificate (ECC) from the Department of Environment and Natural Resources – Environment Management Bureau (DENR-EMB) Region IX.

The certificate is proof that the processing plant has passed the DENR's evaluation and is not expected to have any notable negative impact on the environment. However, with the ECC, the DOST-FPRDI's local partner - the Tambanan Agrarian Reform Beneficiaries Cooperative (TARBEMCO) – also needs to meet all the requirements for protecting the community from any of the project's possible adverse effects. These include effects on the local people's health, welfare and environment.

The DOST-FPRDI project "Processing and Utilization of Senile and Unproductive Rubberwood (Hevea brasiliensis) Trees for the Production of High Value Furniture, Mouldings and Joineries" was initiated in 2018 to provide added income to TARBEMCO rubber farmers.

In the last three years, the Institute has conducted intensive trainings on harvesting and sawmilling, rubberwood preservation and treatment, kiln drying, woodworking machine operation and maintenance, furniture making and basic finishing

With DOST-FPRDI's intervention, the farmers were able to acquire added knowledge on useful application of rubberwood trees that can command higher prices in the market.

In addition, a complete line of processing facilities was established– from sawmilling to finishing– to convert old and unproductive rubberwood trees into high-value products such as furniture, doors, door jambs and other builders' woodworks.

IMPLEMENTED PROGRAMS

RESEARCH & DEVELOPMENT

TECHNOLOGY TRANSFER

S&T SERVICES

Flavors & Fragrances from the Forest Technology

The use of odorous substances and essential oils either for pleasure, medicinal or therapeutic purposes plays a big part in our history. The interests and innovations on utilizing different aromatic materials have evolved into a now renowned flavors and fragrances industry.

The forests, both timber and non-timber, provide a multitude of flavors and fragrances. Among these include gums, resins and oils which are commercially-important non timber forest products (NTFPs) that have wide range of uses for industrial and biochemicals - flavors and fragrances in particular. Tannins which can also be extracted from barks, leaves and wood are used to enhance flavors of some beverages like wine, beer, fruit juice and teas.

Forests flavors and fragrances have diverse applications that are significant to people's day-to-day lives such as personal care products (soaps, hand sprays, toothpaste, perfumes, etc.) household care products (room sprays, dishwashing liquids, cleansers, disinfectants, etc.), healthcare and aromatherapy products (essential oils, massage oils, salves, balm, liniments, lotions, etc.) and food & beverages (herbs, spices, wine, beer, tea, etc.).

List of Projects:

- Characterization and Optimization of Essential Oil Yield from Cinnamon Bark using Supercritical Fluid Extraction
- Cinnamon Oil and Extracts for Antifungal and Antibacterial Products
- Development of Healthcare and Aromatherapy Products from Some Selected Plant Oils

Externally-funded

- Development of Sustainable Tannin Extraction Strategy in the Philippines
- Pinoy Tannin from selected Philippine Plant Species for the Prevention and Control of Wood and Bamboo Destroying Organism

Human Security & Defense R&D

Insurgency and terrorism are the pressing problems that the country faces at present. In trying to overcome this problem the government revitalizes the DND's SRDP (Department of National Defense' Self-Reliant Defense Posture) Program a.k.a Self-Reliant Defense Capability Program. The main thrust is to be self-sufficient in basic military requirements by manufacturing our weapons, small arms and ammunitions, tactical communications equipment, basic land vehicles and small sea crafts, among others.

The significant R & D outputs of the program will be pursued to the piloting of the production process to assess the technical and financial viability, as well as, the environmental and social aspects of the technologies. This component will involve design and fabrication of process equipment and facilities that would meet the targeted outputs in pilot-scale operation, including the commissioning and installation of the said equipment and their accessories.

List of Projects:

- Application of nanocellulose as ballistic material for bullet proof vests
- Development of a Multi-Layered Bullet Resistant Vest from Bamboo
- Development of Military Grade Cellulose Nitrates from Indigenous Materials: Phase 1
- Development of Trinitrophenolic Compound from Indigenous Materials as a Secondary Explosive like Trinitroresorcinol (TNR) – Phase 1

Gubat Obra: Forest-based Creative Products S&T

The Philippine government has been seeing creative industries as a key driver for inclusive growth and competitiveness across the country. This is due to the vast potential of this sector.

According to Fleming (undated), the "continuous growth of the sector is expected for those countries with access to large markets, strong global connections, distinctive and productive cultural sectors and rapid digitalization, which is the case of the Philippines". Furniture and handicrafts, jewelry, musical instruments, wood carving are just some of the creative industries that come from forest-based and related raw materials. According to Tolentino (undated) as cited by Fleming "The Philippines appears to be globally competitive in the handicrafts and cultural segments." DOST-FPRDI plays an important role in positioning the furniture and handicrafts subsectors as a key player in the creative industries.

List of Projects:

- Development of Functional Bamboo Furniture Products
- Development of Commercially-driven Handicrafts and Furniture from Varied Forest Products in the Philippines

Externally-funded

- Gluing and Finishing Characteristics of Thermally Modified Bamboo
- Documentation of Philippine Indigenous Bamboo Musical Instruments
- Development of Protective Processing Technology for Bamboo Musical Instruments
- Processing Facility for Bamboo Musical Instruments and other Lignocellusic Materials.

Bamboo Processing and Industry Development

Bamboo is one of the most economically-important non-timber forest products in the Philippines. Its fast growth and excellent properties makes it an ideal substitute to wood for furniture, handicrafts, construction material, and chemical products. Thus, it is explicable that most of the initiatives undertaken worldwide on bamboo utilization are to exploit its use as substitute to wood. Global market for bamboo in 2006 stands at about 7 billion US dollars and was projected to increase to US$ 17 B from 2015 to 2020.

The recently drafted Philippine Bamboo Industry Roadmap identified the following as S&T Interventions: (1) Development of economical methods of drying and preservation; (2) Product development and processing of lesser-used species of bamboo; (3) Development of processing tools, equipment and machineries; (4) Utilization of field and mill residues; (5) Production of rayon from bamboo (cellulose derivatives); (6) Development of more engineered bamboo products. Thus, there is a need to focus on S&T activities to support the development of the Philippine Bamboo Industry. The project aims to develop a vibrant bamboo industry based on the identified S&T interventions of the Philippine Bamboo Industry Roadmap.

List of Projects:

- Natural Durability of Commercial Bamboo to Wood Destroying Organisms

- Bamboo based Activated Carbon for Industrial Uses – Part 2. Fine Mesh Bamboo based Activated Carbon for Use in Water Purification

- Development of Cross-Laminated Bamboo (CLB)

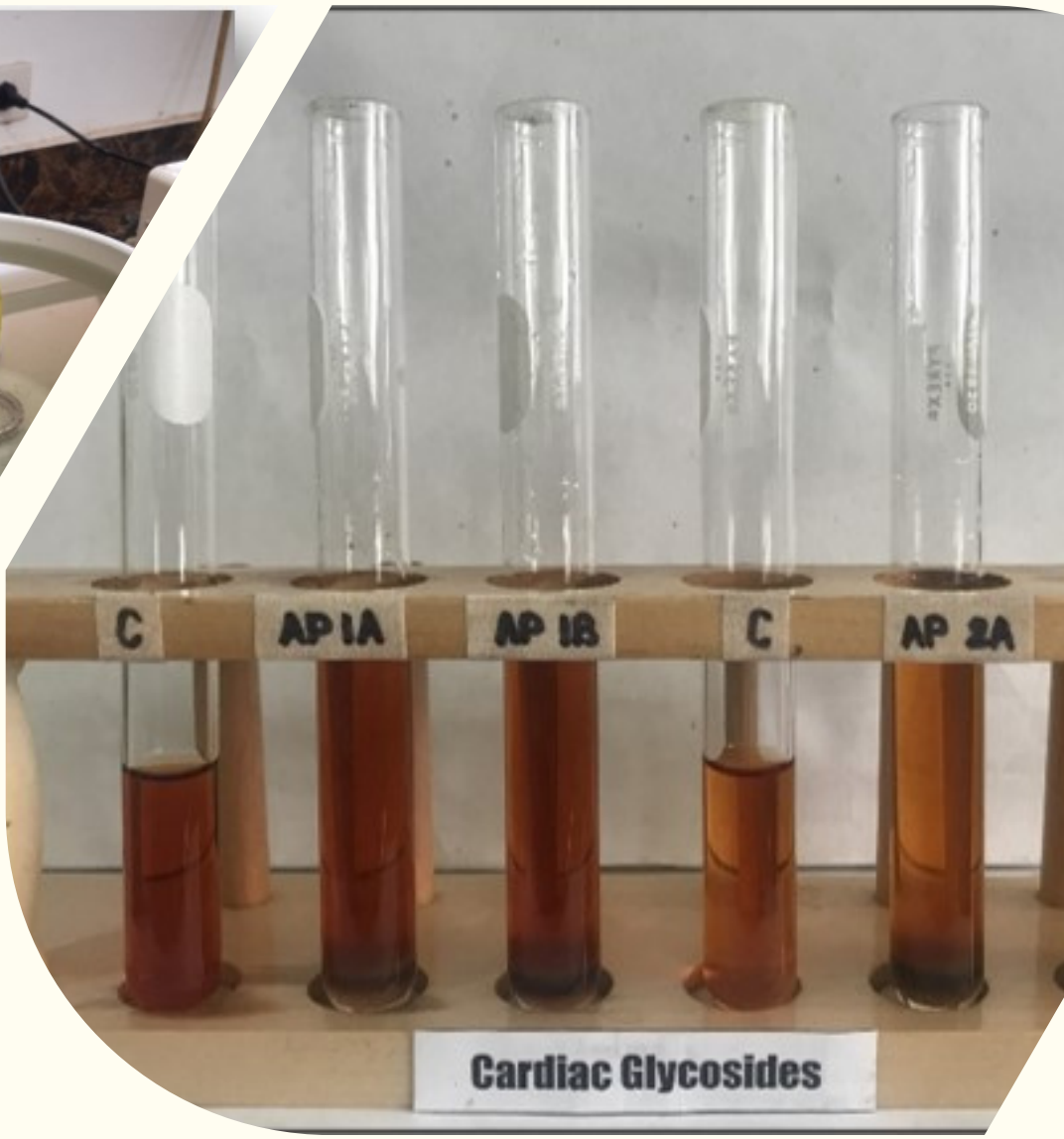
Forest Products Nanotechnology

Nanocellulose, variously termed as nanocrystals, whiskers, rods, nanofibrils or nanofibers, are cellulose fibrils or crystals that has at least one dimension within the nanometer size range. It is an emerging nanomaterial that is produced either from bottom-up approach via biosynthesis or top-down approach thru disintegration of plant materials

Some application areas for nanocellulose include paper, paperboard and packaging where nanocellulose enhances the fiber-fiber bond strength and has a reinforcement effect on paper materials. In food industry, nanocellulose is used as form emulsions and dispersions and is suitable for use in food products as thickeners or stabilizers. Nanocellulose also has good absorption properties and can be used in medical and hygiene products like tissues, non-woven products, or diapers. It also has applications in films, painting, cosmetics, automotive, potential military applications such as its incorporation in ballistic materials and protective equipment. .

List of Projects:

- Production of Nanocellulose by Enzymatic Hydrolysis from Bleached Abaca Fiber
- Development of nanocellulose crystals-reinforced almaciga (*Agathis philippinensis* Warb.) resin varnish
- Application of Abaca Nanocellulose Fibers as Reinforcement Filler in Thermoplastic Starch Film
- Nanocellulose Suspension from Microbiologically-Derived Cellulose Material
- Development of Iridescent Solid Film from Commercial Nanocellulose Crystals for Security Paper Application



Phil. Forest Vines for Handicrafts & other Forest-based Industries

Forest vines are important source of raw materials for the handicraft industry. According to a study Philippines is globally known for its handicrafts and the industry is the country's top contributors to its gross domestic product (GDP) for the production and marketing of baskets, bags, decorative and other novelty items.

Forest vines are, however, one of the least studied non-timber forest products in the country. FPRDI's program on Philippines Forest Vines for Handicraft and Furniture Industry aims to generate information and develop processing technologies for the sustainable production and utilization of forest vines for handicrafts and furniture industry in the country. Its intentions are to determine the volume of available forest vines and their rate of natural regeneration; determine the natural durability, anatomical, physical, mechanical, and chemical properties of forest vines; develop germination or propagation technologies and establish plantations of forest vines; develop high-value products from forest vines.

List of Projects:

- Natural Durability of Forest Woody Vines to Wood Destroying Organisms
- Property Evaluation of Some Economically Important Forest Vines: Part I. Anatomical Properties
- Property Evaluation of Some Forest Woody Vines. Part II. Chemical Properties
- Property Evaluation of Some Forest Vines. Part III. Physical and Mechanical Properties
- Qualitative and Quantitative Phytochemical Analysis of Forest Woody Vines
- Bio-assay Guided Purification for Antioxidant and Antibacterial Evaluation of Phytochemicals from Selected Forest Woody Vines

Externally-funded

- Biological Studies of Economically Important Forest Vines in Camarines Sur and Albay Provinces

Equipment Development

FPRDI's program is a new program for 2021. The Equipment Development Program aims to develop thermally efficient and innovative designs of kiln dryers that would enhance the productivity, product quality and competitiveness of MSMEs in the agro-forest based and allied sector.

