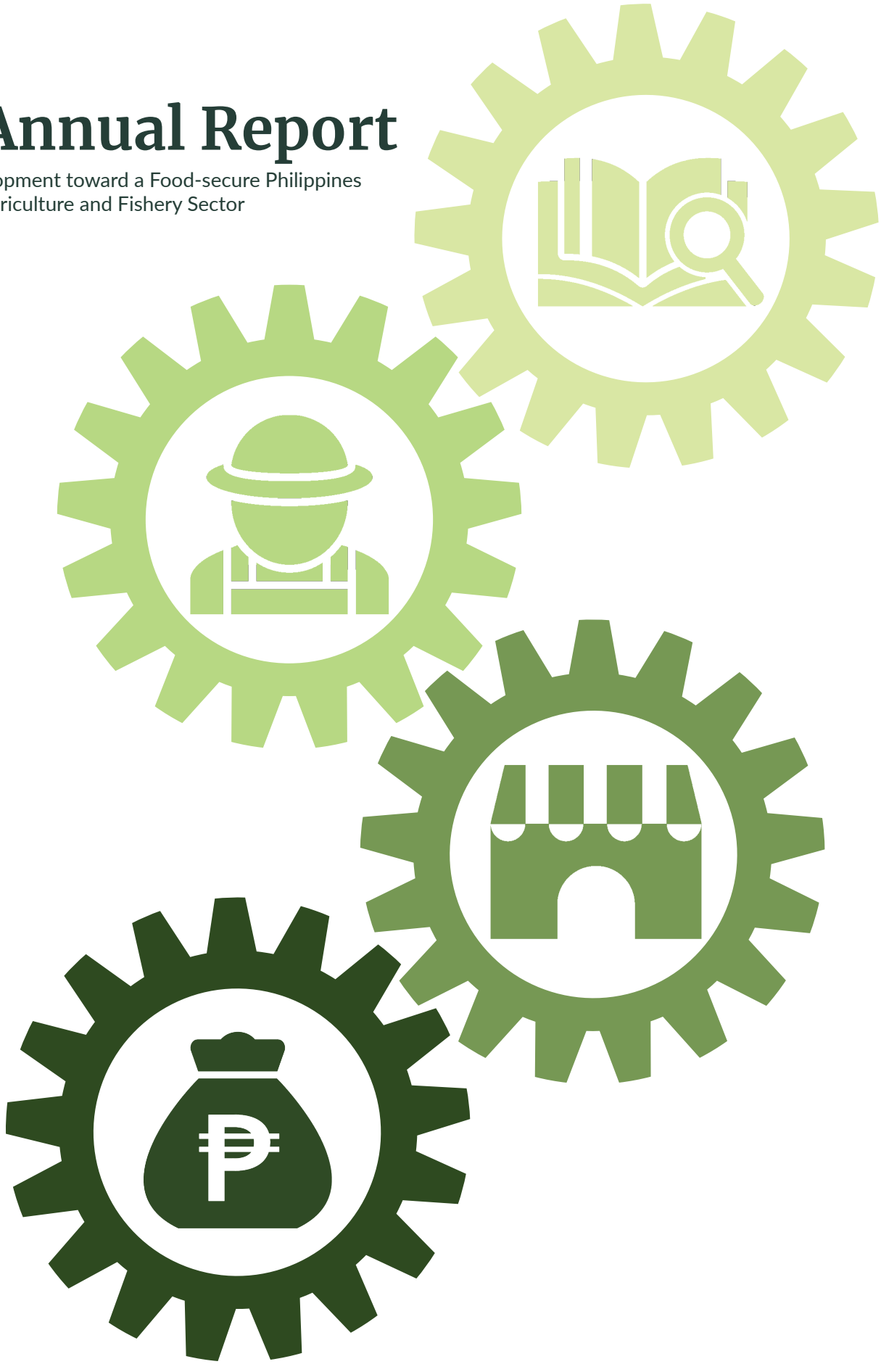
2019 Annual Report

Research for Development toward a Food-secure Philippines
with Progressive Agriculture and Fishery Sector



About the Cover

As the lead research for development (R4D) coordinating agency, the Department of Agriculture-Bureau of Agricultural Research assessed and redesigned its programs and strategies to achieve the department's goal of a food-secure Philippines with prosperous farmers and fishers. Through prioritizing inclusive market-oriented R4D, the bureau with its partner R4D institutions aims to equip farmers and fishers with the latest research-generated technologies and interventions that would increase agricultural productivity and profitability.

