Status of Projects Implemented for 2018

Title of R&D/S&T Project	Project Duration		Accomplishment
	Start	Finish	
Program: Forest Products Research and Development			
Abaca and Other Natural Fibers for the Pulp and Paper			
GAA-Funded			
Alkaline Sulfite Pulping of Abaca Hybrids for Pulp and Papermaking (**Completed)**	July 2017	December 2018	The morphological properties of 27.5 kls of Abaca Hybrid 2 and 15 kls of Abaca Hybrid 7, which were collected at IPB, UPLB, were evaluated.
Fabrication of auto-fed decorticating machine for abaca (*Musa textilis* Nee) (**Completed**)	January 2017	December 2018	The design of the auto-fed decorticating machine had been refined fabricated, tested and cost analyzed.
Morphological and Chemical Properties of Selected Hybrid Abaca Species for Paper, Paperboard and Other Allied Products (**On-Going**)	January 2018	December 2020	Abaca hybrids H2 and H7 were collected and prepared for fiber analysis and chemical analysis. According to the morphological analyses of abaca hybrid 2 (H2), abaca hybrid 7 (H7), tinawagang pula (commercial abaca) and salago are suitable for pulp and papermaking. Sayapo, on the other hand, is not suitable pulp and papermaking based on the Muhlsteph and Runkel ratios, however, upon consultation with Dr. Chao Tian from the China National Pulp and Paper Research Institute (CNPPRI), mechanical pulping is recommended for this type of raw material.
Bamboo Processing and Industry Development			
GAA-Funded			
Natural Durability of Commercial Bamboo Species [Giant Bamboo (*Dendrocalamus asper* (Schults f) Backer ex Heyne, Bolo (*Gigantochloa levis* (Blanco Merr.) and Kauayan-tinik, (*Bambusa blumeana* Schults f.)] to Wood Destroying Organisms. (**On-Going**)	January 2008	December 2025	The resistance of kauayan-tinik and bolo against biodeteriorating organisms was evaluated after 30 months of exposure under field conditions. Bamboo slats of kauayan-tinik exposed above-ground sustained 21.3 to 50.8 beetle holes in the butt, mid and top portions. No termite and fungal damage were observed in all bamboo slats regardless of portions. The butt, mid and top portion of round kauayan-tinik exposed above-ground had an average of 117.1, 114.2 and 101.0 beetle holes, respectively. There was no damage caused

			by termites and fungi on round bamboo. However, the round bamboo installed in-ground, 40% to 80% of samples were invaded by decay fungi. After 36 months of exposure, bamboo slats of kauayan-tinik exposed above-ground sustained 25.7 to 54.3 beetle holes. There was no termite and fungal damage observed on all portions of bamboo. The butt, mid and top portions of round bamboo exposed above-ground had an average of 116.2 to 257.3 beetle holes. There was no termite and fungal damage noted. Round bamboo installed in contact with the ground, 40% to 80% of round bamboo samples were invaded by decay and caused fungal damage of 8.5% to 12.0%. All portions were invaded by subterranean termites and caused damage of 98.0% to 100.0%. For bolo species, the above-ground slats from the butt, mid and top portions sustained beetle holes that ranged from 37.2 to 73.9 after 30 months of exposure. No termite and fungal damaged were noted. The round bolo exposed above-ground, had 28.9 to 62.6 beetle holes. In-ground round bolo about 60% to 80% of bamboo were initially invaded by fungi and only initial damage was observed. All samples regardless of portions of bolo installed in-ground were invaded by subterranean termites and caused 58.0% to 63.0% damage after 30 months of exposure. Fruiting bodies of decay fungi *Schizophyllum commune* were observed in in-ground bamboo samples. *Macrotermes gilvus* Hagen and *Microcerotermes losbañosensis* Oshima were the species of subterranean termites that invaded the

			experimental bamboo samples installed in-ground contact. Further exposure of bamboo samples to the natural population of biodeteriorating agents is being continued to obtain the concrete data on the natural resistance of bamboo under field conditions. Based on the results, the natural resistance of *D. asper*, *G. levis* & *B.blumeana* failed to combined attack of termites and fungi in 30 to 48 months of exposure. A terminal report on the resistance of these bamboo species is being prepared. Two (2) new species of bamboo (Kiling and Bamboo) will be collected to study their resistance against biodeteriorating agents of bamboo.
Chemical Treatment of some Commercially-Important Bamboo Species in the Philippines (**Completed**)	January 2016	September 2018	Needed supplies and materials were procured. Collection of at least 2 bamboo species and site arrangement for sap replacement treatment was finalized. Sap replacement treatment of k. kiling was done and that of bolo as well.. Sap replacement treatment of 3 bamboo species felled during the dry season was completed. Treated culms were evaluated for preservative absorption and depth of penetration. K. kiling and bolo culms were collected and cut into specimen size. Moisture content of specimens were determined. Soaking and pressure treatment of bolo and k. kiling was conducted. Bamboo specimens treated by soaking and treatment process was evaluated. Sap replacement of the 3-bamboo species felled during rainy season was conducted. Treated bamboo culms were examined. Data were consolidated and analyzed. Quarterly, annual accomplishment and terminal

			reports were prepared and submitted.
Phytochemical Analysis and Evaluation of the Antioxidant and Antimicrobial Properties of Bamboo Leaves (**COMPLETED)**	April 2016	April 2018	Phytochemical screening tests revealed the presence of secondary metabolites in bamboo leaf extracts including flavonoids, saponins, tannins, steroids, terpenoids, cardiac glycosides, carbohydrates and reducing sugars. All samples collected during the wet and dry season and ethanolic and aqueous extracts yielded the same phytochemical components. Alkaloids was not detected in all of the bamboo leaf extracts. Total phenolic content and DPPH radical scavenging assay revealed the antioxidant potential of the bamboo leaf extracts. Among the bamboo leaf extracts, kauayan-tinik (Bambusa blumeana) aqueous extract, collected during dry season, had the highest total phenolic content (38.62mg GAE/ml) and DPPH radical scavenging activity (84.2%) which is as good as ascorbic acid (88.37% inhibition). These pharmacological activities can be due to the presence of phytochemicals such as cardiac glycosides, saponins, tannins, steroids and terpenoids. Paper disc method was used to test antimicrobial activity against P. aeruqinoso Escherichia coli, Bacillus subtilis and Aspergillus niger. Antimicrobial testing was done by measuring the zone of inhibition (ZOI). Bamboo leaf extracts of K. tinik was found to have intermediate inhibitory effects to P. aeruginosa (12.17 mm), E. coli, (11.78 mm) and B. subtilis (12mm). Bolo has intermediate inhibitory effects to E. coli (10.17mm). On the other hand, K. kiling exhibited intermediate inhibitory effect against P. aeruginosa (12mm) and B. subtilis (13.33mm). Buho had intermediate inhibitory effect against B.

			subtilis (llmm). Giant bamboo did not exhibit any effect on any of the three test organisms indicating it does not exhibit antimicrobial activity to the test organisms.
Thermal Modification of Three Bamboo Species in Spent Engine Oil Medium (**Completed**)	January 2017	December 2018	Tests were conducted according to ASTM D 143-94. Results showed improved dimensional stability for the thermally modified bamboo samples as shown by the lower water absorption, thickness swelling and moisture content as compared with the control for all species. Negative effect on the flexural strength was observed only with the highest treatment temperature and duration. Spent engine oil can be used as a medium for thermal modification of bamboo in a boiling vat with controlled temperature.
Bamboo Based Activated Carbon for Industrial Uses-Study 1: Fine Mesh Bamboo based Activated Carbon for Use in Water Purification (**On-Going**)	January 2018	December 2019	There were several chemical agents used for activating the prepared bamboo charcoal. The carbonaceous precursor, which is bamboo, was carbonized first using the FPRDI developed bamboo charcoaling kiln which is being piloted at the cooperator (CS First Green) site in Bayambang, Pangasinan. Chemical activation was conducted using different activating agents such as sodium hydroxide, potassium hydroxide, sulfuric acid and barium chloride. Activation was done using 1: 2 ratio of bamboo charcoal precursor and activating agent and heated at 110°C for 6 hours. The resulting activated carbon was then washed, free of acid or base, then placed inside the furnace at 300°C for 3 hours for complete activation. The prepared activated carbons were characterized using scanning electron microscopy (SEM) for the surface morphology of the samples, functional groups present using

			FT-IR analysis and adsorption properties using methylene blue test.
Externally Funded			
Gluing and Finishing Characteristics of Thermally Modified Bamboo (**On-Going**)	April 2018	March 2020	Most of the activities as programmed in the first (May – July) and second (August to October) quarters of the project were accomplished as planned. The four species (Kauayan tinik, K. kiling, Giant bamboo, Bolo) with 20 poles each except for K. tinik with 30 poles were collected from Cavinti, Pagsanjan, and Rosario Batangas. These four species were air-dried for two months prior to cutting to desired length then subjected to thermal modification using hot air in superheated steam environment. Two treatments (175°C-30 min and 200°C-30 min) were done from September up to October. The 225°C were tried however the bamboo turned charcoal hence this treatment was not continued. Samples for finishing studies were prepared from 175°C-30 min and will be applied with finishes this 3rd quarter (Nov – Jan 2019). Slats for physico-mechanical property testing are likewise being prepared for testing this 3rd quarter. Fabrication of oil-bath TM equipment is now in progress and equipment programmed for purchase thru the project were already with purchase order and will soon be delivered.
Development of Innovative Bamboo Jointing System (**On-Going**)	July 2018	June 2019	Benchmarking travels to Australia and Indonesia were pushed to October and November 2018 respectively due to schedule of hosting organization and training schedule. Bamboo poles and other necessary materials has been purchased. Design drawings and specifications has been produced for the joint connections. It has also been implemented and tested.