Specifically, it aims to improve and semi-automate the operation of the FPRDI-designed FTLD, develop a solar-powered lumber dryer with biomass auxiliary heater, develop a portable kiln dryer for NTFP and handicrafts, design and develop a modified heat-exchanger for drying agro-forest and aqua-marine products, develop a high-temperature kiln dryer for thermal modification of wood and NWFP, and design and develop an air-heated Vacuum furnace type dryer

List of Projects:

- Design and Fabrication of Prototype Air-Heated-Vacuum Furnace Type Dryer for Plantation Timber, Bamboo, and other Non-Timber Forest Products for Forest-based Industry

- Performance evaluation of portable solar powered/ heated dryer with auxiliary biomass heater

Externally-funded

- Development of Wastewater Treatment Equipment for Wet-Type Finishing Spray Booth

Natural Rubber Exudates & Wood Utilization

The rubber industry is one of the priority agro-based industries in the Philippines being a priority crop under the Department of Agriculture (DA). In 1997, DA launched the Rubber Development Program (RDP) as a component of Gintong Ani-High Value Commercial Crops Program (GA-HVCC) for the purpose of expanding rubber to 500,000 ha. in 10 years.

The DOST launched the Natural Rubber R & D Agenda during the 1st Philippine Rubber Industry Market Encounter (PRIME) event and was borne out of a series of consultations, mainly with Philippine Rubber Industries Association (PRIA) and rubber processors and farmers in Mindanao. The R & D agenda covered both the upstream through the Industry Strategic Plan (ISP) of the PCAARRD and downstream through the S & T Intervention Program of PCIEERD. Natural rubber still holds a significant market share of 30% to 40% over synthetic rubber despite advances in synthetic rubber compounds.

This program aims to utilize the natural rubber exudates and senescent rubber trees into high value products in increasing the competitiveness of the local rubber industry

List of Projects:

- Processing and Utilization of Senile and Unproductive Rubberwood (*Hevea brasiliensis*) Trees for the Production of High Value Furniture, Mouldings and Joinery Products

- Physical and Mechanical Properties of Rubberwood in the Philippines

Basic R&D and Services

According to a report, the future of the wood-based industries will depend largely on how successful the efforts in developing industrial tree plantations. There is guarded optimism that the investment climate in the forestry sector will improve and translate into more forest plantation development. The furniture industry will continue to be an exporter of high quality products using a mixture of various raw materials such as wood and non-wood forest products.

The program comprises of R&D projects which generally aims to establish potential utilization of some tree plantation species through properties and quality evaluation. The various project components cover the following: basic properties (physical and mechanical, chemical and anatomical) of some TPS; establishment of preservative treatment schedule; characterization of the active components of TPS to be used for preservatives and efficacy of chemical components/derivatives.

List of Projects:

- Morphological and Chemical Properties of Selected Hybrid Abaca, Sayapo (*Trichospermum eriopodium*) and Salago (*Wikstroemia* spp.) Species for Paper, Paperboard and Other Allied Products
- Tree Plantation Species Part III: Wood Anatomy and Fiber Morphology of Selected Plantation Species
- Physical and Mechanical Properties of Fruit Trees in the Philippines
- Evaluation of the processing characteristics and performance for furniture of Plantation-grown Juvenile *Swietenia macrophylla* (Mahogany)
- Resistance of Selected Tree Plantation Species to Decay Fungi and Insects
- Preservative Treatment of Palasan (*Calamus merrilli* Becc.) and Limuran (*Calamus ornatus* Blume) Poles for Outdoor Furniture
- Performance of Borate and Coconut Fatty Acid Distillate Against Biodeteriorating Agents
- Statistical Services for MSD
- Statistical Services for TID
- Sourcing of Non-Wood Raw Materials for Research and Development
- Synthesis of Polyurethane Resin from Chemical Recycling of Polyethylene Terephthalate (PET) Waste Bottle

Externally-funded

- Utilization of Spent Tea Leaves and Tobacco Dust as Additives for Plywood Adhesives
- Piloting of the FPRDI Wine Barrel Technology
- Assessment of the Coppicing Characteristics of Lapnis (*Broussonetia papyrifera*) as a Strategy for its Control and Management and Sustainable Utilization for Pulp and Paper Production

Technology Transfer Program

The Technology Transfer Program brings FPRDI technologies and innovations to the market place (thru IP licensing and commercialization) and provide technical support (thru training and other forms of technical assistance) to improve the productivity and socio-economic well-being of the forest-based industries, communities and MSMEs.

Through the Technical Services Division, it identifies, protects, manages and commercializes technologies and innovations generated by the Institute and provides the technical support needed to bring these to targeted markets and intended customers, guided by RA 10055 (Philippine Techno-Transfer Act of 2009), DOST AO 04 (DOST IP Policy) and DOST AO 09 (Technology Transfer Protocol of DOST-RDIs).

Sub-programs/Sections of TTP/TSD:

- Technology Licensing and Promotion
- Socio-Economics and Marketing
- Training and Manpower Development Services
- Communication Materials Production and Library Services

TECHNOLOGY LICENSING AND PROMOTION

- Technology Forum (TF)/ Demonstration/ Consultative Dialogue (CD) and Technical Series (TS) for the Forest-Based and Allied Industries, Academe, Local Government Units (LGUs) and Constituents, Indigenous People (IP) and other Interested Public
- Information Campaign on FPRDI Technologies and Services thru Electronic and Social Media Promotion
- Visitors' Assistance and Upkeep of FPRDI Visitors' Centers
- Showcasing of FPRDI Technologies and Services through Technology Exhibits and Fairs
- Transfer of FPRDI Technologies for Commercialization
- Technical Assistance and Consultancy/ Advisory Services
- Intellectual Property Management of the FPRDI Generated Technologies

SOCIO-ECONOMICS MARKETING

- Knowledge Management of FPRDI Technical Services
- Intellectual Property (IP) Valuation of Selected FPRDI Technologies
- Piloting of FPRDI Technologies: Bamboo Jointing System Technology
- Market and Value Chain Analysis of the Pallet Industry
- Feasibility Assessment of FPRDI Technologies
- Impact Assessment of FPRDI Technologies Installed in 2018
- Assessment of FPRDI R&D Outputs
- DOST-PCAARRDD-FPRDI Technology Business Incubator for Wood and NonWood Processing Technologies

TRAINING AND MANPOWER DEVELOPMENT SERVICES

- Skills Training for the Forest Based and Allied Industries, Academe, Local Government Units (LGUs) and Constituents, Indigenous People (IPs) and other interested publics
- Preparation and Updating of Training Packages (Training modules, handouts, training and cost-estimates and AV programs)
- Training Needs Identification
- Skills Training Outcome-Based Monitoring and Evaluation
- In-House Trainers' Training

COMMUNICATION MATERIALS PRODUCTION & LIBRARY SERVICES

- 6-Year Development Plan (2017-2022) for a competitive FPRDI Scientific Library
- Publishing of FPRDI Books / Updated Salvosa's Lexicon of Philippine Trees & the Compendium of Properties and Utilization of Tree Plantation Species
- Publishing of FPRDI Books / Handbook of Forest Woody Vines, volume 2
- Preparation of Papers for Submission to ISI Journals
- Publishing of Press/ Web Releases
- Production of Audio-Visual Presentations (AVPs)
- Library Databases Management and Information System

Science & Technology Services Program

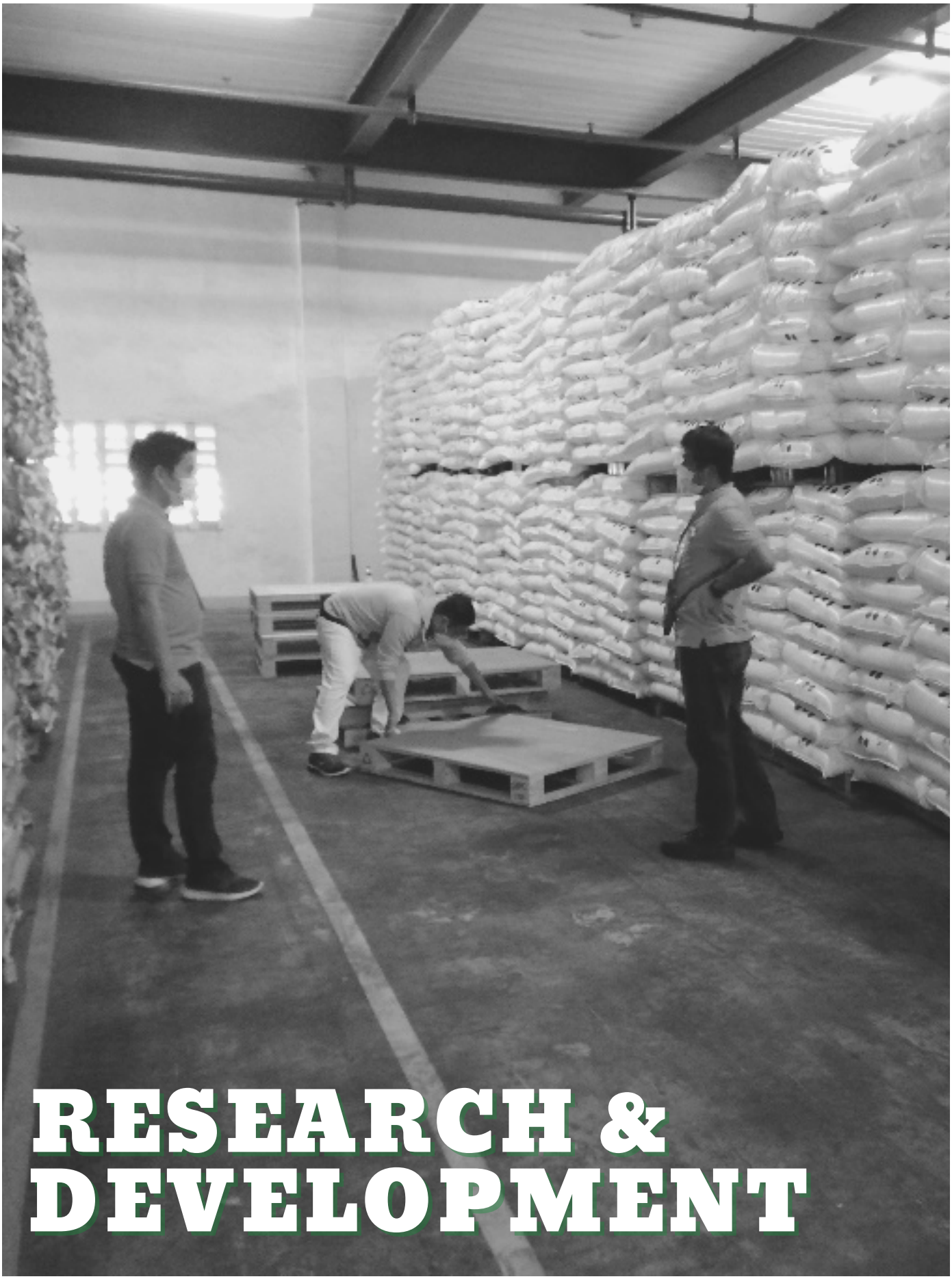
This program involves upgrading/modernizing the ISO/IEC 17025:2005 accredited and non-accredited laboratories to offer continuous quality service to customers. FPRDI aspires for all its testing laboratories to be ISO/IEC-compliant to acquire sound management and recognition for the technical competence for all the type of tests it undertakes. This should be done for the expansion of current services of FPRDI Testing Laboratories which presently include only the testing laboratories of Pulp and Paper, Plywood and Furniture. With this program, other testing laboratories of FPRDI such as FPRDI Pulp and Paper Chemical Testing, Herbarium and Xylarium, Chemistry, Pallets and Packaging, Fire Testing, Calibration, Wood preservation, Wood Anatomy, and Physical and Mechanical Testing, Biomass and Energy Testing and Structural Testing laboratories will be included and prepared for ISO/IEC 17025: 2005 accreditation. The proposed inclusion of other testing services of FPRDI aims to cater to industry requirements that testing laboratory should be complete in its facilities

LIST OF PROJECTS

- Upgrading and Maintenance of FPRDI Herbarium and Xylarium for Research and Development
- Establishment of an ISO Accredited FPRDI Formaldehyde Emission Testing Laboratory
- Upgrading, Improvement and Expansion of FPRDI Chemistry Laboratory
- Upgrading of FPRDI Biotechnology Laboratory
- Upgrading of the Physical and Mechanical Properties Testing Laboratory
- Establishment and Accreditation of Pallet Testing Center
- Upgrading of the FPRDI Wood Anatomy Laboratory
- Upgrading of the Existing Fire Testing Laboratory
- Upgrading of Existing Entomology - Pathology Laboratory
- Upgrading of the Existing FPRDI Wood Preservation Laboratory
- Maintenance and Operation Management System of FPRDI Testing Laboratories
- Measurement Systems Analysis on the Proficiency Testing Results of FPRDI Testing Laboratories
- Inter-Laboratory Proficiency Testing for Paper and Paperboard
- Establishment FPRDI Calibration Laboratory
- Establishment of Nanocellulose Technology R&D Laboratory
- ISO Modernization/ Upgrading of Biomass Energy Testing Laboratory (BETL)
- Upgrading of Pulp and Paper Testing Laboratory – Chemical
- Upgrading of Structural Testing Laboratory
- ISO Accreditation of FPRDI Pulping and Paper Making Laboratory
- Upgrading of Composite Products Testing Laboratory
- Upgrading of the Wood Seasoning Laboratory for R&D and Testing
- Upgrading of the Finishing Laboratory for R&D and Testing
- Restoration and Upgrading of Sawmill Laboratory Facilities and Equipment
- Upgrading of Wood Machining Laboratory Facilities and Equipment
- Improvement and Expansion of Handmade Paper Laboratory
- Upgrading and Maintenance of the Bio Energy and Equipment Development Laboratory
- Establishment of Cellulose Derivatives Laboratory
- Design and Development of Ignitability Test and Fire Tube Apparatus

Major Outputs

R&D | TECHNOLOGY TRANSFER | S&T SERVICES



RESEARCH & DEVELOPMENT

Evaluation of the Physical and Mechanical Properties of Economically Important Forest Woody Vines

This study determined the physical [moisture Content (MC)], relative density (RD), volumetric shrinkage (VS)] and mechanical [bending, compression parallel to grain measured as maximum crushing strength (MCS), tensile strength (TS) and folding endurance] properties of 10 species of forest woody vines collected from Quezon Province. A modified ASTM D 143-14 procedures was followed.