2019 Annual Report

Research for Development toward a Food-secure Philippines with Progressive Agriculture and Fishery Sector

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Changing gears

I am honored to present the 2019 Annual Report of the Department of Agriculture-Bureau of Agricultural Research (DA-BAR).

A key instrument for the bureau to present its accomplishments vis-à-vis its set performance targets and budget, this annual report allows the DA-BAR to account to the Department of Agriculture, and more importantly, to all Filipinos, on its performance the past year.

Under the "New Thinking" strategy, Agriculture Secretary William D. Dar envisions to have a food secure Philippines with prosperous farmers and fishers. Focused on collectively empowering farmers and fishers toward increasing agricultural productivity and profitability, otherwise known as *Masaganang Ani at Mataas na Kita*, underscored in the "new thinking" strategy are the eight paradigms which will pave the way to level up the country's agriculture and fishery sector.

In response to this, DA-BAR, through an innovative and integrated approach, elevated its strategies toward ensuring that relevant and responsive agriculture and fishery research for development (R4D) technologies reach our country's farmers, fishers, producers, and consumers. Firm on its vision of becoming the lead R4D coordinating agency towards a technology-empowered agriculture and fishery sector, DA-BAR reshaped and reinvented its strategies toward a development framework aligned to the "New Thinking." Through collaboration with partner agencies, the bureau shifted the branding of its programs into a more inclusive market-oriented R4D.

Highlighted in this report are specific examples on how DA-BAR's investment in the programs, projects, and activities implemented by partner agencies has contributed in addressing the farmers' and fishers' productivity and profitability in varying degrees. Going forward, the bureau will continuously find more efficient ways of operating and delivering programs to meet its goals and objectives.

I would like to extend my utmost appreciation to the leadership and collaborative efforts of our partner agencies such as the DA regional offices, state universities and colleges, and DA attached agencies, corporations, and staff bureaus. Likewise, I wish to express my gratitude to the head and staff members of the divisions and units of the bureau for continually working together and striving harder toward optimizing R4D as a valuable key to attaining a food-secure Philippines with prosperous farmers and fishers.

Thank you and *mabuhay*!

Nicomedes P. Eleazar, Ph.D, *CESO IV*
DA Assistant Secretary for Special Affairs
and DA-Bureau of Agricultural Research Director

Banner Programs

CPAR

Community-based Participatory Action Research

The Community-based Participatory Action Research (CPAR) program is one of the banner programs of the DA-Bureau of Agricultural Research. It has helped thousands of farmer- and fisher-cooperators all over the country become more profitable and sustainable for more than two decades now. Ultimately, it contributes to the achievement of food security in the country.

The CPAR program is a research cum extension modality that uses an innovative approach in the implementation of research for development (R4D) initiatives. It primarily focuses on the verification, demonstration, and adoption of agricultural technologies at the community level.

A community-based participatory approach is used to actively involve communities in the conduct of research projects. Cooperators take part in testing and applying of new and improved technologies derived from research. Through this, cooperators get firsthand experiences which hopefully hastens adoption of technologies.

PROJECT INVENTORY

50 On-going

Total funds released
PhP 10,823,006.00

National CPAR Congress

The bureau holds the National CPAR Congress every two years. The activity gives farmer- and fisher-cooperators, beneficiaries, and partner implementers all over the country an avenue to showcase and promote technologies that were proven effective through field validation.

The gathering solidifies the positive impact of the program to its stakeholders. Farmers and fishers from across the country share their respective success stories as testimonials. In turn, these testimonials are packaged into information and communication materials to disseminate project results. These materials are also used to serve as inspiration to encourage more farmers and fishers to join the program.

Some of the community projects featured during the National CPAR Congress are:

CPAR on Yellow Corn using Site-Specific Nutrient Management Approach in Sablayan, Occidental Mindoro

- A new farming approach called site-specific nutrient management coupled with proper cultural management practices helped hundreds of farmers in the municipality of Sablayan in Occidental Mindoro boost the yellow corn industry in their locality.
- Under the said project, farmers were capacitated to help increase both their production and income. From a net income of PhP 42,494 using farmer's practice, earnings grew to PhP 60,774 per harvest, a return-on-investment of 111.3 percent.
- Overall yield also improved significantly. In 2016, the national average yield of corn was recorded at five metric tons. However, in Occidental Mindoro, farmers are now at a record of 7.9 metric tons.
- Farmer-cooperators in the locale are now advocating the adoption of technologies introduced by CPAR to farmers in other barangays of their municipality.