			Moreover, the octagonal shaped joint connectors has been fabricated along with the bamboo end connections for testing The connectors and the bamboo joints has been tested
Tree Plantation Species			
GAA-Funded			
Property Evaluation of Selected Tree Species			
Part I. Physical and Mechanical Properties **(Completed)**	Apr 2015	Mar 2018	The physical and mechanical properties of nine TPS from different locations were determined. Physical properties included relative density (RD), moisture content (MC) and volumetric shrinkage (VS) while mechanical properties covered static bending, compression parallel and perpendicular-to-grain, shear, hardness, toughness, and tension parallel to grain. All tests followed the procedures specified in the ASTM D 143-94 (2000). Results show that the Forest Red Gum [*Eucalyptus tereticornis* J.E Smith] has the highet RD but lowest MC among the testes wood species. Jarra [*Eucalyptus marginata* Donn Ex. Smith] has the highest VS in both conditions (green and 12% MC). For the mechanical properties, Forest Rd Gum has the highest modulus of elasticity (MOE), hardness, and toughness while Earpod [*Enterolobium cyclocaropum* (Jacq.) Griseb.] has the lowest modulus of rupture, maximum crushing strength (MCS) parallel to grain, stress at proportional limit (SPL) perpendicular to grain for compression, hardness, shear, and toughness. Hybrid Pellita [*Eucalyptus pellita* F.v. Muell x *eucalyptus tereticornis* J.E. Smith] has the lowest MOE and SPL for static bending in both conditions (green and 12% MC) but has the highest SPL

			perpendicular-to-grain in green condition. Most of the mechanical properties of Hybrid Pellita are intermediate of its parents. In addition, most of the strength properties of the 20-yr old Auri [*Acacia auriculiformis* A. Cunn. Ex. Benth.] are higher than those of the 8-yr pld Auri. Based on FPRDI's classification, the strength and related properties of Jarrah, 20-yr old Auri, Forest Red Gum, and Lemon-Scented Gum [*Corymbia citridora* (Hook.) K.D. Hill & L.A.S. Johnson] fall under moderately high strength (C2). Benguet Pine [*Pinus kesiya* Royle ex Gordon], 8-yr old Auri, Large-Fruited Red Mahogany [*Eucalyptus pellita* F. Muell.], and Hybrid Pellita belong to medium strength (C3). Lastly Earpod and Umbrella Tree [*Musang cecropioides* R. Br. Ex Tedlie] belong to moderately low strength (C4) group.
Part II. Chemical Properties **(Completed)**	Apr 2015	Mar 2018	Analysis on the chemical properties of *Corymbia citriodora (Hook.) K.D. Hill & L.A.S Johnson* has been completed. Terminal report has been prepared and submitted.
Part III. Wood Anatomy and Fiber Morphology **(Completed)**	Apr 2016	December 2018	Wood anatomy and fiber morphology of Blunt-budded River Red Gum [*Eucalyptus camaldulensis ssp. obtusa (Blakely) Brooker & M.W. McDonald*] were observed and analyzed.
Evaluation of the Processing Characteristics and Performance for Furniture of Plantation-Grown *Eucalyptus teretecormis* (Sm.)X *Eucalyptus pellita* (*F. Muell.*) hort, var. **(Completed)**	January 2017	June 2018	Veneering and plywood manufacture has been prepared, tested, and evaluated. Machining and finishing test has been completed. Two armchairs using 2 different jointing systems has been fabricated and tested using the PNS ISO 7173:2006. And terminal report has been submitted.
Physical and Mechanical Properties of Fruit Trees in the	January 2018	Dec 2022	Physical and mechanical properties of 3 fruit tree species

Philippines **(On-Going)**			namely, mangga (*Mangifera indica L.*), guyabano (*Annona murica L.*), and bignai, [*Antidesma bunius (L.) Spreng*] has been completed. Preparation of terminal report covering the mentioned 3 fruit tree species is being prepared.
Evaluation of the Processing Characteristics and Performance for Furniture of Plantation-Grown *Eucalytus camaldulensis subspecies obtusa (Blakely)Brooke & M.W. McDonald(Blunt-Budded River Red Gum)* **(On-Going)**	January 2018	December 2019	Log samples for all of the studies has been collected and transported to FPRDI. Sawmilling activities has been done. Initial trials of bending quality of solid wood has been started. Kiln drying of 50 mm samples and air drying of 25 and 50 mm samples has been performed. Wood bolts has been veneered using the rotary veneer lathe followed by spindle less veneer lathe. Thickness and tightness evaluation of veneers has been completed.
Preservative Treatment of Lumber from *Eucalyptus camaldulensis spp. obtusa (Blakely)Brooke & M.W. McDonald(Blunt-Budded River Red Gum) and Eucalyptus Grandia W. Hill (Flooded Gum or Rose gum)* **(On-Going)**	January 2018	December 2019	*Eucalyptus camaldulensis ssp. obtuse (Blakely) Brooker & M.W. McDonald l*ogs collected in Botolan, Agro-Forest, Inc. (BAFI), Iba, Zambales were cut into flitches/lumber. These lumber were further cut into specimen size of 5 x 5 x 50 cm (2 x 2 x18 in.) and its initial moisture content determined. Average initial moisture content was 35.0These were left to air-dry inside the laboratory until the desired moisture content of 19% were attained. These were labeled and numbered prior to soaking and pressure treatment. Soaking in DOT and pressure treatment with DOT, deltamethrin and deltamethrin + propiconazole were conducted and specimens were evaluated for the preservative retention and depth of preservative penetration. Average retention of this wood species ranged from 5.48 to 10.17 kg/m3 in sapwood and 4.97 to 6.97 kg/m3 in heartwood soaked DOT. For pressure treatment using DOT, the average retention obtained was 11.27 to 15.21 kg/m3 for sapwood and

			6.36 to 14.11 kg/m3 for heartwood. Meanwhile, specimens treated with deltamethrin using pressure process, the average retention ranged from 1.28 to 1.57 kg/m3 for sapwood and 0.93 to 1.58 kg/m3 for heartwood. Specimens treated with Deltamethrin + propiconazole by pressure treatment gave higher retention compared with deltamethrin alone. Average retention was 3.66 kg/m3 for sapwood and 2.44 kg/m3 for the heartwood.
Leaching and Weathering Properties of *Eucalyptus pellita (F. Muell.) hort, var. Eucalyptus teretecormis (Sm.)X* Wood Treated with Zinc Oxide **(Completed)**	January 2017	December 2018	All project activities were implemented and accomplished. All data on leaching and weathering properties were gathered, collated and analyzed..
Weathering Properties of *Swieteria macropyhlla* Treated with Wood Preservatives and Applied with Finishing Materials **(Completed)**	January 2017	December 2018	Wood samples were treated with chemical preservatives, applied with finishing material and exposed to natural and accelerated weathering processes.
Establishing Biological Treatment Condition for the Finishing Spray Booth Wastewater **(Completed)**	January 2017	Mar 2018	The finishing spray booth wastewater (FSBW) was experimented for the determination of condition suitable for its biological treatment method. A laboratory scale experiment was done for this purpose. The FSBW was collected from a furniture and handicraft plant in Pampanga. The freshly collected wastewater samples were initially characterized for Pampanga. The freshly collected wastewater samples were initially characterized for COD, BOD_5 TSS, TDS, oil and grease, color and pH. Analysis was done following standard testing method. The optimum biological treatment condition was studied by aerating the raw and pre filtered FSBW at different hydraulic retention time (HRT) and mixed liquor suspended solids (MLSS) using the jar-test experiment. The filtration

			consists of a column with charcoal beads and sand. While aeration was done at MLSS of 0, 10 and 1000mg/L and HRT of 0,1,2,4,6 and 8 hours. The aeration tank was maintained at 5-8 mg/L, 24+2°C and 7$\pm$0.3 of DO, temperature and pH, respectively. The initial characterization of FSBW showed BOD, COD, oil and grease. TSS, pH and color of 744 mg/L, 1288 mg/L, 29 mg/L, 219 mg/L, 7.3 and 94 CPU respectively. After the treatment, TSS was efficiently removed. Addition of MLSS in the aeration system significantly improved the COD removal. However, even up to 1000 mg/L of MLSS the concentration of COD removed did not pass the Philippine discharged standards. Likewise, filtration prior to aeration had no significant effect on the removal of COD suggesting the major pollutant in the FSBW is associated on the dissolved organics.
Externally-Funded			
Performance evaluation of 0.5% HexaFlumuron Sentricon Always Active HD Against Philippine Subterranean Termites **(Completed)**	Nov 2016	Mar 2018	The performance of three Sentricon termite bait formulations namely, 0.5% Hexaflumuron Sentricon Always Active HO, 0.20% Hexaflumuron + MAC and 0.5% Hexaflumuron + MAC was evaluated to control M. *gilvus* and M. *tosbetiosensis* by mound test and termite chamber method, respectively. In addition, the bio-efficacy of 0.5% Hexaflumuron Sentricon Always Active HO was evaluated using houses and building infested with C. *gestroi* as experimental units. Laboratory test showed that the period of termite invasion on the 3 Sentricon termite bait formulations varied. A total of 40% of the mounds baited with 0.50% Hexaflumuron Sentricon Always Active HO were