Diplay [*Rhaphidophora acuminata* Merr.] showed the most promising attributes among the vines such as lowest VS (15.17%), no bending failure, and highest RD (0.552), TS in green condition (39.44MPa in split form and 41.78MPa in round form), and MCS in green condition (15.67MPa), Alagau-baging (*Premna subscandens* Merr.) exhibited good attributes in most of the mechanical properties such as TS and MCS. Palus-palusan (*Parabaena denudata* Diels.) and singkamas-singkamasan (*Mucuna reticulata* Burck.), though without remarkable physical and strength properties, had good folding endurance in both split and round forms in their freshly harvested state. These four vine species can be used for furniture and handcraft making.

Property Evaluation of Selected Forest Woody Vines: Anatomical Properties

The stem anatomy of 6 forest woody vines, namely: baknitan (*Connarus monocarpus* L.); lanotan (*Agelaea* sp.); bulakan (*Merremia peltata* L.); susung-kalabaw (*Uvaria sorzogonensis* Presl.); duktong-ahas [*Streptocaulon cumingii* (Turcs.) F. Vill] and tingkul kugos [*Jasminum aculeatum* (Blanco) Walp. Ex. Hassk.] was studied to determine their gross anatomical properties or diagnistic features that can be used for their identification.

Generally, all forest woody vines exhibited cylindrical stem and circular cross section. Growth rings were indistinct. Pores were slightly visible to visible to the naked eye, circular to oval in shape, diffuse and predominantly solitary with radial multiples of 2 to 3. Average vessel or pore diameter ranged from medium-sized to extremely large. Average vessel length ranged from moderately short to medium sized. Average fibers length ranged from extremely short to medium sized, very thin to thin walled.

Cambial variant was observed in bulakan, while duktong-ahas exhibited conspcuous and wide rays.

Utilization of Spent Tea Leaves and Tobacco Dust as Additives for Plywood Adhesive

The technical feasibility of using waste tobacco particles (TP) and spent tea leaves (STL) as plywood glue-mix additive for urea-formaldehyde (UF) and phenol-formaldehyde (PF) resin was investigated. TP from stalks and leaf dust were provided by the National Tobacco Administration (NTA) while the STL was obtained from the Universal Robina Corporation (URC). The TP and STL were processed to produce flour-like powder with various particle sizes as one of the study variables. Other variables were the various combinations and percentage compositions of TP and STL. Parameters investigated were the effect of replacing tha traditional extender (i.e. viscosity and pH), bond strength (BS), formaldehyde emission (FE) and resistance against subterranean and drywood termites (TR).

The best UF and PF glue-mixes developed were piloted in the plywood factories of IM-Wood for the UF and Winlex for the PF. Properties of the pilot-produced plywood were tested for their BS, FE, and TR. Economic viability of producing tobacco stalk flour was calculated based on the laboratory and field data gathered including the cost of producing a full-size 1.22 x 2.44m plywood from the cooperating factories. Service testing through the project's construction company cooperator was also conducted and various house components such as cabinets, ceiling and wall partition were made from the pilot-produced plywood.

Figure 7.6. Pilot production of the developed urea formaldehyde (UF) glue-mix with tobacco stalk flour additive conducted in a plywood factory.

Results showed that the best TP and STL particle size to be used as glue-mix additives for the UF and PF was the passing 200 mesh or < 74 µm. Both the UF and PF bonded plywood produced from the laboratory and factory using developed glue-mix formulations with either TP and STL or combination at 4-8% by mass passed the minimum requirements of the PNS ISO standards for the BS and FE. In addition, both the laboratory and pilot-produced plywood attained a certain degree of TR attributed to the presence of nicotine and other alkaloids in the TP. Cost analysis showed that TP production cost was about P16.29/kilo. For UF, the pilot-produced plywood's glue-mix cost per panel for a 3-ply 5mm plywood was P29.03 at double glue line (DGL) spread while the factory formulation glue-mix cost was P35.04 per DGL, which had a difference of P6.03. For PF, the total production price difference for 3-ply 5mm plywood computed for the same quantity of glue-mix for the developed formulations (P437.75/panel) and commercial control formulation (P487.19/panel) was about P49.44/plywood. The lower glue-mix cost and total production cost of 3-ply 5mm plywood both for the UF and PF showed the great potential of using the new additives in lieu of the traditional additives used by the Philippine plywood factories.

Development of Wastewater Treatment Equipment for Wet-type Finishing Spray Booth

Finishing spray booth (FSB) is a chamber that provides cleaner working area and better quality of finished products by collecting overspray, dust and mist during finishing operation. However, recently, disposal of wastewater from the wet-type FSB becomes a challenge. RSU Manufacturing Corporation (RSUMC) seeks help to work on a solution on the proper treatment and disposal of wastewater from wet-type FSB (WFSB). The current wastewater disposal practice is either discharge within the local drainage system or direct disposal to bodies of water. This can contribute to environmental pollution as the wastewater contains toxic chemicals from finishing overspray. WFSB is a rarely research area, however, there were many researches on wastewater from water-based paints and varnishes manufacturing.

Physical, chemical and biological treatment methods were all tested for various paint manufacturing wastewater. The results showed WFSB the potential to be treated using combination of treatment methods. The collected wastewater was characterized in terms of the chemical oxygen demand (COD), biological oxygen demand (BOD), total suspended solids (TSS), total dissolved solids (TDS), oil and grease, lead, cadmium, benzene, toluene, ethyl benzene, xylene, phenol, phosphates, sulfates and color. From all the parameters tested, the collected wastewater failed in the discharged limit for COD and BOD. Wastewater samples was also brought to the lab for the jar test experiments. Coagulation-Flocculation test using Alum and polyaluminum chloride (PAC) revealed that 0.10 g/L and 0.05 g/L of alum and PAC as the optimum coagulant dosage. Wastewater pre-treated with Alum and PAC where then subjected to HRT determination and activated carbon/sorption material test. The test showed that the optimum HRT is 120 minutes.

Comparison of performance and cost of alum and PAC, PAC was selected as the best coagulant. Through the continuous sorption test using activated carbon (AC), a breakthrough curve was achieved and 0.079365 mL/s was determined to be the best flowrate. Based on the data of the laboratory experiment the design of the treatment equipment was created and conceptualized. After construction of the equipment, the saturation of the AC was determined. It was concluded that the AC tank is to be backwashed every after five days. The personnel assigned to the equipment were trained for the laboratory work, and equipment operation, maintenance, and troubleshooting.

Design and Fabrication of Prototype Air-Heated-Vacuum Furnace Type Dryer for Plantation Timber, Bamboo, and other Non-Timber Forest Products for Forest-based Industry

A 500-bdft capacity prototype air-heated-vacuum furnace type dryer was designed, constructed, and evaluated based on its drying performance. It has a double-wall mild steel plate installed with a double stage liquid ring vacuum pump with 1.5 m3/minute maximum pumping capacity and -750mmHg maximum ultimate vacuum pressure. The source of heat was a biomass furnace connected with an 8" diameter x 10' length flue pipe. A 32" diameter propeller fan was installed to distribute the heat inside the chamber.

Yemane (25mm thick), mahogany (25mm thick), and kawayan tinik poles were used for the trial run from March to June 2021, with intermittent drying (due to COVID restrictions) with a maximum of 8 hours of operation per day. Yemane, with 106.3% initial MC, reached 10.2% MC after 168 hours. Mahogany with an initial MC of 57.7% reached 9% MC after 88 hours, and kawayan tinik with 115% MC reached 9.4% MC after 73 hours under discontinuous vacuum drying or cycling drying (47053 degrees Celcius and 30-40Kpa vacuum).

The prototype air-heated-vacuum furnace type dryer can be operated by a single worker. Yemane has the highest drying cost per board foot (Php29.78), followed by mahogany (Php20.68) and kawayan tinik having the lowest (Php17.21). The drying cost is expected to decrease as the dryer capacity increases.

The cost of fabricating the air-heated-vacuum furnace type dryer (AVFTD) is Php 572,123.60. Supplies and material used were valued at Php 394,568.00 while labor (approximately 45% of direct materials) amounted to Php 177,555.60.

Production and Property Testing of Bamboo Pellet for Biomass Energy

There is high demand for wood pellets abroad, so timber companies in the Philippines are showing interest in entering the bioenergy market. However, to secure the sustainability of feedstocks, other alternative biomass must be tested if characteristics are within the standard of wood pellets such as dimensions, ash content, durability, fine particle content, additives, gross calorific value, net calorific value, bulk density, nitrogen (N) sulfur (S), chlorine (Cl), trace metals Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Zinc (Zn), and Iron (Fe), ash fusion temperature and particle size distribution.

In this study, various species of bamboo such as bayog (*Dendrocalamus merrillianus* (Elmer) Elmer), kawayan tinik (*Bambusa spinosa* Roxb.), beema (*Bambusa balcooa* Roxb.), and giant bamboo [*Dendrocalamus asper* (Schult f.) Backer], and napier grass [*Cenchrus purpureus* (Schumach.) Morrone] were converted to fuel pellets. Ten bamboo poles per species were crushed using a manual splitter and chipper and particle sizes were further reduced using a hammermill with 1mm grind screen. The FPRDI-developed pelletizing machine was used to produce 1-2 kgs/hr of fuel pellets. All the samples passed the standard for wood pellet in terms of dimension, durability, fine particle content, additive, net calorific value, As, Cd, Cr, Ph, Hg, Ni and Zn. However, for properties such as bulk density, S, Cl, and ash fusion temperature, the values for all the samples were lower than the wood standard.

Pellets from kawayan tinik have the greatest number of qualities that passes the standard for wood pellets; therefore, it is recommended to be used as the best alternative for wood pellet.

Cinnamon Oil and Extracts for Antifungal and Antibacterial Products

The main goal of this project is to assess the antifungal and antibacterial properties of *Cinnamomum mercadoi* S. Vidal essential oil, hydrosol samples, and extracts via disk and well diffusion assays, respectively. Essential oils produced inhibition zones on plates against Gram positive (*Bacillus subtillis* 1679) and Gram negative (*Pseudomonas aeruginosa* 1335 and *Escherichia coli* 1634). Fungal strain *Candida tropicalis* was found to be the most susceptible to *C. mercadoi* S. Vidal essential oil yielding as large as 21.71mm average inhibition zone. Fourier-transform Infrared (FTIR) spectroscopy of essential oils show differences in band peak between bark and leaves samples. Qualitative phytochemical analysis of extracts were also conducted and geenrally shown absence of alkaloids for Bicol variant.

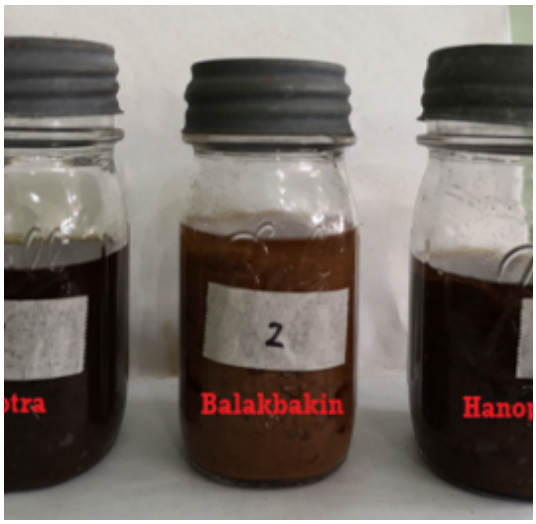
Cinnamon bar soaps were made using the hydrodistillation bark extract wastes. Dermal irritation test was also conducted for 21 days in adult albino rabbits wherein erythema/mild irritations were initially observed in 2 days period then disappeared completely by Day 3. Edema was noted at the 4th hour but was not observed after 24 hours of exposure.

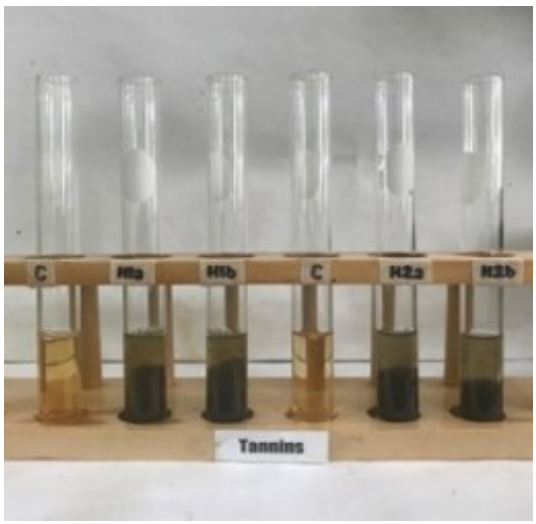
Antimicrobial handmade soaps were also made in laboratory scale and distributed to 29 individuals for testing to obtain preliminary data on consumer preference, buying behavior, product acceptability and costing. Some valuable product acceptability and marketing insights were obtained and was found that the soap product formulation is very acceptable.

Qualitative and Quantitative Phytochemical Analysis of Forest Woody Vines

The stems of eight forest vine species, namely: balakbakin (*Strychnos minor* Dennst.), albotra [*Arcangelisia flava* (L.) Merr] , bulakan [*Merremia peltata* (L.) Merr.]. lalapau (*Hypserpa nitida* Miers ex Benth), mulawing-baging [*Symphorema luzonicum* (Blanco) F. Vill.], tilob [*Dicranopteris linearis* (Burm. f.)], kamagsa brown [*Agelaea macrophylla* (Zoll.) Leenh.], gugo [*Entada phaseoloides* (L.) Merr] were studied for their phytochemicals and antioxidant activities. Samples were air-dried, ground, and subjected to extraction using ethanol as solvent. The dried crude extracts were screened for their phytochemical components, total phenolic content, total flavonoid content and antioxidant activity. Results showed that among the forest vine species, balakbakin and mulawing-baging had the highest extraction yield of 6.28 ‡ 0.39% and 6.26 + 0.77%, respectively.

Phytochemical screening revealed that forest vine crude extracts contain different phytochemicals such as alkaloids, flavonoids, steroids, terpenoids and tannins. FTIR analysis was done to further confirm the presence of alcohols (-OH), alkanes (C-H stretch), alkenes (C=C), carboxylic acids/ketones (C=0 stretch), and nitro compounds (N-O). In terms of total phenolic content, ethanolic extracts of kamagsa brown and mulawing-baging were found to have higher amounts with values of 640.24 ‡ 7.13 and 398.94 ‡ 20.08 mg GAE/g dried extract, respectively. Moreover, tilob, mulawing-baging, gugo, kamagsa brown and bulakan possessed strong antioxidant activities which ranged from 13.26 to 26.17 ug/mL IC50 and is comparable to BHT standard. The results of this screening will be used as baseline in the purification of their bioactive components. Antimicrobial assay was also done in the crude ethanolic forest vine extracts which showed that the growth of *Staphylococcus aureus* and *Candida tropicalis* is "intermediate" to albotra and the growth of Pseudomonas aeruginosa and *Bacillus subtilis* is also "intermediate" to bulakan and mulawing baging.





Synthesis of Polyurethane Resin from Chemical Recycling of PET Waste Bottle

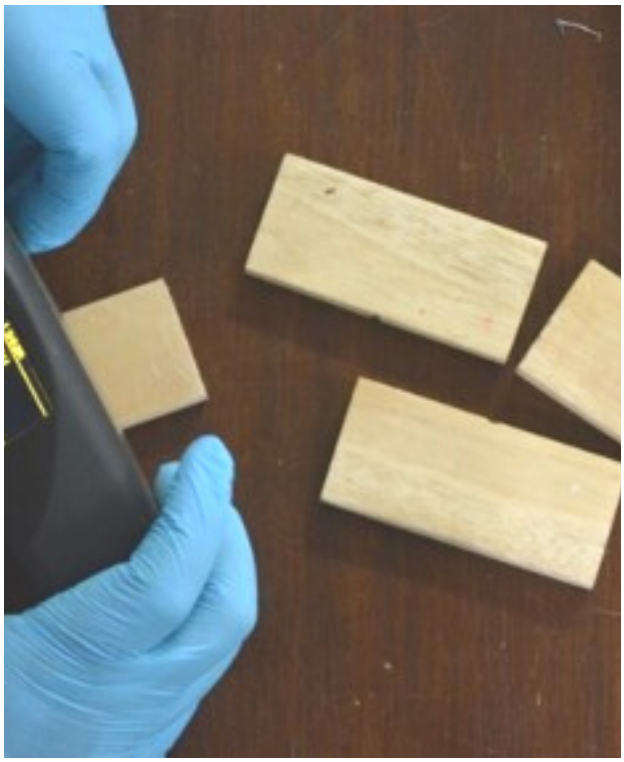
The feasibility of synthesizing polymer from the chemical recycling of waste polyethylene terephthalate (PET) bottles for the production of wood finishing material was investigated.

The waste PET was subjected to a two-stage reaction. Initially, the cleaned PET pellets were reacted with amino propanol under reflux at three different ratios: 1:3, 1:4 and 1:5 PET to amine ratio in the presence of sodium acetate as catalyst. After the four-hour reaction, a yellowish to brownish homogenous solution was formed as end-product. This product turned creamy white at room temperature. The product was then subjected to the second reaction stage where it was reacted with E-caprolactone at 1:20 ratio, with dibutyltindilaurate (DBTDL) as catalyst. The process was done through refluxing for three hours in the presence of nitrogen. This yielded an orangebrown homogenous product at room temperature.

FT-IR analysis was then done to characterize the products from the two-stage reaction. The FT-IR spectra of the synthesized first-stage product showed the presence of alcohol, amines/amide and aromatic ring functional groups characteristic of bis (3-hydroxy propyl) terephthalamide (BHPTA). On the other hand, the FT-IR spectrum of the synthesized second stage product showed the presence of asymmetric and symmetric CH2 groups, ester, amide, carbonyl and aromatic ring functional groups characteristic of polyol.

A test was done to determine the product's suitability as wood finish. The synthesized polyol was mixed with a catalyst of two-component commercial finishes: polyurethane (PU) and acrylic urethane (AU) at 1:1 (w/w) ratio and thinned with xylene. The finish was then applied on wood samples via brushing, then allowed to cure for 24 hours. The gloss and thickness of applied formulated finishes were then recorded. The applied formulation showed a film-forming finish similar to the two commercial PU and AU. Film thickness ranged from 61.80 to 76.40 micron and gloss ranged of 28.4 to 94.6 GU at 60° incidence angle.

Further, synthesized polyol was formulated into polyurethane finish by mixing with isophorone diisocyanate, DBTDL and xylene showed similar result. Formulated finish applied on Gmelina arborea Roxb showed comparable color, lower gloss, better adhesion and lower gouge and scratch resistance than commercial PU.



Development of Healthcare and Aromatherapy Products from Some Selected Plant Oils. Phase I. Extraction and Characterization of Essential Oils

Essential oils (EOs) were extrcated from some non-timber forest products (NTFPs) namely: *Canarium luzonicum* (Blume) A. Gray resin and *Canarium ovatum* Engl. resin commonly called Manila elemi, *Cinnamomum mercadoi* S. Vidal leaves and *Eucalyptus camaldulensis* Dehnh. leaves using the FPRDI developed bench-scale extractor. They were characterized by FTIR spectroscopy and GC-MS analysis. In addition, their antimicrobial activities were also determined.

Based from GC-MS analysis, the major components of *C. luzonicum* (Blume) A. Gray resin essential oil (CLREO) were D-Limonene (49.71%), myristic acid (19.67%) and palmitic acid methyl ester (16.99%). On the other hand, major components of *C. ovatum* Engl. resin essential oil (COREO) were limonene (43.41%) and α-phellandrene (32.42%). Both limonene and α-phellandrene compounds were present in both resins but α-phellandrene is more abundant in COREO.

The GC-MS chromatogram *C. mercadoi* S. Vidal leaf EO showed 12 components which were mostly monoterpenes and sesquiterpenes compounds. The most abundant component of the leaf oil was methyleugenol (42.61%), a phenylpropanoid, followed by β-Linalool (38.23%), a monoterpenoid.

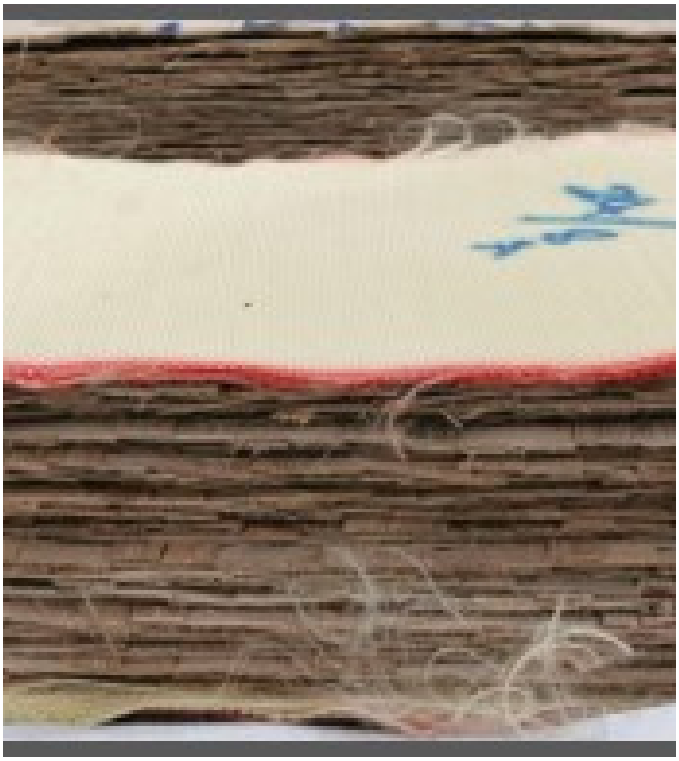
Results also showed that volatile oils of cinnamon leaves, Manila elemi resin and Eucalyptus leaves have good antimicrobial activities against various gram-positive and gram-negative bacteria including pathogens.

Application of Nanocellulose as Ballistic Material for Bullet Proof Vest

Bench scale production of nanocellulose was successfully conducted following Saito 2007) method of extraction.A white gel like material was extracted which is comparable to commercial cellulose nanofibrils (CNF) slurry. The extracted nanocellulose has a diameter under 10nm and a consistency of 2.23% solids.

Vapor casting of nanocellulose using vacuum oven was successfully conducted at 40˚C. An increase in thickness was observed as the amount of nanocellulose was increased. Similarly, polyvinyl alcohol (PVOH)-based films were also successfully vapor casted in a convection oven set at 50˚C. The transparency PVOH film were visibly affected with the addition of CNF as it becomes a translucent film. Moreover, the reinforcement CNF into the PVOH matrix also increased the thickness. However, initial inspection of the film indicated its unsuitability for ballistic material.

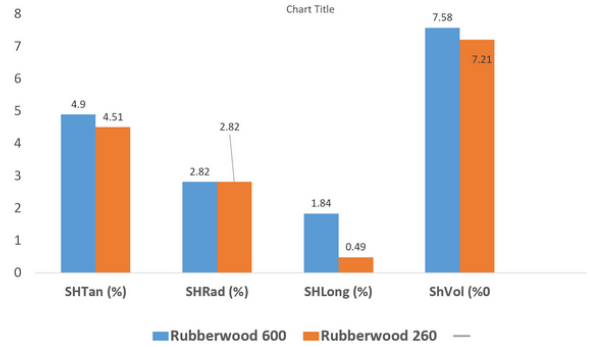
On the other hand, laminated fiberglass and abaca fibers were prepared using unsaturated polyester (PE) reinforced with fiberglass, abaca fiber and CNF. Reinforcement of polyester using CNF reduced the length of cracking by 27%. In addition, laminated abaca fiber using PE with CNF showed that it was not enough to prevent the bullet from penetration. Lastly, unsaturated polyester reinforced with CNF combined with abaca fiber and fiber glass successfully passed the Level IA category for ballistic material.