			invaded by M. *gilvus* in week 14 and 20% of the mounds mounted with 0.20% Hexaflumuron + MAC were invaded in week 28. On the other hand, 20% of the mounds baited with 0.50% Hexaflumuron + MAC showed population occurrence in week 14. The untreated group baited with placebo were invaded as early as week 2 and 100% of the mounds were all invaded in week 14 suggesting that placebo bait was more attractive to forage than the three Sentricon termite bait formulations.
Processing and Wood Quality evalutation of Paper Mulberry (*Broussonetia papyrifera (L.) L' Herit ex Vent*) For Furniture, handicrafts and Other Byproducts **(Completed)**	Apr 2017	Sept 2018	Conditions for the lumber production, handmade paper, charcoaling, briquetting, and pyroligneous liquor production of paper mulberry were determined.
Anatomical, Physico-Mechanical Veneering Properties of Young Aged (3-5, and 7-yr-old) Falcata [*Falcataria moluccana (Miq.) Barneby & J.W. Grimes] and Yemane (Gmelina arborea Roxb.*) **(On-Going)**	Apr 2018	Mar 2020	The anatomical, physico-mechanical and veneering properties of falcata at 3-, 5- and 7- year-old and effect of various parameters on the recovery and quality of veneers has been determined.
Natural Rubber Exudates and Wood Utilization			
GAA-Funded			
Design and Development of Sheeting machine for the Production of Non-Technically Specified Rubber (TSR) **(Completed)**	January 2017	December 2018	A sheeting machine was fabricated and test runs were conducted.
Processing and Utilization of Senile and Other High Value Furniture, Moulding and Joineries **(On-Going)**	Apr 2017	December 2019	The wood processing plant is fully operational for the production of high value furniture, mouldings and joineries.
Biomass as Green Energy Source and Other Related Products			
GAA-Funded			
Development of Extrusion Machine for Sawdust Briquette **(Completed)**	January 2017	December 2018	Extrusion machine for sawdust briquette was fabricated and its performance was evaluated.
Compendium of the Physico-Chemical Properties of Biomass as Green Energy Source **(Completed)**	January 2018	December 2018	This study provides information on the physico-chemical properties of biomass (11 tree plantation species, 6 fruit bearing tree species, 18 other biomass, and 14 charcoal & charcoal briquettes) to the men

			and women engaged in the biomass energy for fuel. This compilation of the physico-chemical properties of biomass will help the biomass energy industry to choose which biomass can be used and propagated for the use of biomass into energy. Likewise, it will provide the end-users like industrial plants the knowledge on the volume of wood to be used in their furnaces in meeting their heat requirements.
Heating Value (HV) and Proximate Chemical Analysis (PCA) of Selected Tree Plantation Species **(On-Going)**	January 2018	December 2019	Nine (9) Invasive alien species has been collected and sample preparation for each species has been conducted.
Drying Technologies innovation			
GAA-Funded			
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 (**On-Going**)	January 2018	December 2019	Conducted benchmarking of vacuum dryer. Finished the design of AVFTD. Purchased of materials for the chamber and other components. Started construction and installation of dryer components
Externally-Funded			
Improvement and Semi-automation of the Furnace Type Dryer (FTD) For the lumber, bamboo, and other raw materials of the forest-based Industries (**On-Going**)	January 2018	December 2019	Designed, and constructed a 1000 bd.ft. cap. Furnace Type Dryer.
Philippine Forest Vines for Handicraft and Other Forest-Based Industries			
GAA-Funded			
Natural Durability of Forest Woody Vines to Wood Destroying Organisms (**On-Going**)	January 2005	December 2025	The resistance of kauayan-tinik and bolo against biodeteriorating organisms was evaluated after 30 months of exposure under field conditions. Bamboo slats of kauayan-tinik exposed above-ground sustained 21.3 to 50.8 beetle holes in the butt, mid and top portions. No termite and fungal damage were observed in all bamboo slats

			regardless of portions. The butt, mid and top portion of round kauayan-tinik exposed above-ground had an average of 117.1, 114.2 and 101.0 beetle holes, respectively. There was no damage caused by termites and fungi on round bamboo. However, the round bamboo installed in-ground, 40% to 80% of samples were invaded by decay fungi. The fungal damage of round bamboo ranged from 8.5% to 12.0%. All portions were invaded by subterranean termites and caused damage of 92.0% to 98.0%. After 36 months of exposure, bamboo slats of kauayan-tinik exposed above-ground sustained 25.7 to 54.3 beetle holes. There was no to termite and fungal damage observed on all portions of bamboo. The butt, mid and top portions of round bamboo exposed above-ground had an average of 116.2 to 257.3 beetle holes. There was no termite and fungal damage noted. Round bamboo installed in contact with the ground, 40% to 80% of round bamboo samples were invaded by decay and caused fungal damage of 8.5% to 12.0%. All portions were invaded by subterranean termites and caused damage of 98.0% to 100.0%. For bolo species, the above-ground slats from the butt, mid and top portions sustained beetle holes that ranged from 37.2 to 73.9 after 30 months of exposure. No termite and fungal damaged were noted. The round bolo exposed above-ground, had 28.9 to 62.6 beetle holes. In-ground round bolo about 60% to 80% of bamboo were initially invaded by fungi and only initial damage was observed. All samples regardless of portions of bolo installed in-ground were invaded by subterranean

			termites and caused 58.0% to 63.0% damage after 30 months of exposure. After 36 months, aboveground-slat of bolo of the butt, mid and top portions had 40.5 to 82.8 beetle holes. No termite and fungal damage were noted within the period. Round bolo samples exposed above-ground had beetle holes that ranged from 30.9 to 70.1. Round bolo installed in contact with the ground showed that 60% to 80% of round bamboo were invaded and decay fungi caused damage of 10.0% to 15.0%. All samples regardless of portions of bolo installed in-ground were invaded by subterranean termites and caused 61.0% to 75.0% within the period. After 4.0 years of exposure, bamboo slats from the butt, mid and top portion of giant bamboo exposed above-ground had average number of beetle holes of 39.9 to 133.2 with percent beetle damage of 8.3% to 20.7%. Termite and fungal attack were not observed during the same test period. All portions of round bamboo installed above-ground were invaded by beetles and the number of beetle holes ranged from 17.0 to 86.0. Round bamboo installed in-ground had 50% to 90 % were invaded by fungi while 100% showed termite invasion after 4.0 years of exposure. Decay fungi caused 9% to 10% fungal damage. All in-ground samples failed to termite attack within the period. Fruiting bodies of decay fungi *Schizophyllum commune* were observed in in-ground bamboo samples. *Macrotermes gilvus* Hagen and *Microcerotermes losbañosensis* Oshima were the species of subterranean termites that invaded the experimental bamboo samples installed in-ground contact.

			Further exposure of bamboo samples to the natural population of biodeteriorating agents is being continued to obtain the concrete data on the natural resistance of bamboo under field conditions. Based on the results, the natural resistance of *D. asper*, *G. levis* & *B.blumeana* failed to combined attack of termites and fungi in 30 to 48 months of exposure. A terminal report on the resistance of these bamboo species is being prepared. Two (2) new species of bamboo (Kiling and Bamboo) will be collected to study their resistance against biodeteriorating agents of bamboo.
Identification of Philippine Commercial and Potentially Commercial Forest Vines for the Handicraft and Furniture Industry (**Completed**)	January 2017	December 2018	A handbook in publishable form was prepared and was made available for publication.
Property Evaluation of Some Forest Woody Vines. Part II. Chemical Properties. (**On-Going**)	January 2018	March 2019	Four species of forest woody vines were collected namely: Agpoi, Baknitan, Dilang kawitan, Dilang baka and Balakbakin. MC, ash content, EtOH:cyclohexane extractives and lignin content of the woody vines were determined. Holocellulose and cellulose content determination is still on-going. Phytochemical screening was completed for Agpoi, Baknitan, and Dilang kawitan.
Qualitative and Quantitative Phytochemical Analysis of Forest Woody Vines (**On-Going**)	April 2018	March 2021	Awareness seminar in safety precaution in laboratory hazards for men and women staff of CBS involved in phytochemical analysis has been conducted. Chemistry and Biotechnology Safety Manual has been drafted. Screening of phytochemical properties has been started.
Externally-Funded			
Biological Studies of Economically Important Forest Vines in Camarines Sur and Albay	January 2018	December 2020	Site selection and MOA signing were done prior to project implementation. Resource

Provinces (**On-Going**)			survey and inventory of forest vines were conducted in the 5 project sites namely: Bula, Pamplona, Balatan (Camarines Sur) and Maramba and Bogtong (Albay). Species identified were: nito (*Lygodium circinatum* (Burm.) Bedd.), hinggiw [*Ichnocarpus frutescens* (l.) W.T. Aiton], bulakan [*Merremia peltata* (L.) Merr.], albotra (*Arcangelisia flava* (L.) Merr.), lapak (*Derris elliptica* (Roxb.) Benth.), agpoi (*Bauhinia integrifolia* Roxb.), kalit-kalit (*Cayratia japonica* (Thunb.) Gagn.), lukmoy [*Rhaphidophora pinnata* (L. f.) Schott.], bamban [*Donax canniformis* (G. Forst.) K. Schum], baleteng baging (*Ficus subulata* Blume), bayati [*Anamirta cocculus* (L.) W. & A.], baling-uai (*Flagellaria indica* L.), kamagsa (*Agelaea* sp.), gulyasan (*Artabotrys blumei* J. K. & Th.), bolng-kahinai (*Pothoidium lobbianum* Schott.) and silong pugo [*Pericampylus glaucus* (Lam.) Merr.]. Regenerants were tagged for the monitoring of growth (increase in length and diameter). Phenology (flowering and fruiting) of forest vines were also monitored every month. Nursery was established inside the CBFM area of Samahang Organisasyong Pangkalikasan (SOK), Kinalabasahan, Bula, Camarines Sur.
Treatability and Performance of Commercial Forest Woody Vines Using Chemical and Organic Preservatives (**On-Going**)	April 2018	March 2020	An inception meeting was conducted last May 2018 to ensure smooth implementation of the project activities. As part of initial activities, needed supplies and materials as well as equipment were requested and procured. Survey of manufacturers of forest woody vine products and sources of raw materials were conducted on 19-20 July 2018 in Tiaong, Tayabas, and Lucena City,