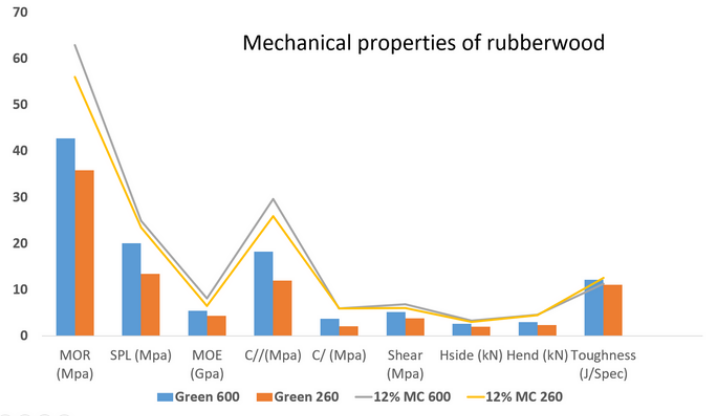


Anatomical, Chemical, Physical and Mechanical Properties of Rubberwood in the Philippines

The physical properties (relative density, moisture content (MC) and shrinkage), and mechanical properties (static bending, compression parallel and perpendicular-to-grain, shear, hardness and toughness), anatomical (fiber length and diameter, lumen diameter and cell wall thickness, vessel length and width), and chemical properties (ash content, hot water extractives, sodium hydroxide, and starch content of two (2) rubberwood varieties (P260 and P600) are presented.

The relative density mean value of rubberwood P 260 (0.48) was lower than P600 (0.53). As per relative density classification, rubberwood P260 mean values fell under Group IV (moderately low), while P600 under Group Ill (medium) For the MC, P260 (125.94%) was higher than P600 (102.89%). Inverse relationship between relative density and MC as also reported in literature was observed. On the other hand, the volumetric shrinkage (ShVol) of P260 (7.21%) was lower than P600 (7.58%) although both fell under low ShVol (Group V). The mechanical properties of rubberwood P600 fall under moderately low (C4) while P260 under low (C5).





The ash content of P600 (0.20%) was lower than P260 (0.28%) while the hot water solubility, sodium hydroxide soluble and starch content of rubberwood P600 (4.47%), (21.57%) and (2.00%) were higher than P260 (2.85%), (20.37%) and (0.96%). Fiber length (1.2793 mm) and diameter (0.0297 mm), lumen diameter (0.0218 mm), vessel length (0.7529 mm) and diameter (0.2591 mm) of rubberwood P260 were higher than those of rubberwood P600 (1.2021 mm), (0.0270 mm), (0.0179 mm), (0.6601) and (0.2316).

Based on the anatomical, chemical, physical and mechanical properties, rubberwood is recommended for end-uses such as furniture, wood carvings, pallets and other light to moderately light construction purposes particularly those requiring dimensional stability. Likewise, the wood showed potential for pulp and paper making as indicated by low ash content and anatomical properties confirmation.

Performance Evaluation of Portable Solar Powered / Heated Dryer with Auxilary Biomass Heater

A. 1.18 cu.m (500 bd.ft) capacity portable kiln dryer with solar energy and biomass as heat source was designed, constructed and evaluated for its performance.

During the trial run, 120 kawayan kiling (*Bambusa vulgaris* Schrad) bamboo poles with 58.72% average initial MC were dried in the glazed chamber to 13.07% MC in 29 days using only the solar heated collector which attained at maximum temperature of 69.4%.

In the actual performance evaluation, 50-mm thick paper mulberry [*Broussonetia papyrifera* (L.) Vent] lumber were kiln dried in the solar dryer. From an average initial MC of 54.95% the lumber samples were dried to final MC of 12.32% in 10 days. The cost of solar drying the lumber was Php 10.12/bd.ft. Another run of 25-mm mahogany (*Swietenia macrophylla* King) lumber with an average initial MC of 60.74% lumber samples were dried to final MC of 10.49% in 20 days of the day operation. Average temperature inside the whole drying time is 41.9C. Computed solar drying of mahogany lumber was about Php 28.59/bd.ft Eighty pieces of 8-ft kawayan kiling was loaded with an average initial MC of 130.58% and dried to final MC of 9.54% in 14 days of day operation. The cost of solar drying of kawayan kiling is Php 48.84/bd.ft.

Based on the mahogany trial run, the dryer's thermal efficiency was computed. The equivalent heat supplies was 6.209.34 Btu/hr. While the computed total heat output was 23,423.74 Btu/hr during the 160 hours of drying operation. This resulted to the dryer's thermal efficiency of 26.51%.

The cost of the solar photocoltaic (PV) system is Php 320,000.000 and the chamber with auxiliary heater is Php 119,554.00. The solar dryer can be one of the options for drying lumber or bamboo. However, the initial investment of this dryer is high due to the PV system.

Development of an Automated, Quick, and Accurate Wood Identification Tool/Device for Selected Endemic, Native and Exotic Species Including Imported Timber Species Traded in the Philippines

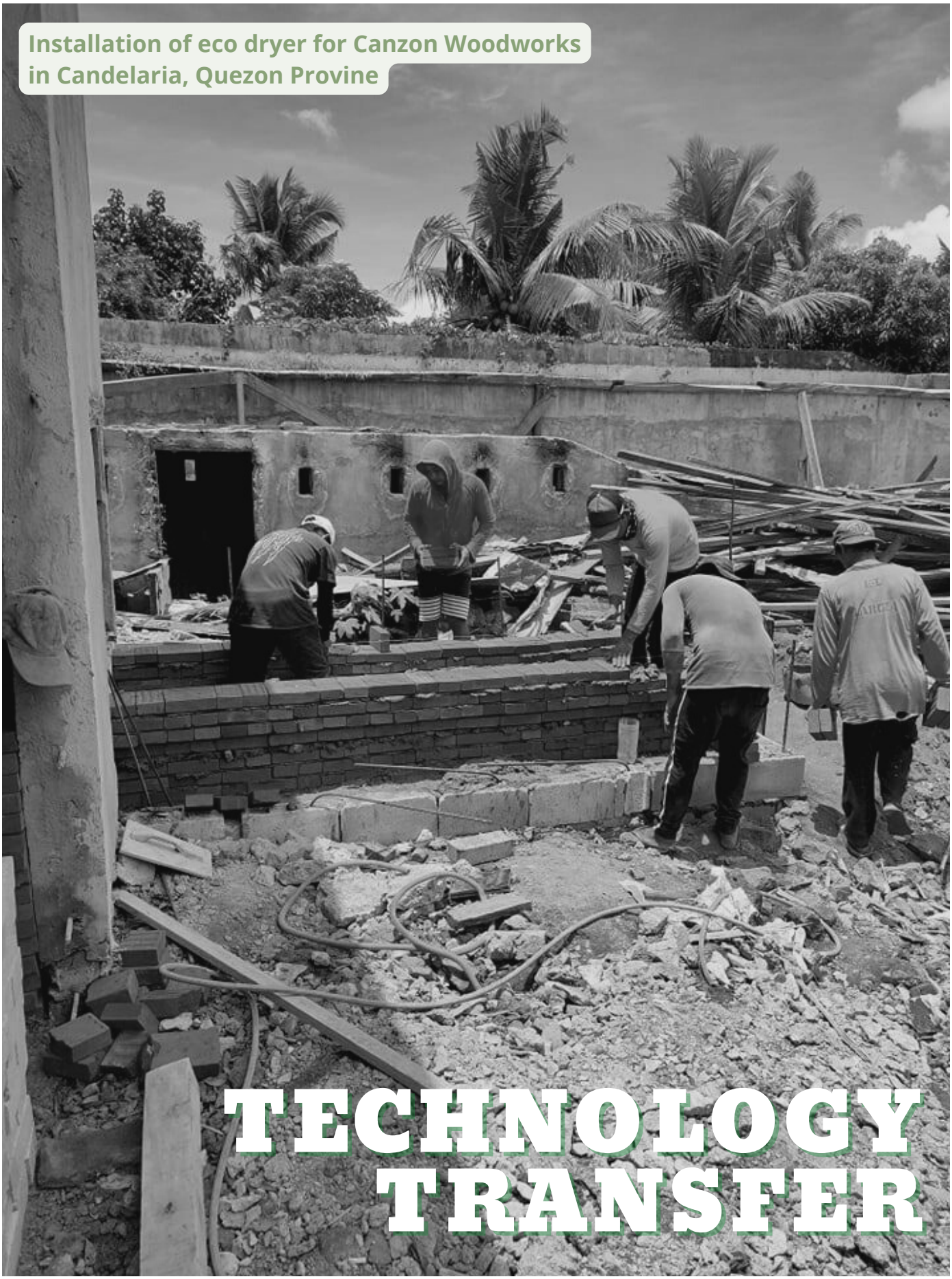
A total of 30 timber species, composed of endemic, exotic and imported species, presently being traded in the country were identified, collected from FPRDI Xylarium/Sawmill area and DENR Regional offices and then prepared/sanded for image generation.

Using the built-in camera of the Android smartphone retrofitted with XyloPhone, a total of 2,363 images were captured at 5X (1,600) and 7X (763) magnifications. Wood identification model and phone application were then developed using these images.

A database management system containing the macroscopic anatomical characteristics and representative cross section images of the 30 species were also developed.





Installation of eco dryer for Canzon Woodworks in Candelaria, Quezon Provine

TECHNOLOGY TRANSFER

TECH-TRANS IN A GLANCE

36
TRAINING ACTIVITIES

1,357
TRAINING PARTICIPANTS

207
FORESTERS BENEFITED FROM CPD TRAINING ACTIVITIES

13
TECHNOLOGIES ADOPTED

14
TECHNOLOGY FORA

1,480
VISITORS ACCOMMODATED

470
CONSULTANCY/ADVISORY SERVICES

23
CONSULTATIVE DIALOGUES

6
TECHNOLOGY EXHIBITS

2
TECHNOLOGIES PILOTED

7
INCUBATEES UNDER TBI

12
REGISTERED INTELLECTUAL PROPERTIES

25
PRESS RELEASES

96 Media Landings

5
TECHNICAL ARTICLES PUBLISHED IN ISI JOURNALS

1
BOOK PUBLISHED

426
LIBRARY ASSISTANCES

Skills-Training

FPRDI conducted 36 training activities. These benefitted 1,357 training participants. Of the 36, 32 are through the DOST-FPRDI Training Services Delivery System for the New Normal. This is a three-level system that ensured the presence of all the major activities (lecture, demonstration and hands-on) in the previous normal way of conducting trainings. The other 4 training activities were rendered face-to-face and conducted on-site.

As a PRC accredited CPD provider, four training courses with CPD units were offered to in-house foresters and from other organizations. A total of 207 foresters benefitted from the training.

Impact Assessment of FPRDI Technologies Installed in 2018

A series of interviews were conducted to gather data for assessing impacts of FPRDI installed technologies from adaptors in 6 regions (CAR, Region III, NCR, Region IV-A, Region V and Region VIII). The analysis was based on interview responses and secondary data collection from seven adaptors of FPRDI technologies on charcoal production and briquetting and drying of lumber and handicrafts.

Results showed that adopted FPRDI technologies have contributed to improvements in the productivity and efficiency in local production of wood for housing and construction, furniture and charcoal briquettes. These technologies have also helped in upgrading the quality and competitiveness of the forest products in the local market.

However, dwindling supply of raw materials due to government restrictions on logging and wood transportation have caused drying operations and use of FPRDI technologies to be suspended. are and business lockdowns and travel restrictions caused by the COVID19 pandemic for the last two years have also disrupted government livelihood projects and manufacturing operations that likewise rely on adopted FPRDI technologies.

Thus, it is recommended that FPRDI continue to design, innovate and deliver new and/or better technologies that would help wood and non-wood forest products industries to become more resilient against pandemics and other significant business disruptions while adapting and complying with government policies and regulations. The Institute must also continue developing and implementing impact assessments and other feedback mechanisms in order to come up and deliver relevant and sustainable technologies and services.

Technical Assistance and Consultancy Services

For 2021, technical assistance and consultancy/advisory services were rendered to 470 FPRDI customers in response to their written/walk-in requests/inquiries.

Three hundred ninety-nine (399) consultancy/advisory services (CAS) were provided to FPRDI customers in response to their written/ walk-in requests/ inquiries. One hundred seventy-eight (44.6%) were from private enterprises/ industry, 136 (34.85%) were from government agencies, 7(1.7%) from NGO/ Cooperatives/ Foundation and 75 (18.7%) from the academe.

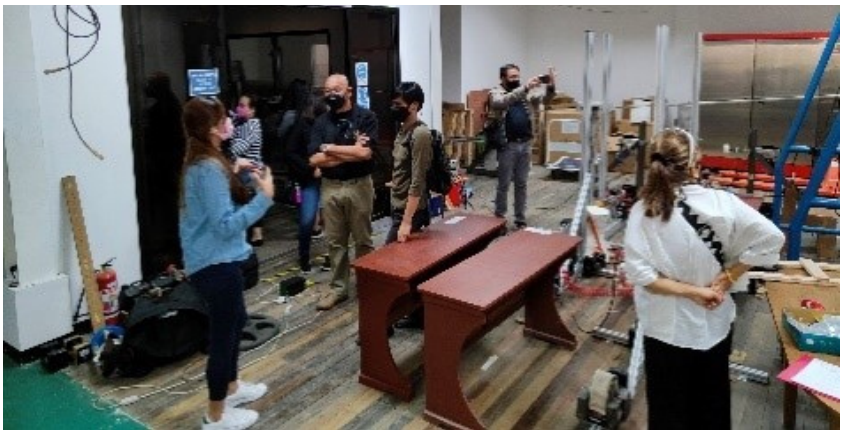
Seventy-four (74) technical assistances (TA) were extended to 37(50%) private enterprises/ industries, 34 (46%) government agencies, and 3 (4%) NGO/Cooperative/Foundation.