			Quezon. Four species of forest woody vines were collected in Malicboy, Pagbilao, Quezon. These include Hagnaya or diliman *(Stenochlaena palustris)*, Tilob *(Dicranopteris linearis)*, Silong-pugo *(Pericampylus glaucus)* and Albotra or galtang *(Arcangelisia flava)*. Forest woody vines samples collected are being prepared and conditioned. Annual-In House and quarterly accomplishment reports were prepared and submitted.
Gums, Resins, Oils and Other Exudates			
GAA-Funded			
Bark strip harvesting and callusing of Philippine Cinnamon (**On-Going**)	April 2016	March 2019	Project terminal report. Recommended protocol for Philippine cinnamon bark harvesting.
Inventory and Habitat Assessment of Selected Gums, Resins, Oils and other Extractive Producing Species (**On-Going**)	January 2018	December 2020	Compilation of bibliographic researches related to GROE producing species Coordinated, facilitated and conducted meetings and workshops with target collaborators Secured approval and/or permits related to project implementation
Optimization of Essential Oil Yield of Cinnamon Bark by Supercritical Fluid Extraction. (**On-Going**)	April 2018	March 2020	Cinnamon barks were dried and ground for essential oil extraction. Cinnamon oil was extracted from the barks of *Cinnamomum mercadoi* and *Cinnamomum mendanense* by hydro-distillation. SFE was installed at the CBS laboratory although extraction is not yet started because compressor needs to be installed.
Synthesis of Polyurethane Resin from Chemical Recycling of Polyethylene Terephthalate (PET) Waste Bottle (**On-Going**)	April 2018	March 2020	Bis-(3-hydroxy propyl) terepthalamide (BHPTA) was successfully synthesized from waste PET bottles.
Utilization of Natural Dyes as Colorants for Handicrafts and Biojewelries (**On-Going**)	January 2018	December 2019	Collected and prepared raw materials like pandan leaves in Luisiana, abaca fiber in Bicol, abaca pulp from ALINDECO, and wooden beads in Bohol and Cebu. Likewise, collected natural dyes from Namarabar INDIGO (Itneg

			Natural Dyes Indigenous Group Organization) in Namarabar, Abra. Attended training workshop on natural dye extraction in Abra. Optimization of dyeing conditions for the different raw materials using natural dyes from indigo, talisay and sibukaw were conducted. Experimental tests for the evaluation of colorfastness of different dyed materials using the following conditions: exposure to heat, exposure to sunlight and soaking in water were also conducted. Evaluation of colorfastness was conducted in PTRI. Production of prototype biojewelry with natural colorants was also prepared. Visited different prospective partners and cooperators in handicraft and biojewelry/ fashion accessories industries in Bicol, Cebu and Bohol. Other accomplishments included the preparation of poster during the 61st FPRDI Anniversary and won 3rd prize FN Tamolang poster competition. Presented echo seminar of training in Abra during the TID Seminar Series.
Externally-Funded			
Technology Adoption on Paper Harvesting and Utilization of Philippine Cinnamon (**Completed**)	October 2016	September 2018	Facilitate and process documents for the release of project's 2018 First Quarter Fund; Data gathering and monitoring of bark callusing of Philippine cinnamon trees; and Preparation of 2018 First Quarter Narrative and Financial report to funding agency. Submission of 2018 First Quarter Narrative and Financial report to funding agency; Facilitate and process documents for the release of project's 2018 Second Quarter Fund; Data gathering and

			monitoring of bark callusing of Philippine cinnamon trees; Conduct learning visits to local cinnamon product manufacturers; Prepare cinnamon bark oil samples for laboratory chemical analysis; and Preparation of 2018 Second Quarter Narrative and Financial report to funding agency.
Nanocellulose Technology			
GAA-Funded			
Bench scale production of nanocellulose for various human security equipment (**On-Going**)	January 2018	December 2019	Materials for the nanocellulose extraction facility has been acquired and fabrication of the reactor has already started. Benchscale production of microfibrillated cellulose was conducted in a 120L capacity oil jacket reactor using commercial pulps and S2 grade laylay pulp. A 64.55% yield was obtained from laylay pulp while 11.90% and 24.98% were obtained from commercial tow grade bleached pulp and specialty pulp respectively.
Human Security and Defense R&D			
GAA-Funded			
Application of nanocellulose as ballistic material for bullet proof vests (**On-Going**)	January 2018	December 2020	Trials for the fabrication of nanocellulose ballistic material for bulletproof vest has started. Cellulose nanocrystals (CNC) and cellulose nanofibrils has been casts into a 4" diameter mould. In addition, various combination of CNC with CNF has also been tested.
Nitrated Cellulose from dissolving pulp of Abaca (**On-Going**)	January 2018	December 2019	Purified or bleached cellulose has been produced
Preliminary Investigation on the Development of a Bullet Resistant Vest from Bamboo (**Completed**)	March 2018	December 2018	The technical viability and cost effectiveness of producing engineered bamboo from woven mats as bullet resistant vest were determined. Laminated bamboo woven mat boards (300 X 300 mm) from kawayan tinik (Bambusa blumeana) and polyurethane-

			based glue were manufactured at thicknesses of 12, 18, and 24mm. Stainless steel plates (1 x 300 x 300 mm) were also glued and screwed to one surface of the boards and was compared to those without plates. The weights and densitites of the manufactured boards were determined and their ballistic resistance was tested at the Research and Development Center, Army Service Command of the Philippine Army in Libis, Quezon City. Further studies are recommended to improve the resistance of bullet resistant vast from laminated woven mat boards. This may include determination of the effect of bamboo species and strand sizes, effect of other glues types, manipulation of arrangement of strands and mats within boards and use of traditional materials for bullet resistant vests in combination with laminated woven mats.
Program: Forest Products Technology Transfer			
Technology Transfer			
Technology Promotion and Information Assistance Services			
Technology Forum and Consultative Dialogue for the Forest-Based and Allied Industries	2018	continuing	For the year, this activity was able to facilitate the conduct of eight (8) fora namely Bamboo Processing and Livelihood Opportunities, DOST Reg. I. La Union. May 02. 2018. DOST-FPRDI Mandate and Services. World Vision Development Foundation. May 10. 2011 Bamboo Processing. DOST Reg. I, Ilocos Sur, May 10. 2018 Bamboo Processing and Utilization. Bukidnon State University. Malaybalay Bukidnon. September 12, 2018. Bamboo Processing Technology forum with PI 11 1,

			Bacolor. Pampanga. August, 2018. Significance of FPRDI Digital Moisture Meter to Furniture & Handicraft Industries. Bukidnon State University. Malaybalay Bukidnon. September 12, 2018. Finishing Techniques on Furniture and Handicraft. Kalinga state University. Luna. Apayao. Oct. 23.2018 FPRDI dialogue with the Forest-Based Industries, Heritage Hotel. Pasay City.30 Oct 2018
Information Campaign on FPRDI Technologies and Services thru Electronic Media Promotion	2018 -	continuing	Coordinated/facilitated the conduct of 4 radio/TV interviews and maintained linkages with media partners.
Visitors' Assistance and Upkeep of FPRDI Visitors' Centers	2018 -	continuing	A total of 4,659 visitors were accommodated in the Institute broken down as follows: 2,091 (44.89 %) students and staff from the academe, 2,013 (43.21%) personnel from private companies, 17 (0.36%) officials from local government units (LGUs), 528 (11.33%) officers from national government agencies, 8 (0.17%) foreign delegates and 2 (0.04 %) personal visits . FPRDI technology information brochures totaling 600 were distributed to selected visitors. In addition, a total of 33 technology demonstrations were arranged and conducted. Immediate benefits of the Institute's visitors 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 8 industry groups, LGUs ,8 foreign delegates and 11 academic institutions.
Showcasing of FPRDI Technologies and Services through Technology Exhibits and	2018 -	continuing	A total of 29 technology exhibitions/fairs were participated in by FPRDI in

Fairs			twelve regions of the country. Fifteen of the technology exhibitions were complemented the holding of the " DOST Regional Science and Technology Week Celebration and the Regional Invention Contest and Exhibits (RICE). These 29 technology exhibits/fairs created awareness to some 10,300 exhibit viewers and identification of potential adoptors of technologies on manual briquette production, lumber dryer, handmade papermaking, engineered bamboo products, bamboo processing and utilization technologies. A total of 10,000 copies of info materials were distributed/disseminated during the DOST S&T Fairs and other promotional activities of the Institute.
FPRDI Information Services to Lawmakers and Local Government Units (LGUs)	2018 -	continuing	two (2) consultative dialogues with concerned lawmakers has been facilitated, S&T needs of their constituents identified and if applicable, appropriate S&T Action Plans formulated.
Intensified Promotion of FPRDI Developed Technologies and Services – Externally Funded	March 2018	February 2019	Five (5) technology fora conducted; five (5) consultative dialogues conducted; four (4) TV and radio interviews aired; eight (8) technology exhibits participated in; *Dalaw Eskwela* conducted in 6 schools; 5,000 likes on Facebook and at least 25% increase in inquiries and consultancies regarding FPRDI technologies and services.
Technology Business Development			
Transfer of FPRDI Technologies for Commercialization	2018 -	continuing	As of October 2018, 16 new technology installations were rendered namely, Manual briquettor, Drum kiln, Charcoal Grinder, Charcoal mixer,

			Moisture meter and Furnace Type Lumber Dryer in the following regions: National Capital Region, Cordillera Administrative Region, Regions 4 and 8. The initial outcomes of technologies installed/adopted are: users of FPRDI moisture meter are satisfied with its performance; for FTLD, meet the requirements of the customers and additional income for the briquetting equipment.
Technical Assistance and Consultancy/Advisory Services	May 2012 -	continuing	As of October 2018, technical assistance and consultancy/advisory services were rendered to 188 FPRDI customers in response to their written/walk in requests/inquiries. Twenty-eight technical assistances (TA) were extended to 14 private enterprises/ industries, 8 government agencies, and 6 NGO/ Cooperatives/ Foundation. One hundred sixty consultancy/ advisory services (CAS) were provided to FPRDI customers in response to their written/ walk-in requests/ inquiries. Fifty-seven were from private enterprises/ industry, 82 were from government agencies, 8 from NGO/ Cooperatives/ Foundation and 13 from the academe.
Intellectual Property Management of the FPRDI Generated Technologies	2012 -	continuing	Mariluz SP Dionglay, et al's Intellectual Property application re Article on Philippine Albizia Species: Potential Source of Phytochemicals and Antimicrobials was granted Copyright registration by the National Library of the Philippines, Manila. Utility Model applications were submitted in IPO Phl namely: Process of Producing Spalted Wood from Malapapaya Furnace Type Handicraft Dryer Endorsed the following IPR

			application to TAPI-DOST: Wood Moisture Meter Hammer Type Probe by Dr. Marina Alipon et al Multi-Heated Double Acting Hot Press for Engineered Bamboo by Engr. Edward Paul Marasigan et al. Engr. Anniver Ryan Lapuz re Controlled Stirred Tank Reactor cum Distillation Apparatus. Conducted patent search as requested by FPRDI researchers.
Knowledge Management Systems for Commercialization of FPRDI Technologies	Jan 2012 -	continuing	Knowledge management system consisting of databases of FPRDI intellectual property assets (KIP) and technology installations (KIT) was maintained and updated based on data and information from approved monthly and quarterly reports of accomplishments of the Technical Services Division. Based on the data and information consolidated in the KMS, historical and regional summary reports were generated. The knowledge requested by FPRDI researchers, Planning Staff and management were used as references for their project proposals, technical presentations and institutional reports. In the last in-house review, it was recommended that the developed KMS shall be merged with the Technical Services Knowledge System (TSKS) developed as part of the DOST Medium-Term Information and Communications Technology Harmonization Initiatives (MITHI). After integrating the two systems, the new TSKS shall be deployed to selected TSD staff for encoding new and updating existing data and information.

Intellectual Property (IP) Valuation of Selected FPRDI Technologies: Thermal Modification of Wood	July 2011 -	continuing	Intellectual property value of the thermal modification technology was determined using the cost, income and market approaches. The IP values were calculated at 578,000.00, P1,121,677.13. Using the market approach. IP Value for the thermally-modified wood was estimated on the assumption that the volume of thermally-treated wood is 300,000 bd.ft and priced at P27/bd.ft. At 2% royalty rate, IP value using the market approach is P162,000.00 per year.
Piloting of Some FPRDI Selected Technologies	July 2011 -	continuing	Investment Primer/Technology package was prepared. Ms. Cristina Angeles of Angeles Furniture Shop was selected as prospective cooperator on the fabrication of wine barrel. Technical meeting was conducted with Ms. Angeles here in FPRDI. Questionnaires for selection of cooperators on wine producers were prepared. A survey was conducted in La Union and Benguet provinces. Results showed that respondents inquired for the availability of Santol trees and the organoloptic test. The design and technical specifications of the wine barrel for Ms. Angeles are on hold. Survey for the availability of the senile trees will be conducted first. Survey on the availability of senile Santol trees was conducted in Paete and Pakil, Laguna. It was learned from the staff of DA and MENRO that there is a Municipal ordinance that cutting of any kind of trees are prohibited. Likewise, the owners of the Santol trees are not cutting it, because the Santol fruits are their source of income. Paete and Pakil are well known/popular to sweet Santol fruits. Another concern is the Organoloptic test which is

			about Php 500,000. Due to high cost of the test, the activities for this project was merged in the approved PCAARRD Funded project on "Piloting of Wine Barrel." Another piloting study has been considered. Piloting of Multi-Headed Double Acting Hot Press for Engineered Bamboo. A cooperator has been selected, LGU-Gloria, Occidental Mindoro. Fabrication of equipment is on-going.
Socio-Economic Projects			
Feasibility Assessment and Business Plan Preparation: *Thermal heat modification technology*	Jan 2012 -	continuing	Technical assistance as SMS on economics was provided to three FPRDI researchers 2) Updated, prepared, printed and distributed 2018 Price List of FPRDI Technologies; 3) Updated investment analysis of three technologies; 4) Completed report on feasibility of the commercial production of thermally modified wood.
Ex Ante Assessment, Monitoring and Ex Post Impact Assessments of FPRDI Installed Technologies	1995 –	continuing	Ex ante data from 3 adoptors of FPRDI technologies were gathered namely: one adoptor each of Furnace Type Lumber Dryer (FTLD), low cost dryer cum heat treatment facility and charcoal briquetting equipment in Catbalogan City, Laguna and Muntinlupa City, respectively. The impacts of 5 FPRDI interventions installed in different firms were determined as follows: for FTLD, adoptors were Angeles Woodworks in Silang Cavite; Search Lima Libros Paint Center in Aklan; Mirola Hardware in Capiz; W and R Velarde`s Furniture and General Merchandize, Camarines Sur and R.U Garcia Shop,Vigan City. For Finishing Spray Booth, three adoptors were interviewed namely Eliano Baluyot Pottery,Inc. in Arayat Pampanaga; Peter`s Custombuilt Furniture in San

			Fernando City and Lampara Trends , Inc. in Sucat Paranaque City. For Heat treatment facility, interviewed ACE and FA Enterprises, in Brgy. Sala, Cabuyao City. Over all a total of 9 units of FPRDI installed technologies were assessed its impacts on micro level. The adoption of FTLD for drying wood provides significant socio-economic benefits to the firms like more than 50% increase in productivity; product diversification, more than 50% increase income and profits andit contributed to the community development like employment and income generation. For adoptors of spray booth, there was 10%-50% increase in productivity of workers and it protects the health of workers since there was no more dissipation of fumes in the work place and environment. The heat treatment facility resulted to less attacked by insects infesting the wooden pallets and it provides 30% increase in productivity.
Market Validation for the Thermal Modification of Wood Technology	2011 -	continuing	The thermal modification technology was validated in the Regions I, IV, VI, CAR, NCR and XII. The results of the market validation showed that the thermal modification technology was acceptable as a construction material both as wood and as bamboo for flooring, paneling, deck boards, ceiling, and doors. The different attributes for adopting the thermal modification technology were: wood quality, wood appearance, dimensionsal stability, durability, environment-friendly, water resistance, workability and ease of use, lightness and sound insulation. However, respondents have expressed problem on

			sustainability when it comes to wood because of raw material procurement policy imposed by the Department of Environment and Natural Resources (DENR). On the other hand, bamboo was found to be more favorable in terms of raw material availability. The respondents recommended that the thermally-modified wood should be available in hardware stores if already commercially-available. They should be available as tongue-and-groove forms and in different sizes of wood available for construction purposes. Thermally-modified bamboo was also requested to be available as round poles, slabs or laminated to be used as stair treads, paneling, and flooring materials.
Industry Analysis of Forest and Non-Forest Based Industries (Engineered Bamboo Producers in the Philippines)	Jan 2011 -	continuing	For 2018, the project of industry analysis/ profiling focused on the status, problems and prospects of engineered bamboo. A number of industry players: bamboo suppliers, traders, producers (both public anf private), influencers and support institutions were interviewed. Findings show that the performances of public and private engineered bamboo producers were different. Public processors (e.g. LGU-controlled Shared Service Facilities) were generally limited to job order production and product sampling. On the other hand, private enterprises are relatively more successful. Some of the key success factors identified are the following: (1) sustainable supply of raw bamboo, (2) quality of raw bamboo poles to be processed, (3) affordable price of raw materials (e.g. bamboo poles, glue, treatment, etc.), (4) engineered bamboo yield per bamboo input, (5) industry acceptance of

			engineered bamboo, and (6) technological advancements in engineered bamboo processing. The study also analyzed the industry using Porter's Five Forces Model. It showed that most of the respondents attributed the relatively low acceptance of engineered bamboo to the strong threat coming from its most related substitute - wood. Wood is still the traditional preference of end-consumers, thus, also the preferred product to be produced by its manufacturers. Additionally, the bargaining power of both suppliers and buyers are high, which is unfavourable on the perspective of the producers. Barriers to entry are also high mainly due to the high investment costs, mostly coming from cost of equipment requirements. According to influencers, particularly architects and interior designers, they seldom push the utilization of engineered bamboo to their clients due to lack of availability. Its limited market presence makes it expensive.
Technology Piloting of the Bamboo Flattening Equipment – Externally Funded	May 2017 to	April 2018	1) Feasibility study of the thermal heat modification technology; 2) Business plan on the thermal heat modification technology; 3) Advisory/ consultancy services on product costing, feasibility study and business plan preparation are provided to requesting parties.
Training and Manpower Development Services			
Skills Training for the Forest-Based and Allied Industries, Academe, Local Government Units and Constituents,	1987 –	continuing	For 2018, TMDSS coordinated and managed the conduct of 36 trainings in various regions of the country from which more