Bamboo technologies (engineered bamboo, DIY bamboo shelter, bamboo musical instruments, bamboo veneer lathe, bamboo frame face shields, etc.) and charcoal

Visitor's Assistance and Upkeep of FPRDI Visitors' Center CY 2021

A total of 1,480 visitors were accommodated in the Institute comprised of the following: personnel from private companies, 1,383 (93.44 %); students and staff from the academe, 13 (0.88 %); officials from local government units (LGUs) 14 (0.95%); and officers from national government agencies, 70 (4.73%). A total of 312 FPRDI technology information brochures were distributed to selected visitors. Likewise, 3 technology demonstrations were arranged and conducted.

Immediate benefits of the Institute's visitor's information and assistance program were: (1) creation of awareness on forest products processing and utilization and (2) establishment of new and maintenance/strengthening of existing contacts with industry groups, LGUs, foreign delegates and academic institutions.



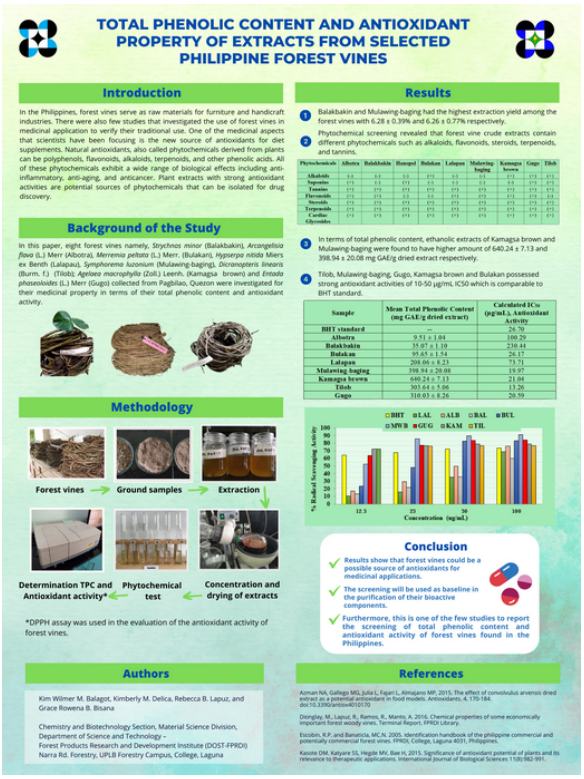
Transfer of FPRDI Technologies for Commercialization

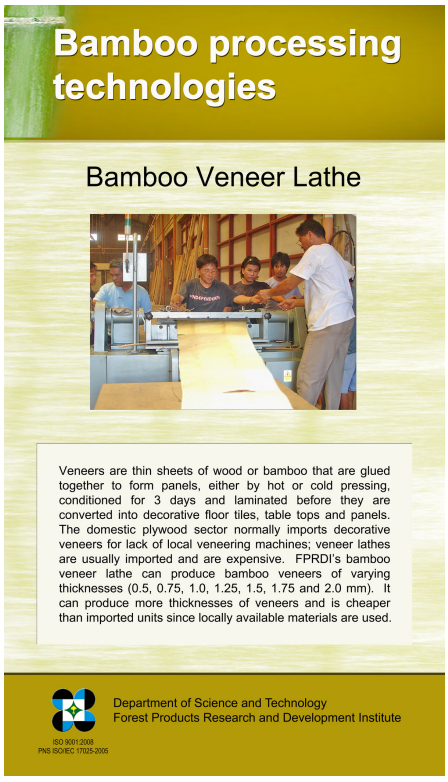
For 2021, a total of 13 FPRDI technologies namely, Bamboo Framed face shields, Steam bending, Charcoal Briquetting Equipment (Drum Kiln, Manual briquettor, Charcoal Grinder, Charcoal mixer), Non-wood Dryer, Eco-dryer for Handicraft and Bamboo, Eco-dryer cum Heat Treatment Facility, Finishing Spray booth, Furnace Type Lumber Dryer (FTLD), Multi-Purpose Hot Press and DIY Bamboo Shelter were adopted and transferred in Regions III, IV-A, IV-B, V, VII, X and XII. The initial outcomes of technologies transferred/adopted are: Briquetting Equipment for briquette production became source of livelihood for association members; users of Finishing Spray Booth-reduced air pollution and protected workers' health. For Eco-dryer cum Heat treatment facility, complied with the market product specifications and eliminated insect pests, diseases and mold infestations and additional income. Bamboo framed face shields still became useful this COVID 19 crisis and contributed to "Bayanihan to Healas One Act"; Cost of technologies/investment generated is around Php 7,605,000.00

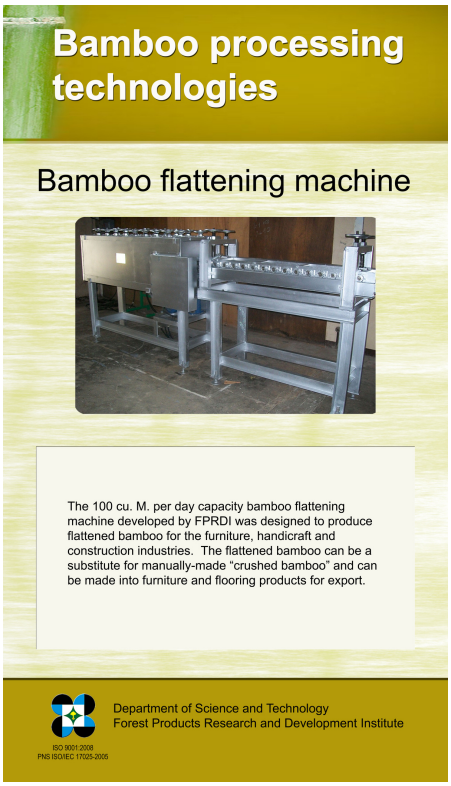
Showcasing of FPRDI Technologies and Services Through Participant in Technology Exhibits and Fairs

A total of six technology exhibitions/fairs were participated in by FPRDI in three regions of the country:

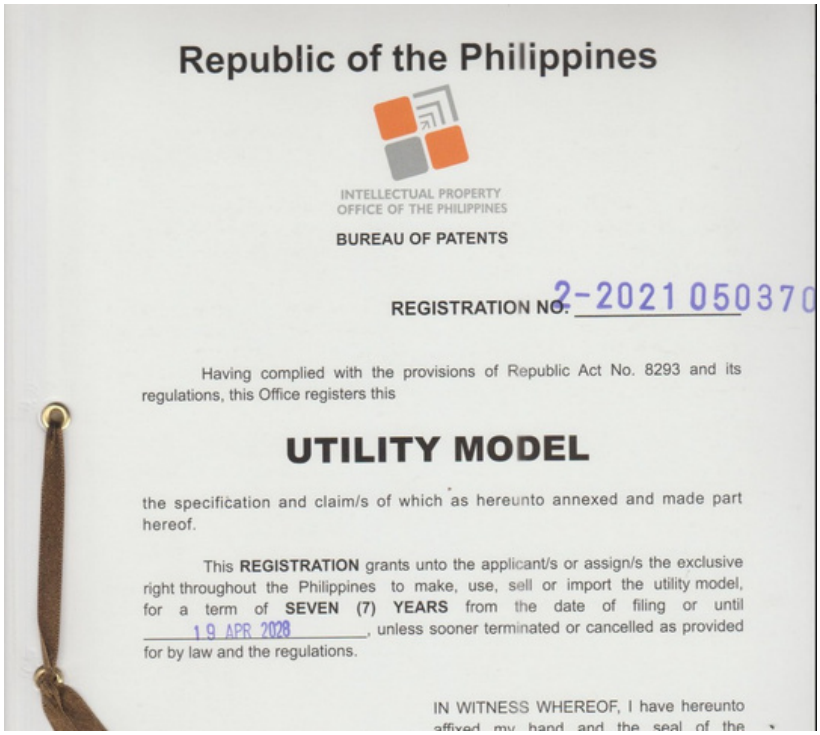
Three of the technology exhibitions were organized by the Department of Science and Technology namely: 1) DOST National Science and Technology Week Celebration: 2) DOST Region I Regional Science and Technology Week Celebration and Invention Contest: and 3) DOST Exhibit at SM Malls. The Department of Interior and Local Government (DILG) chaired this year National Biotechnology Week Celebration 2021 and the University of Philippines, Open University hosted the Los Bans Science Community Foundation, Inc. "SyenSaya 2021".







Intellectual Property Management of the FPRDI Generated Technologies



Republic of the Philippines

INTELLECTUAL PROPERTY OFFICE OF THE PHILIPPINES

BUREAU OF PATENTS

REGISTRATION NO. 2-2021050370

Having complied with the provisions of Republic Act No. 8293 and its regulations, this Office registers this

UTILITY MODEL

the specification and claim/s of which as hereunto annexed and made part hereof.

This **REGISTRATION** grants unto the applicant/s or assign/s the exclusive right throughout the Philippines to make, use, sell or import the utility model, for a term of **SEVEN (7) YEARS** from the date of filing or until 19 APR 2028, unless sooner terminated or cancelled as provided for by law and the regulations.

IN WITNESS WHEREOF, I have hereunto affixed my hand and the seal of the

For 2021, two FPRDI Intellectual Property Application were filed to Intellectual Property Office of the Philippines (IPOPHIL) thru the SciTech Superhighway Program of DOST namely:

- Lignocellulosic Ignition Aid-Coated Charcoal Briquettes
- Non-Hold-On Type Decorticating Machine for Abaca.

Two Trademark Application were also filed namely:

- Bamboo Musical Instruments (BMI); and
- Bamboo Musical Instruments Processing Center.

Four Copyright Application were submitted at the National Library of the Philippines and awaiting for Copyright Registration Certificate namely:

- Instructional Video on Bamboo Charcoal Hand Soap Making;
- Instructional Video on Germicidal Soap Making;
- Instructional Video on Tawa-Tawa Hand Mist Making; and
- K-FAP: Kawayan-Forest-Based Antimicrobial Products

Moreover, the IPOPHIL approved the Utility Model applications on:

- Manual Double Screw-Type Mixer for Charcoal Briquetting; and
- Process of Producing Ballistic Vest from Engineered Woven Bamboo Mats with Metal Plates

Two International Patent Application (Patent Cooperation Treaty/National Phase Entry) through DOST-TAPI for:

- Antimicrobial Bamboo Charcoal Hand Soap
- Process of Producing Antimicrobial Bamboo Charcoal Hand Soap

S&T SERVICES

FPRDI TESTING LABORATORIES

FPRDI aspires for all its testing laboratories to be ISO/IEC-compliant to acquire sound management and recognition for the technical competence for all the type of tests it undertakes to better serve its customers.

The FPRDI Testing Laboratories (FTLs) under the ISO 17025:2005 accreditation which include the Pulp and Paper, Plywood and Furniture are the only ones offering such testing services in the Philippines.

The FPRDI Testing Laboratories are now recognized by the furniture, plywood and pulp and paper industry as competent testing laboratories in the country. This is due to its modern testing facilities acquired from abroad and competent personnel that provides reliable and accurate test results delivered on time.

PROFICIENCY / INTERLABORATORY TESTING

The FPPTL inter-laboratory proficiency testing membership to Collaborative Testing Services, USA is renewed yearly since 2007. Generally, results of evaluation of tests are within the satisfactory limit.