Indigenous Peoples and Other Interested Publics			than 850 individuals benefitted. Most requested topics/technologies for the training include FPRDI bamboo processing and utilization technologies, charcoal production and briquetting, handmade paper production and product conversion, and rubber latex harvesting.
Technical Seminar for the Forest-Based and Allied Industries, Academe, Local Government Units and Constituents, Indigenous Peoples and other Interested Publics	1987 –	continuing	Managed/facilitated 18 requested activities and conducted 89 techno demos and 8 seminars. The techno demos were attended by 1,603 participants (1,002 females and 601 males). These were held in Regions CALABARZON and 1 with 11 and 6 activities held at each region, respectively. The most requested technologies are charcoal briquetting and handmade papermaking with six requests each. In terms of techno demos conducted per technology, charcoal briquetting topped the list with 49 followed by handmade papermaking with 43. There were two techno demos for charcoal production/making while one each for hand sheet forming, engineered bamboo production and furniture testing. The 8 requested technical seminars were attended by 229 interested individuals (94 females and 135 males) representing various sectors. These were held in Regions CALABARZON (5), NCR, 7 and 9 (1 each). Seminar topics include FPRDI processing and utilization technologies, FPRDI wood processing and utilization technologies, wood treatment and preservation, various tools and equipment for wood furniture manufacture.
Technology demonstration for the	1987 –	continuing	Four technology

forest-based and allied industries, academe, local government units and constituents (LGUs), indigenous peoples (IPs) and other interested public			demonstrations has been coordinated, managed and documented for FPRDI customers, particularly the forest-based and allied industries. Relevant issues and concerns, identified needs and evaluation results from conducted FPRDI technology demonstration has been fed back to the concerned FPRDI units and non-FPRDI sectors, through provision of completed activity reports.
Design and Development of Training Course Packages	2018 –	continuing	Updated/prepared 9 training hands outs, 5 training modules, 4 training overviews, 6 training cost estimates and 1 AVP on FPRDI Technology. The updated/prepared training packages and its integral part and training cost estimates were based on the most in demand training courses of FPRDI for 2018, as requested by clients. Similarly, the choice of finishing of wood and non-wood forest products for the audio-visual presentation (AVP) production was based on its being the most requested topic for training in 2018.
Training Needs Identification (TNI)	2018 –	continuing	A total of 16 Training Needs Identification (TNI) activities were conducted in different parts of the country. Of the 16 interviews conducted, 13 were in Luzon, 1 in the Visayas and 2 in Mindanao. Respondents came from varied institutions such as private companies (6), government agencies (6) (5 DOST provincial offices and 1 LGU), and organizations or cooperatives (4). Through the conducted TNIs and technical services rendered, two (2) respondents requested from the Institute the conduct of specific trainings and technical assistance in

			putting-up FPRDI technology-related business.
Skills training outcome-based monitoring and evaluation (OBME)	2018 –	continuing	On the first year of this activity's implementation, a total of six outcome-based monitoring and evaluation (OBME) of skills training conducted from 2014 to 2015 were done. These were devoted to Luzon-based trainings being its initial year of implementation. Prior to actual conduct, the OBME protocol was prepared and duly revised based on pre-test experiences. Results of the OBME show that trainings on finishing techniques conducted in the three selected firms were all applied immediately after the training until the day of the survey. For the other three trainings on charcoal production and briquetting, one with complete equipment complementation courtesy of DOST Rizal stopped production after several months of learning application. The results that elicited the most impact to the beneficiaries' socio-economic well-being shall be recommended for AV and/or print documentation in other TMDSS or TSD projects, for promotional and recording purposes.
Capability Building on Tapping and Use of Appropriate Coagulant for Improved Rubber Latex Yield, Year 2 - Externally Funded	April 2017	March 2019	At least 6 trainings (2 for trainer-tappers and 4 for farmer –tappers) has been coordinated, managed and documented. Production of 4,000 printed IEC materials in English, Filipino, Cebuano and Ilonggo at 1,000 copies per version.
Communication Materials Production and Library Services			

6-Year Development Plan (2017-2022) for a Competitive FPRDI Scientific Library	January 2017	December 2022	Barcoded 491 library materials; Enrolled/Edited 50 FPRDI employees' profiles to SILMS; Transferred most of library holdings back to the renovated Library; Digitized 223 Library holdings (The Philippine Lumberman; FPRDI Journal/Phil. Forest Products Journal; FPRDI Technical Bulletin Series; Philippine Raw Materials Sourcebooks 1-4); Incorporated watermark (FPRDI logo) to the FPRDI publications uploaded to the FPRDI website; Purchased 19 new book titles as requested by Institute personnel (12 delivered, 5 for delivery); Provided lists of new acquisitions to concerned personnel.
Publishing of FPRDI Books	January 2018	December 2018	After both undergoing final editing/ polishing, both the Revised Wood Identification Handbook for Philippine Timbers, vol. 1 and the Philippine Raw Materials Sourcebook 5 (Biojewels) are currently in-press. They are expected to become available for dissemination by end of December 2018.
Publishing of the 2017 FPRDI Annual Report	January 2018	December 2018	The 2017 FPRDI Annual Report came-off-the-press in September 2018.
Production of the 2017 & 2018 Philippine Forest Products Journal	January 2018	December 2018	The line-up of papers for the 2017 PFPJ was completed only by November after a series of "technical reviewer-back to author" cycle, and replacement of 4 papers with questions that respective authors failed to address. The substitute papers came from the 2018 Journal line-up (originally with 11 papers), thus depleting the said issue. The remaining 7 papers had been technically reviewed, but found "unacceptable" yet for publication. These will be

			subjected again to several "technical reviewer-back to author" cycles until deemed ready to be published. At the same time additional papers will be collected to complete the 2018 issue.
Publishing of Press/Web Releases	January 2018	December 2018	At least 27 press/web releases were drafted and uploaded to the FPRDI website. Nineteen of these were picked up by and published at least 35 times in regional and national dailies, and in local and international online news sites.
Production of Audio-Visual Presentations	January 2018	December 2018	Revised the FPRDI Story and provided copies to concerned units; AVP on the FTLD adoptor in Bohol (Mr. Sumampong) ongoing (finalized the script; for voicing over & final production).
Maintenance of the FPRDI Official Facebook Fanpage	January 2018	December 2018	Managed the FPRDI official Facebook Fanpage; Attended to 236 client inquiries sent via the Facebook messenger feature; Posted 112 photos, videos, and links. As of October, the FPRDI Fanpage has 8,303 likers/fans online.
Library Databases Management & Information Services	January 2018	December 2018	Encoded 386 serials/analytics, 47 terminal/progress reports and 149 reprints; edited 684 previously encoded bibliographic entries; assigned 2198 subject headings; accessioned 138 holdings; labelled 836 books and inserted 833 book pockets; stamped 636 holdings for ownership; catalogued 54 books. Uploading/Updating of records to the DOST-ScINET portal on hold pending the availability of DOST-STII's focal person (busy with Starbooks activities). Acquired free of charge 10 books, 64 FPRDI reports (terminal, progress & travel), 17 journals, 6 reprint, 46 periodicals, 14 annual

			reports, 1 yearbook, 52 e-copies and 16 TAPPI standards. Emailed acknowledgements of 25 publications received & proforma invoices for international membership renewals and others. Retrieved 193 borrowed library materials. Issued 158 overdue recalls. Provided 564 information assistance to 370 library users (internal and external). Renewed 5 annual foreign subscriptions and memberships. Attained an average of 95.75% CSM rating. Submitted 10 monthly accomplishment & 3 quarterly reports.
Program: Forest Products Science and Technology Services			
Upgrading, Improvement/Expansion of FPRDI Testing Laboratory			
Statistical Services for TID **(Continuing)**	2003	Continuing	Reviewed project proposal and recommended appropriate experimental design when necessary. Processed, analyzed and assisted in the interpretation of statistical results of 14 projects. Reviewed 26 terminal/ progress reports/articles for FPRDI Journal in terms of presentation of results, analysis and interpretation.
Maintenance and Operation Management System of FPRDI Testing Laboratories **(Continuing)**	Jan 2008	Continuing	The income of FTLs (Furniture, Plywood and Pulp and Paper) from January to September 2018 amounted to P2,824,700. The customers served were 422 (53 new), No. of tests conducted: 2,447 from 633 samples. Facilitated PAB Surveillance Audit last May 15-16, 2018. The correction reports were submitted last June 14, 2018. Attended training/ workshop towards the transition of FTLs quality management system

			from ISO/IEC 17025:2005 to ISO/IEC 17025:2017 last September 26-29, 2018 at Technopark, Nuvali. Sta Rosa, Laguna, ISO/IEC 17025:2015 seminar/training workshop, Uncertaintry of measurement at MIRDC, DOST, Bicutan, Taguig City, Good Laboratory Practices at SGS, Philippines and other related seminar workshops. Facilitated the construction of the FFTC building and renovation of the new FPPTL.
Measurement Systems Analysis on the Proficiency Testing Results of FPRDI Testing Laboratories **(Continuing)**	April 2009	Continuing	The following parameters were enrolled at CTS: For packaging paper: Tensile Energy Absorption (TEA), Tensile Breaking Strength, Elongation to Break and Bursting Strength. For printing paper: Tearing Strength and Bursting Strength. And Grammage and Thickness. All parameters except for bursting strength printing paper and thickness were within the set limit, acceptable and consistent. Bursting strength for printing papers was marked with an 'x' by CTS in July 2018. In September, bursting test for both packaging and printing papers were not included because the instrument for burst test was being calibrated. Thickness was marked with 'x' in August 2018. The instrument being used in the CTS test was being calibrated that month. So another instrument was used instead. This instrument is calibrated and is being used for the clients but different from that was required by CTS. In the plywood laboratory, due to insufficient samples to be used in the testing, only an intralaboratory testing was conducted for 2 quarters, 1st and 3rd quarter.