PULP & PAPER TESTING LAB

PLYWOOD TESTING LAB

FURNITURE TESTING LAB

FPRDI'S ISO-ACCREDITED LABORATORIES

- Plywood Testing Lab (PTL)
- Pulp and Paper Testing Lab (PPTL)
- Furniture Testing Lab (FTL)

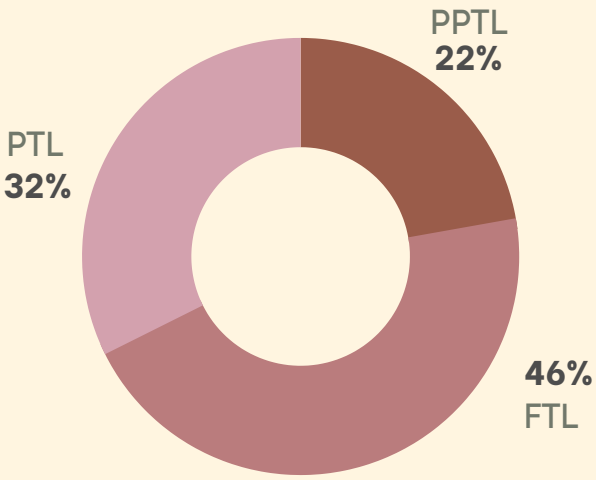
4 M

INCOME GENERATED
(in PHP)

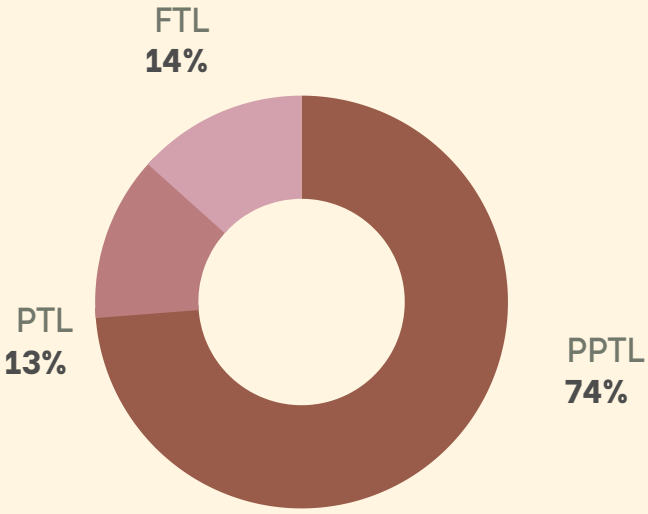
401

CUSTOMERS

DISTRIBUTION BY INCOME



DISTRIBUTION BY CUSTOMER



OTHER LABORATORIES CATEGORIZED PER SECTION:

- Bio-Energy & Equipment Development (BEEDS)
- Engineered Products and Development (EPDS)
- Solid Products Development (SPDS)
- Anatomy and Forest Botany (AFBS)
- Chemistry and Biotechnology (CBS)
- Physical and Mechanical (PMS)

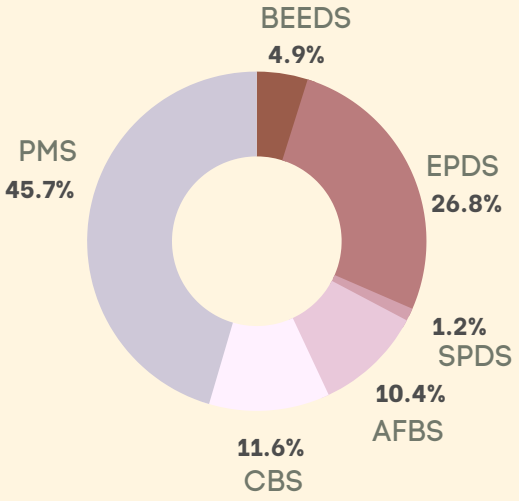
1,239,164

INCOME GENERATED
(in PHP)

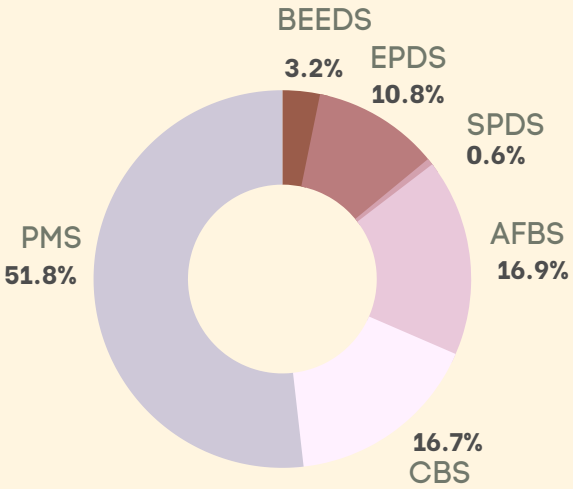
165

CUSTOMERS

DISTRIBUTION BY CUSTOMER



DISTRIBUTION BY INCOME



OTHER FPRDI LABORATORIES

BIO-ENERGY AND EQUIPMENT DEVELOPMENT

WOOD PRESERVATION LABORATORY

ANATOMY AND FOREST BOTANY

FORMALDEHYDE EMISSION TESTING LABORATORY

CHEMISTRY & BIOTECHNOLOGY LABORATORY

PHYSICAL & MECHANICAL

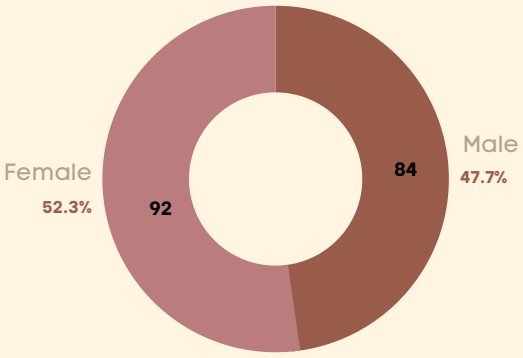
HUMAN RESOURCES AND FINANCIAL MANAGEMENT

Human Resources

HUMAN RESOURCES

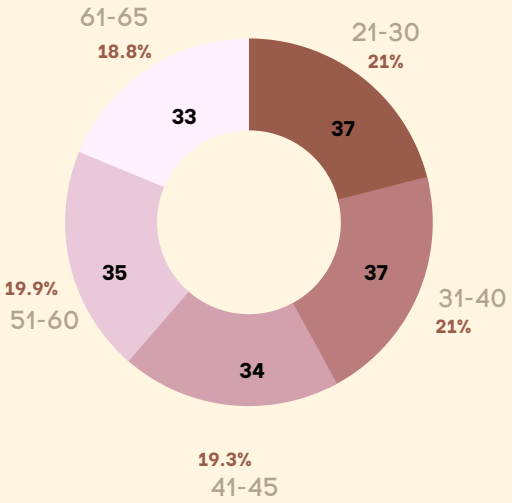
Plantilla Positions: 192
Filled: 176
For Filling-Up: 16

BY GENDER



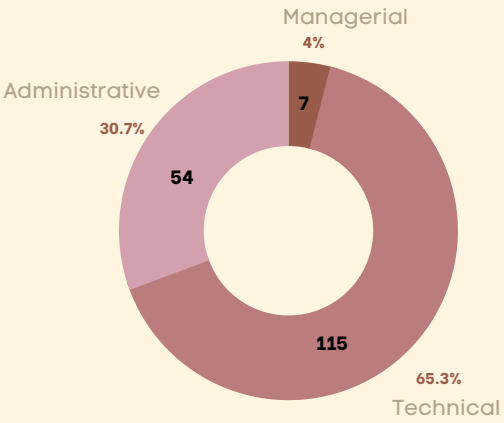
The workforce of the Institute is comprised of 52.3% female and 47.7% male.

BY AGE GROUP



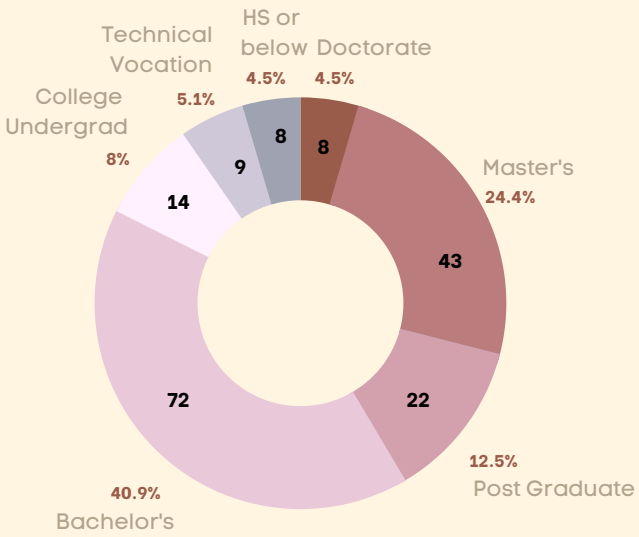
42.05% of the employees are composed of the millennials - 21-30 yrs old (21.02%) and 31-40 yrs old (21.02%). The average age of the employees is 44.68.

BY POSITION



The Institute's workforce is composed of 65.3% Technical staff, 30.7% Administrative staff, and 4% Managerial staff.

Human Resources

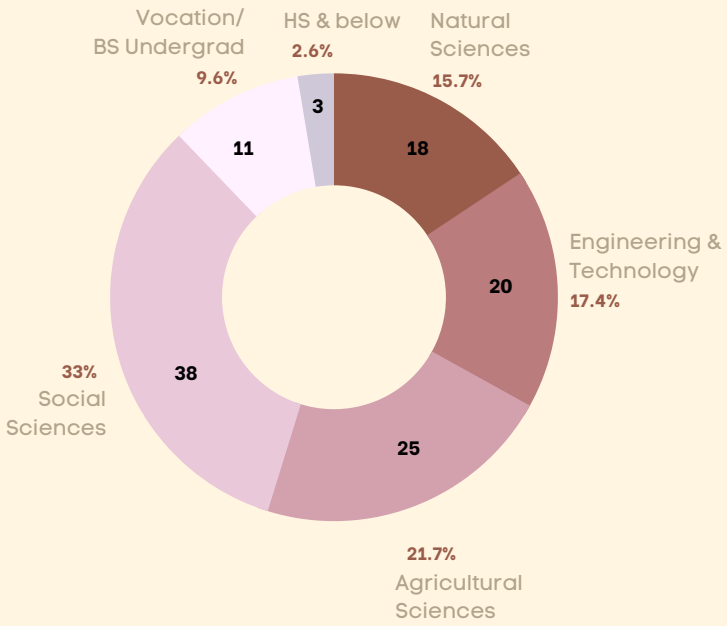


BY EDUCATIONAL ATTAINMENT

40.9% of the FPRDI employees have a bachelor's degree and seconded by those with master's degree at 24.4%.

BY FIELD OF SPECIALIZATION

54.78% of technical personnel specializes in the fields of Agricultural Science (21.73%), Engineering & Technology (17.4%), and Natural Sciences (15.7%).



FINANCIAL RESOURCES

APPROPRIATIONS

Particulars	Personal Services	Maintenance & Other Operating Services	Capital Outlays	TOTAL
A. PROGRAMS				
A. General Administration & Support				
• General Administration & Support Services	72,932,000.00	21,607,000.00		94,539,000.00
• Administration of Personnel Benefits	7,011,000.00			7,011,000.00
Sub-Total General Administration & Support	**79,943,000.00**	**21,607,000.00**		**101,550,000.00**
B. Operations				
• Scientific Research & Development Services	44,337,000.00	11,907,000.00		56,244,000.00
• Technology Transfer/Promotion	21,214,000.00	714,000.00		21,928,000.00
• Testing, Analysis and Other Technical Services	7,639,000.00	11,193,000.00		18,832,000.00
Sub-Total Operations	**73,190,000.00**	**23,814,000.00**		**97,004,000.00**
B. Locally Funded Projects				
• Infrastructure Outlay			10,000,000.00	10,000,000.00
• MITHI		4,490,000.00	7,870,000.00	12,360,000.00
Sub-Total Locally Funded Projects		**4,490,000.00**	**17,870,000.00**	**22,360,000.00**
TOTAL APPROPRIATIONS	**153,133,000.00**	**49,911,000.00**	**17,870,000.00**	**220,914,000.00**

FINANCIAL RESOURCES

STATEMENT OF ALLOTMENT, OBLIGATIONS, INCURRED, AND BALANCES

Particulars	Allotment Received	Obligations Received	Balances
A. Personal Services	158,617,000.00	129,944,717.71	18,672,282.29
B. Maintenance & Other Operating Expenses	41,021,000.00	26,891,732.90	14,129,267.10
C. Capital Outlay - Current			
• Infrastructure	10,000,000.00	9,984,079.24	15,920.76
D. Locally-funded			
• MITHI - MOOE	4,490,000.00	4,169,836.42	320,163.58
• MITHI - Capital Outlay	7,870,000.00	7,638,480.00	231,520.00
Total Locally Funded Projects	**12,360,000.00**	**11,808,316.42**	**551,683.58**
Total Current Appropriations	211,998,000.00	178,628,846.27	33,369,153.73
Add: RLIP	8,916,000.00	8,473,460.71	442,539.29
Other Releases - PBB 2019	3,048,301.00	3,048,238.99	62.01
Continuing Appropriations			
• Personal Services	7,340,803.83	4,199,812.40	3,140,991.43
• MOOE	32,913,096.80	30,210,296.95	2,702,799.85
• Capital Outlay	6,334,150.00	5,948,979.00	385,171.00
GRAND TOTAL	**270,550,351.63**	**230,509,634.32**	**40,040,717.31**

FINANCIAL RESOURCES

STATEMENT OF INCOME

Description of income	Amount
A. OPERATING & SERVICE INCOME	
• Testing Fee	4,943,343.60
• Cooperative Fee	0.00
Sub-Total Operating & Services Income	**4,943,343.60**
B. MISCELLANEOUS INCOME	
• Sale of Waste Material	0.00
• Lease/Rent Income	0.00
• Miscellaneous	85733.15
Sub-Total Miscellaneous Income	**96,733.15**
C. PRINTING AND PUBLICATIONS	2,660.00
TOTAL INCOME	**5,033,936.75**

FINANCIAL RESOURCES

EXTERNAL RESOURCES GENERATED THRU FUNDING

FUNDING AGENCY	PROJECT TITLE	VALUE OF ASSISTANCE (PHP)
DOST-GIA	• Documentation of Philippine Indigenous Bamboo Musical Instruments	3,356,926.30
	• Development of Protective Processing Technology for Bamboo Musical Instruments	20,442,640.90
	• Processing Facility for Bamboo Musical Instruments and other Lignocellusic Materials.	1,470,739.80
PCAARRD-GIA	• Bamboo for Wellness Products	1,500,000.00
	• IMPACT: Reinforcing the Capability of the Technology Transfer Program of the DOST - Forest Products Research and Development Institute	2,000,000.00
	• Mass Production and Distribution of Lapnis - Framed Face Shields	3,502,488.00
	• Development of Bamboo-Abaca Hands Free Disinfectant Dispenser and Foot Bath Prototypes for Covid-19 Prevention	3,041,973.60
	• Safety Assessment and Determination of Wine-Property Enhancing Compounds of Wines Aged in FPRDI Toasted Wine Barrel	2,613,139.00
	• Patent Mining of Bamboo Thru Intellectual Property and Technology Business Management Office in the DOST-FPRDI	1,296,267.00
PCIEERD-GIA	• Towards Leveling-Up One Lab for Research, Development and Innovation	1,079,309.00
AIDI	• Production and Characterization of Biomass Pellets from young bamboos	346,154.50
FAO TIMBER	• Development of an Automated, Quick and accurate wood identification tool/device for selected endemic, native and exotic species including imported timber species traded in the Philippines	244,120,00
		GRAND TOTAL 40,892,758.10

ANNEXES

COMPLETED REGULAR PROJECTS

- Cinnamon Oil and Extracts for Antifungal and Antibacterial Products
- Synthesis of Polyurethane Resin from Chemical Recycling of Polyethylene Terephthalate (PET) Waste Bottle
- Development of Healthcare and Aromatherapy Products from Some Selected Plant Oils
- Application of Nanocellulose as Ballistic Material for Bullet Proof Vests
- Development of Functional Bamboo Furniture Products
- Property Evaluation of Some Selected Forest Woody Vines Part I. Anatomical Properties
- Property Evaluation of Some Selected Forest Woody Vines Part II. Physical and Mechanical Properties
- Design and Fabrication of Prototype Air-Heated-Vacuum Furnace Type Dryer for Plantation Timber, Bamboo and Other Non-Timber Forest Products for Forest-based Industry
- Performance Evaluation of Portable Solar Powered/Heated Dryer with Auxilliary 'Biomass Heater
- Physical and Mechanical Properties of Rubberwood in the Philippines
- Qualitative and Quantitative Analysis of Forest Woody Vines

COMPLETED EXTERNALLY-FUNDED PROJECTS

- Gluing and Finishing Characteristics of Thermally Modified Bamboo
- Production and Property Testing of Bamboo Pellets for Biomass Energy
- Development of Wastewater Treatment Equipment for Wet-type Finishing Spray Booth
- Processing and Utilization of Senile and Unproductive Rubberwood (*Hevea brasiliensis*) Trees for the Production of High Value Furniture, Mouldings and Joinery Products
- Utilization of Spent Tea Leaves and Tobacco Dust as Additives for Plywood Adhesives
- Piloting of the FPRDI Wine Barrel Technology
- Assessment of the Coppicing Characteristics of Lapnis (*Broussonetia papyrifera*) as a Strategy for its Control and Management and Sustainable Utilization for Pulp and Paper Production
- Development of an Automated, Quick and Accurate Wood Identification Tool/ Device for Selected endemic, Native and Exotic Species Including Imported Timber Species Traded in the Philippines
- DOST-PCAARRDD-FPRDI Technology Business Incubator for Wood and Non-Wood Processing Technologies

SCHOLARS

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M in Marketing Communications

LEARNING & DEVELOPMENT INTERVENTION

INHOUSE

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	NO. OF PARTICIPANTS
Prof. Alleli Ester C. Domingo (as organized by the Integrity Circle Committee)	Ang Saysay ng Pagiging Mahusay: An Online Seminar on Excellence	104
Civil Service Commission (Atty. Clifford C. Chan)	Awareness Seminar on the Anti-Sexual Harassment Act of 1995 (RA 7877) and 2017 Rules on Administrative Cases in the Civil Service (2017 RACCS) Section 51. A. The Offense of Sexual Harassment	134
Ms. Maria Cielo M. Lampa (Chief Administrative Officer University of the Philippines Los Baños)	Procurement 101 (Key Features of GPRA and Procurement Organization) Efficient Procurement Measures During a State of Calamity or Implementation of Community Quarantine or Similar Restriction; Simplified Posting and Electronic Submission of Procurement Reports	39
Ms. Leslie B. Cañafranca (Supervising Administrative Officer Department of the Interior and Local Government)	Procurement Planning and Budget Linkage, including Early Procurement Activities	35
Atty. Lawrence P. Villanueva (Private)	Standard Bidding Procedures for Goods and Infrastructure Projects	36
Dr. Carina S. Cruz (Chief Administrative Officer Department of the Interior and Local Government)	Preparation of the 6th Edition of Philippine Bidding Documents for Goods and Services and Infrastructure Projects	40

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	NO. OF PARTICIPANTS
Mr. Leoncio A. Arellano (Supervising Budget and Management Specialist Department of Budget and Management)	Alternative Modes of Procurement	36
Mr. Julius T. Pelegrina, Ms. Arlene G. Torres, and Ms. Rowena E. Ramos	Harmonized Gender and Development Guidelines: A Gender Mainstreaming Tool Learning Session	76
Civil Service Commission	CSC Public Sector HR Symposium	2
Atty. Rosalita B. Rances-Petaca Director III CSC-OHRMD	Republic Act No. 6713: The Code of Conduct and Ethical Standards for Public Officials and Employees	118

LEARNING & DEVELOPMENT INTERVENTION

EXTERNAL

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	PARTICIPANTS
Department of Science and Technology (Dr. Teodoro Fajardo)	Webinar on SARS-COV2: Many Variants for One Vaccine	Arene A. Quiambao Grace Rowena B. Bisana Maureene L. Del Valle Mary Zarah Jane A. Moredo
Department of Science and Technology (Central Office)	Online Training/Workshop on Coaching and Mentoring for Supervisors	Maria Cielito G. Siladan
Center for Professional Development in Business (Ramon V. del Rosario College of Business, DLSU)	Digital Marketing Program	Carolyn Marie C. Garcia Emelyne C. Cortiguerra Sarahme Corazon B. Esteban Carl Anthony O. Lantican
PCHRD	DOST Webinar on the Various Covid-19 Vaccines entitled "Are the Covid-19 Vaccines Safe?"	Romulo T. Aggangan Rico J. Cabangon Dwight A. Eusebio Victor G. Revilleza Maria Cielito G. Siladan Loreto A. Novicio Arene A. Quiambao
Civil Service Institute (CSI)	Developmental Conversations for Leaders	Arene A. Quiambao Rizza W. Vardeleon Maria Cielito G. Siladan
E-Blackboards Learning and Solutions Inc.	PhilGEPS Buyers Training	Cecilia A. Baltazar Heide A. Villamayor Ericamil D. Rivera Mary Grace B. Katigbak

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	PARTICIPANTS
Forest and Natural Resources Research Society of the Philippines, Inc. (FORESPI)	Forest and Natural Resources Research Society of the Philippines, Inc. (FORESPI) International Conference 2021	Jennifer M. Conda Emmanuel P. Domingo Julius T. Pelegrina Jennifer P. Tamayo Ma. Cecile B. Zamora Rogelio O. Rantael Jr. Amando Allan M. Bondad Anniver Ryan P. Lapuz Kristopher R. Breis Alexis B. Dorado Cheyenne R. Marqueses Elvina O. Bondad Oliver S. Marasigan Mario Angelo M. Mundin Marina A. Alipon Maria Cielito G. Siladan Margie B. Dizon Zenaida R. Reyes Moreno L. Santander Jr. Jennifer P. Arcebuche Jeriel S. Payuan Christian R. Amante Rebecca B. Lapuz Florena B. Samiano Rowena E. Ramos Kim Wilmer M. Balagot Kimberly M. Delica Rodrigo E. Cortez Jr. Sheryll C. Micosa Mylene D. Rizare Alaine G. Pagatpatan Ariene C. Gregorio Catherine D. Masacayan Rico J. Cabangon Roxanne A. Buenaseda Aralyn L. Quintos Ailene A. Tagolabong Armando Gillado Jr. Alvin F. Vardeleon Jovito A. Elec James Anthony J. Chan Wency H. Carmelo Edward Paul S. Marasigan

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	PARTICIPANTS
STRAT One	Virtual Workshop on Research, Data Science, Strategic Planning, Design and Implementing a Monitoring and Evaluation System and Statistics for Public Health of the STRAT One for the 4th Quarter 2021: Fundamentals of Strategic Planning Workshop	Ryan Paul P. Paz Muriel Laisa B. Dizon Arlene G. Torres Renato S. Vergara Maylin P. Smith Loreto A. Novicio
STRAT One	Virtual Workshop on Research, Data Science, Strategic Planning, Design and Implementing a Monitoring and Evaluation System and Statistics for Public Health of the STRAT One for the 4th Quarter 2021: Statistical Tools Enablement In-depth Training Workshop (using JASP and JAMOVI)	Carl Mathew L. Replan Magico S. Geli Ronnie S. Gutierrez Razzel P. Gayomali Francis Andersen M. Lim Ryan Paul P. Paz Keith B. Bitao
Asian Media Information and Communication Centre, Inc.	28th (AMIC) Annual Conference Science Communication: Managing the Now and the Future	Emerita R. Barile Rizalina K. Araral Apple Jean M. De Leon Suzanne A. Odejar Maria Greatchin S. Brucal Maria Cielito G. Siladan Margie B. Dizon Zenaida R. Reyes Moreno L. Santander Jr. Jeriel S. Payuan Christian R. Amante
Integrated Chemists of the Philippines (ICP)	5th National Conference of Chemical Laboratories REMOTE ASSESSMENTS: CHALLENGES AND OPPORTUNITIES	Rebecca B. Lapuz Kim Wilmer M. Balagot Kimberly M. Delica John Jefferson A. Collera
STRAT One	Virtual Workshop on Research, Data Science, Strategic Planning, Design and Implementing a Monitoring and Evaluation System and Statistics for Public Health of the STRAT One for the 4th Quarter 2021: Designing and Implementing a Monitoring and Evaluation System Workshop	Ryan Paul P. Paz Muriel Laisa B. Dizon Senen E. Navarro Arlene G. Torres Renato S. Vergara Maylin P. Smith Loreto A. Novicio

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	PARTICIPANTS
PICPA	76th Annual National Convention (ANC) of the Philippine Institute of Certified Public Accountants (PICPA)	Rizza W. Vardeleon Franz Carisse S. Samiano Jasper Kent M. Gulay
PCAPI Region 4A	Accredited (ON-LINE) Eight (8) Hour Orientation Training (On Environmental Regulations) for Managing Heads in Compliance to the Requirements of DENR DAO 2014-02	Rico J. Cabangon
Society of Filipino Foresters, Inc.	2021 SFFI International Conference: Optimizing Forestry for Economic Recovery (OFFER)	Christian R. Amante Zenaida R. Reyes Jeriel S. Payuan Moreno L. Santander Jr.
STRAT One	Virtual Workshop on Research, Data Science, Strategic Planning, Design and Implementing a Monitoring and Evaluation System and Statistics for Public Health of the STRAT One for the 4th Quarter 2021: Introduction to Data Science	Keith B. Bitao
STRAT One	Machine Learning In-Depth Training Workshop using JASP and Orange	Carl Mathew L. Replan Magico S. Geli Ronnie S. Gutierrez Razzel P. Gayomali Francis Andersen M. Lim Ryan Paul P. Paz

SERVICE PROVIDER	TITLE OF TRAINING/SEMINAR	PARTICIPANTS
Institute for Food Safety Advancement	ISO/IEC 17025:2017 Technical Webinar	Adela S. Torres Cesar O. Austria Sheena Kryzel F. Siapno Bleselda M. Escolano Abie Gay U. Lagunda Queenie B. Ortinero Ramon Joshua A. Pangan Joshua Marion Ros M. Linis Angela Jhanel C. Martin Yale John C. Aggangan James Anthony J. Chan Christian S. Camacho Alberto O. Pareja Edgardo M. Villena Val V. Valderama Finrel G. Mosteiro Ernesto G. Aquino Jr. Alexis B. Dorado Cheyenne R. Marqueses Cherrie Mae J. Martinez Roderick A. Mariñas Melvie C. Emprese Victor G. Revilleza Edward Paul S. Marasigan Aimee Beatrix R. Habon Ralph Nathaniel L. Burton Mario DR. Ramos Jennifer M. Conda Emmanuel P. Domingo Julius T. Pelegrina Karen Mae R. Lego Catherine D. Masacayan Rodrigo E. Cortez Jr. Florena B. Samiano Kimberly M. Delica John Jefferson A. Collera Oliver S. Marasigan Alaine G. Pagatpatan Mario Angelo M. Mundin Bianca Belle G. Eusebio Ramon P. Dimapilis Shereyl A. Daguinod Mylene D. Rizare

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SCIENCE FOR THE PEOPLE

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