Inter-Laboratory Proficiency Testing for Paper and Paperboard **(Continuing)**	July 2010	Continuing	Conducted an interlaboratory proficiency testing program on the physical properties namely grammage, thickness, tensile breaking strength and tearing strength for the 1st and 2nd quarters. Visited TIPCO, TANN PHIL, SPMI and ALINDECO and distributed samples for testing. Collected paper samples from Vanhawk, Philippines, Inc. Prepared, packaged and sent testing specimens to TIPCO, TANN PHIL, SPMI and ALINDECO. Distributed test specimens for testing and facilitated the collection of data from participating laboratories Copy paper samples used as specimens collected from Vanhawk Paper Phil. were packed and distributed TIPCO, SPMI, TANN Phil. and ALINDECO. The thickness and grammage values of the participating laboratories were not significantly different. This confirms that the performance analysis of the comparative performance value of the laboratories were near the consensus.
Design and Development of Laboratory Scale Thermal Conductivity Analyzer **(Completed)**	January 2017	December 2018	A steady state thermal conductivity apparatus using the Fourier: Law of thermal conductivity was developed to measure the thermal conductivity of insulating materials. The American Society of Testing of Materials (ASTM) test methods (D5470 / EI225) were used as a baseline and the heat of conduction analysis was conducted. The design of the apparatus was developed in a simple steady-state method in which sample mounted between a heating block and a temperature controlled cooling block. An electric type heater was used to maintain a constant heat

			temperature. Measurement consist of a TC's sensors are attached to the heating block to determine the temperature difference and measure the heat flux thru the insulating material in a close environment. Thermal conductivity of copper, brass and aluminum as reference matebals was measured to assess the reliability of the develop apparatus.
Establishment FPRDI Calibration Laboratory **(On-Going)**	January 2017	December 2022	Continue set-up of the laboratory and acquisition of initial calibration equipment, tools and materials. Continue training of calibration personnel.
Establishment of Nanocellulose Technology Testing and Service Facility **(On-Going)**	January 2018	December 2022	The establishment for nanocellulose technology service and testing facility has started. Two adjacent rooms were identified and are both undergoing repair and renovations for the nanocellulose based composite fabrication as well as testing and characterization of nanocellulose and its various applications. In addition, an open area was also allotted and is being rehabilitated for the bench scale productions nanocellulose. Auxiliary equipment have also been installed.
ISO Modernization/Upgrading of Bio-Energy Testing Laboratory (BETL) **(On-Going)**	January 2018	December 2022	The Biomass Energy Testing Laboratory was renovated and continuously upgraded. Awareness seminars on the transition of ISO 17025:2005 to ISO 17025:2017 were attended by some of the BETL staff. Training on the operation and maintenance of the LECO AC600 Bomb Calorimeter was attended by BETL staff in Florida, USA. Chemical laboratories like CRL in the Philippines, the Joint Bioenergy Institute (JBEI) and University of California in Davis, California, USA were visited by

			the BETL staff. Best practices on the chemical laboratory was used as benchmark activities of the BETL. The laboratory applied for the 'License to Operate Chemical Establishments' thru the Philippine Regulation Commission (PRC) to comply with RA 10657 (Chemistry Profession Act). PRC, on the other hand, inspected the BETL in preparation for the certification to be issued upon completion of the requirements recommended by them. The BETL served 18 clients with more than 100 laboratory tests with an income of more than Php 170,000.
Upgrading of Pulp and Paper Testing Laboratory – Chemical **(On-Going)**	January 2018	December 2022	Intra-laboratory testing been conducted and the laboratory fumehood has been repaired.
Establishment of an ISO Accredited FPRDI Formaldehyde Emission Testing Laboratory **(On-Going)**	January 2018 to	December 2022	A Chemistry and Biotechnology Section (CBS) laboratory safety manual was prepared. Staff from the Formaldehyde Emission Testing Laboratory (FETL) attended the PNS ISO/IEC 17025:2017 Awareness Training. The purchase of laboratory supplies, calibration of equipment and repair of the laboratory were facilitated. Formaldehyde emission testing services were conducted and test reports were prepared.
Upgrading, Improvement/ Expansion of FPRDI Chemistry Laboratory **(On-Going)**	January 2018 to	December 2022	Laboratory safety manual was prepared. Inventory of chemicals and glasswares were done. Prepared and submitted concept design and scope of work for the renovation/upgrading of the Chemistry Laboratory. Supervision of the renovation of the Chemistry Laboratory is being done. Report on the chemical analysis of samples were prepared and submitted.
Upgrading of FPRDI	January	December	Creation of safety and protocol

Biotechnology Laboratory **(On-Going)**	2018 to	2022	manual; Facilitation of FPRDI Biotechnology laboratory upgrading; Involvement in chemical waste identification and segregation; Provision of MSDS, chemical reagent records and equipment log, purchase and maintenance of equipment or devices; Benchmarking and attendance to local seminars and trainings to upgrade quality of work.
Upgrading of the Physical and Mechanical Properties Testing Laboratory **(On-Going)**	January 2018 to	December 2022	Facilitated repair of the storage room, PR for laboratory supplies needed has been served. Calibration of the Old UTM machine will be served after preventive maintenance has been done. Testing from different industries is in progress.
Establishment and Accreditation of Pallet Testing Center **(On-Going)**	January 2018 to	December 2022	Facilitated and served the quotation for preventive maintenance (change oil) of the Old UTM Machine to Shimadzu. Documents (survey form) for industry profile in Laguna, data gathering and pallet testing in different industries is in progress.
Upgrading of Structural Testing Laboratory **(On-Going)**	January 2018 to	December 2022	The existing laboratory has been assessed to identify the scope of works for its rehabilitation and upgrading. Initial equipment and laboratory supplies requirement has been purchased.
ISO Accreditation of FPRDI Pulping and Paper Making Laboratory **(On-Going)**	January 2018 to	December 2022	In its initial stage of preparation, ISO-related documents were reviewed and collated. About four (4) relevant trainings were attended. Around three (3) functional equipment were repaired and restored. And a benchmarking activity was conducted. Renovation of the old laboratory is underway.
ISO Accreditation of FPRDI Wood Anatomy Laboratory **(On-Going)**	January 2018 to	December 2022	Started preparation of relevant documents and attended training/seminar related to

			requirements for ISO/IEC17025:2005; and facilitated the maintenance and repair of existing scanning electron microscope.
Upgrading of Particle Board Testing Laboratory to Wood Composite Testing Laboratory **(On-Going)**	January 2018 to	December 2020	Contributed PhP 270,996.00 to the income of FPRDI from January to October 2018. Desktop computer preloaded with licensed Windows OS and MS Office was purchased. Supplies needed for the documentation of Work instruction, TOP, MOP and OP forms were requested for purchase. Documentation software and soft copies were transferred from FPRDI-PTL to Particleboard testing lab computer. Editing of WI, TOP, OP and MOP ongoing up to year end. Purchase of small equipment was not pushed thru because of the MOOE limits. Two window type aircons were emergency-purchased as a result of the breakdown of two more-than-15 year old airconditioner units in the top floor.
Upgrading of the Existing Fire Testing Laboratory **(On-Going)**	January 2018 to	December 2022	Conducted inspection of the existing fire testing laboratory and assess its status. The laboratory needs rehabilitation as the building components like ceiling, lavatory, viewing room have already has been damaged. Some of the fire testing apparatus as reviewed from the list of equipment inventory obtained from Property and Supply Section, like multi-probe pyrometer and flammability tester have already been condemned. Other equipment obtained from previous years were noted down and inspected if these are still functional or could still be repaired. Fire test standards that may be applicable to the existing equipment were likewise reviewed.
Enhancing OneLab for Global	January	December	Completed referral transactions

Competitiveness – Externally Funded **(On-Going)**	2017 to	2019	from DOST-CALABARZON-L1, DOST Region 9 and DOST Region 3 as Testing Laboratory and as receiving laboratory, refer sample for testing to DOST-ITDI. 3 FPRDI Laboratories sustained their accreditations. (Pulp and Paper, Furniture Testing Center and Plywood Testing Laboratory). Organized Awareness/Training Workshop on transition from ISO/IEC 17025:2005 to ISO/IEC 17025:2017 last Sept. 26-29, 2018 held at Technopark Hotel, Don Jose, Sta. Rosa City, Laguna. FTLs' (FFTC. FPPTL and FPTL) gross testing fees collected from January to October 26, 2018 from 633 samples (2,447 tests) submitted by 422 customers amounted to P2,824,700. The targeted CSI rating for every quarter was 92% and the actual rating is 98%.
Other Services			
Statistical Services for MSD (**Continuing**)	2003	Continuing	Reviewed 1 research project proposal and recommended appropriate experimental design when necessary. Processed, analyzed and assisted in the interpretation of statistical results of 4 projects. Reviewed statistical presentation of results, analysis and interpretation of 25 terminal/progress reports and publication articles.
Upgrading and Maintenance of FPRDI Herbarium and Xylarium for Research and Development (**Continuing**)	Apr 2002	Continuing	Relabeled 100 authentic samples in the family Leguminosae. processed 10 specimens of *Eucalyptus camaldulensis* subsp. *obtusa* (Blakely) Brooker & M.W.McDonald; processed 4 herbarium specimens of *Canarium luzonicum* (Blume) A. Gray from Alabat, Quezon; produced 83 new standard-sized (authenthic) wood samples of *Eucalyptus*

			camaldulensis subsp. *obtusa* (Blakely) Brooker & M.W.McDonald; provided wood samples to CENRO-Masinloc, Zambales and CENRO-Sipocot, Camarines Sur; naturally treated 30 termite infested wood samples; Provided wood identification services to the following: Red Pallet Provider Company, Brgy. Ganadao, Mamplasan, Biñan, Laguna; E.A. Saguid Construction, Sta. Cruz, Laguna;Arctic Forest Products Inc., Tandang Sora Ave., Brgy. Sangandaan, Quezon City; Nathaniel Sept Valles and Abigail Tiongson, Centro Escolar University, Mendiola St., Manila; Trans-Asia Wood Inc., Diezmo Road, Pulo, Cabuyao, Laguna; Matimco Inc., Hi-way Estancia, Mandaue City; Worldwood Trading Corp. & Philippine National Railways; Atty. Felix S. Allicer, DENR Regional Office No. 13, Ambago, Butuan City; SI Felix B. Odencio, National Bureau of Investigation-Environmental Crime Diviion, Taft Avenue, Manila ; Sheila Marie O. De Guzman MTV Investment Properties Holdings Corporation, 2/F Corporate Business Center, 151 Paseo de Roxas, Makati City ;Razel Sta. Rita, CCAP Fairtrade for Development Inc., CCAP Bldg., 693 G. Araneta Ave., corner Kaliraya St., Quezon City; MCV Gomez Enterprises, Moncada, Tarlac; SpecsConsult, Unit 1B Dreamhouse Bldg., #10 F. Collantes St., Xavierville, Loyola Heights Quezon City; Worldwood Trading Corporation, Km. 28, Bo. Wakas, Bocaue, Bulacan; Alfredo F. Garrido, Jr. , Misamis University, H.T. Feliciano St., Ozamis City; Col. Jed G. Motus, PA (Ret.) D.Hum., Executive Director,

			Task Force DENR Enforcers Metro Manila, DENR, Visayas Avenue, Quezon City; SI Claro C. Ramos, National Bureau of Investigation-Environmental Crime Division, Taft Avenue, Manila; For. Arleigh J. Adorable, RED, DENR Region 10, Macabalan, Cagayan de Oro City. Provided herbarium/plant identification services to the following: Students of Jose Panganiban National High School, Parang, Jose Panganiban, Camarines Norte: Kylene Mae C. Ted, Dennisse Ayleen B. Banja, Clarence Jethro C. Adea, Jose Panganiban National High School, Parang, Elizabeth S. Villamonte, Sharmaine D. Villaluz, Joyce Ann Rojas, Rommela Vicente, Irish T. Sabili, Rajah Sizelle Z. Villaluz, Hazel Ann V. Puse, Sofia Amorin H. Oco, Angela Kristine N. Salem, Laarnie Abby G. Sabaco, Ma. Philomena C. De Viana, Jennie Mae V. Emata, Leanza N. Cortez, Eirene G. Ret,; Arrby Ruiz & Donna Ferrer, Far Eastern University, Nicanor Reyes St., Sampaloc, Manila; Rosette A. Cruzat, RMT and Patricia Mae U. Macalalad, RMT, Lyceum of the Philippines University-Batangas, Capitol Site, Kumintang Ibaba, Batangas City ; Leslie O. Herrera, Regine C. Granada, Paul Vasquez, Noreen A. Bugna, University of Perpetual Help System-Laguna, Sto Niño, Biñan, Laguna; Precious Andrea R. Hernandez; Philippine Center for Postharvest Development and Mechanization (PHILMEC), CLSU Compound, Science City, Muñoz, Nueva Ecija; Cyrus H. Oliveros, Export Manager, Hirang Farms, Alabat, Quezon. Attended to the following

			visitors: 19 FPPS 11 students from UPLB-CFNR, per request of Dr. Vivian C. Daracan; 11 Biology students from the Institute of Biological Sciences, College of Arts and Sciences, UPLB per request of Dr. Nerissa K. Torreta; trained 3 OJT students from the Polytechnic University of the Philippines; accommodated staff of DOStv for video taping.
Sourcing of Non-Wood Raw Materials for Research and Development (**Continuing**)	2002	Continuing	Collected 40 culms "kauayan-kiling" (*Bambusa vulgaris* Shcrad.) for powder post beetles rearing of Dr. C.M. Garcia from Nagcarlan. For Mr. K.W. Balagot and Engr. G. Sapin's project on chemical properties and physical and mechanical properties, respectively; 5 species of forest woody vines: "saging-saging" *(Pytocrene* sp.), "Lanotan" (*Agelaea* sp.), *Jasminum* sp., "agpoi" [*Bauhinia integrifolia* subsp. *cumingiana* (Benth.) K. Larsen & S.S. Larsen], and "ubas-ubasan" [*Cayratia japonica* (Thunb.) Gagnep] from Pagbilao, Quezon were collected. Additional 3 species of forest woody vines: "albotra" [*Arcangelisia flava* (L.) Merr.], "hanopol" *[Poikilospermum acuminatum* (Trécul) Merr.], and "balakbakin" (*Strychnos minor* Dennst.) for Mr. K.W. Balagot's project on phytochemical analysis from Pagbilao, Quezon. Coordinated the collection of 51 culms each of "kauayan-kiling" (*Bambusa vulgaris* Schrad.) and "bolo" (*Gigantochloa levis* (Blanco) Merr.) for Ms. S. Pelayo's project on chemical treatment of some commercially-important bamboo species in the Philippines from Nagcarlan, Laguna. For E.O. Bondad's PCAARRD project, 5 species of forest

			woody vines: "diplay" (*Rhaphidophora acuminata* Merr.), "hinggiw-puti" (*Melodinus cumingii* A.DC.), "dikay" (*Tetrastigma corniculatum* Merr.), "palus-palusan" (*Parabaena denudata* Diels), "alagau-baging" (*Premna subscandens* Merr.).were collected from Pagbilao, Quezon. Collected 4 species of forest woody vines; "hagnaya" [*Stenochlaena palustris* (Burm.f.) Bedd.], "tilob" [*Dicranopteris linearis* (Burm.f.) Underw.], "silong-pugo" [*Pericampylus glaucus* (Lam.) Merr.], "albotra" [*Arcangelisia falava* (L.) Merr.] for Ms. S. Pelayo's PCAARRD assisted project from Pagbilao, Quezon. Ten culms (10) "kauayan-kiling" (*Bambusa vulgaris* Schrad.), and 20 culms "bolo" [*Gigantochloa levis* (Blanco) Merr.] from Nagcarlan, Laguna were collected for Ms. S. Pelayo's R&D project.
Resistance of Selected Tree Species to Decay Fungi and Insects (**On-Going**)	January 2005	December 2023	Evaluation on the natural durability of the five (5) selected tree species Jarrah (*Eucalyptus marginata* Donn Ex. Smith), Lemon Scented Gum [*Corymbia citriodora* (Hook) K.D. Hill & L.A.S. Johnson], Umbrella Tree (*M. cecropioides* R. Br. Tedlie), Earpod (*Enterolobium cyclocarpum*) and Large-fruited Red Mahogany (*E. pellita*) to decay fungi and insect is being continued under field conditions. The percentage of wood stakes invaded, and the degree of damage caused by wood destroying organisms is being collected regularly every six (6) months. *E. pellita* – After 2.5 years of field exposure, 80.0% to 100.0% of the wood stakes from the butt mid and top portions were invaded by decay fungi. The degree of fungal

			decay range from 12.0% to 18.0%. 90.0% to 100% of the wood stakes from the butt, mid and top portions were invaded by *M. gilvus* and caused 10.05 to 13.5% termite damage. *M. cecropoides* - 100% fungal invasion were observed regardless of portion with fungal damaged ranging from 64.0% to 71.0% after 5.5 yrs. Similarly, 100% termite invasion occurred on all portions and infected 58.0% to 61.0% termite damage. In *E. cyclocarpum* – (6.5 yrs.) - One hundred (100%) percent fungal invasion was observed on all portions with 69.0% to 73.0% damage while termite invasion was observed in 80% of the wood stakes from the butt and mid portions causing 11.5% to 17.0% termite damaged. *E. marginata* (2nd batch) – After 7.5 years of exposure, 100% of the wood stakes from the butt, mid and top portions were invaded by *Macrotermes gilvus* and the degree of damage ranged from 40.0% to 52.0%. Likewise, 100% fungal invasion occurred in all portions that caused 38.0% to 52.0% fungal damaged. In E. *marginata* (1st batch), 100% fungal invasion was observed and the degree of damage ranged from 17.0% to 26.3%. The 100% of the wood stakes from the butt and mid portions were invaded by termites and caused 62.50% to 67.5% termite damage, respectively. In *C. citriodora* (8.0 yrs.) – Although all the wood stakes from the butt, mid and top portions were invaded by termites, the degree of damage caused was only 9.0% to 12.0%. On the other hand, fungal invasion was observed on 100% of the wood stakes from the butt mid and top portions with fungal damage ranging from 10.5% to 15.0%

			respectively. Based from the data gathered, it indicates that *C. citriodora* was highly resistant to the attack of both termites and fungi.
Other Services			
GAA Funded			
Updating and Maintenance of the FPRDI Herbarium and Xylarium Information System (**On-Going**)	January 2018	December 2019	Various xylarium and herbarium specimens specifically of the Family Dipterocarpaceae has been included in a fully operational information system.
Externally-Funded			
Wood identification of wooden structures, ecclesiastical collection and other immovable crafts in six (6) churches of Bohol and five (5) selected shrines and landmarks of the Philippines (**Completed**)	January 2017	December 2018	A Terminal Report of for the identified wooden structures, ecclesiastical collection and other immovable crafts in six (6) churches of Bohol and five (5) selected shrines and landmarks of the Philippines has been submitted to the Planning Staff.
Utilization of Spent Tea Leaves and Tobacco Dust as Additives for Plywood Adhesives (**On-Going**)	April 2018	March 2020	Most of the activities as programmed in the first (April – June) and second (July to October) quarters of the project were accomplished as planned. Collections of materials such as two trucks load of tobacco stalks (TS), 15 sacks of spent tea leaves (STL), veneers from plywood factory and adhesive from the glue manufacturer were obtained. Purchase of the equipment for the project is in process as well as the laboratory supplies. Continuous manual processing of the materials such as chipping, sun drying are still on going in the absence of the processing equipment that are still in the procurement process. Bottleneck in the screening process of the hammermilled stalks and STL were experienced due to competing use of the equipment. Nevertheless, initial glue mix formulations using phenol formaldehyde (PF) glue were made in the second quarter of the project using the 100 mesh and 200 mesh particles of the

			three varieties of TS and STL. As viscosity of all the 11 mixes made from PF with TS and STL additives were found acceptable, the formulations made all proceeded with experimental plywood production. Six to 10 panels were made for each formulations as some experimental panels resulted to blistering probably because of the high moisture of the veneers used. Formaldehyde emission test were also conducted in three test batches instead of just one run due to limitation in the availability of desiccators. Bond test were also carried out for the experimental plywood made from PF glue with the ground TS and STL as additives.

Prepared by:

LORETO A. NOVICIO
Acting Chief, Planning Staff

Approved by:

ROMULO T. AGGANGAN
Director