CPAR: Improvement of Cacao Production in Brgy. Sirib and Brgy. Subasta, Calinan District, Davao City

- Pest and disease management strategies introduced to the farmers improved their cooperation and organizational capability which all resulted in the significant increase in income in the community.
- Series of training and seminars were conducted about Good Agricultural Practices which include nutrient and integrated pest and disease management on cacao production.

CPAR on Integrated Organic Vegetable Farming Under Coconut-based Areas in Dolores, Quezon

- The presence of a wide range of grazing areas in the community sparked the idea of tapping the potential of raising dairy buffalos for milk and other milk products to augment the income of farmer-cooperators.
- The introduction of milking technologies and processing enabled farmers to find means of income apart from farming alone. The founding of agriculture-based enterprise programs helped put the community back on their feet.

CPAR on Fishpond Tilapia Production and Processing in Lamut, Ifugao

- An OFW returned to his farming roots realizing that one can earn the same by ventureing in agriculture and fisheries enterprise in the country.
- Through capacity-building activities, training, and seminars done as part of the project, he later became a major supplier of vegetables and livestock in their locality in Ifugao as well as in neighboring provinces.
- At present, he is now involved in advocacy works promoting agriculture in collaboration with the Department of Agriculture. He also trains farmers and partners with other technical and state colleges and universities in their province.

CPAR on Water Management of Rice-based Cropping System in Lucban SWIP in Brgy. Lucban, Benito Soliven, Isabela

- Small water impounding project (SWIP) is a water collecting and storage structure consisting of a spillway, outlet structure, and canal facilities designed for soil and water conservation, as well as a flood control system by holding water during the rainy season.
- The existence of SWIP in a farming community, however, does not guarantee good production as is with Lucban Benito Soliven in Isabela. Hence, the introduction of proper water management strategies to the community.
- The community recorded increased farm productivity and yield after the introduction and adoption of technologies such as hybridization, additional irrigation, postharvest facilities, and package of technology on cropping patterns and water management.

NTCP

National Technology Commercialization Program

The National Technology Commercialization Program (NTCP) continues to support the development of the agriculture and fishery enterprises. As one of the banner programs of the bureau, NTCP has generated and commercialized a number of technologies that have been beneficial to farmers' and fishers' productivity and profitability.

NTCP ensures proper transfer of mature technologies for adoption and utilization by farmers and fishers. It emphasizes technology transfer, promotion, adoption, utilization, and commercialization of products.

Institutionalized in 2005, NTCP has provided technical and funding support to microenterprises and various agribusiness ventures. This strengthens the beneficiaries' capability to employ a market-driven approach for holistic and integrated development.

PROJECT INVENTORY

19 Completed 18 New 41 On-going

Total funds released
PhP 95,068,362.64

Agriculture and Fisheries Technology Forum and Product Exhibition

For 15 years, the Agriculture and Fisheries Technology Forum and Product Exhibition (NTF) has served as a platform for the bureau and its partner R4D institutions to showcase how an inclusive market-oriented approach to agriculture could significantly improve the farmers' and fishers' productivity and profitability.

Conducted annually, NTF promotes the value of R4D technologies in increasing agricultural productivity and farmers' and fishers' income by showcasing various products and other innovations developed through research. To further disseminate mature technologies to potential takers, seminar series and product demonstrations were also conducted during this activity.

The bureau annually recognizes the best product on display during the exhibit based on the following criteria: 1) creativity and uniqueness; 2) relevance to food security or health and wellness; 3) product attributes; 4) packaging and labelling; and 5) market potential and competitiveness.

In 2019, the coconut sauce of DA-Northern Mindanao emerged as the best product. Made from pure coconut water, the all-purpose coconut sauce was an initiative of a CPAR cooperative in Oroquieta City, Misamis Occidental.

Other activities during the 2019 NTF include the awarding of Intellectual Property Rights certificates and launching of Agriculture Secretary William D. Dar's book, "The Way Forward: Level Up Philippine Agriculture." His book advocates the leveling up of the Philippine Agriculture System through technology and agripreneurship.

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PHOTO COURTESY OF AURORA STATE COLLEGE OF TECHNOLOGY

Featured Technologies

Technology Development and Promotion for the Conservation, Production, and Commercialization of Indigenous Upland Rice in Selected Areas in the Bicol Region

- In Bicol region, the native cultivars namely *Bolibod*, *Gayang-gang*, and *Gios* are few of the scarce indigenous rice varieties in the country.
- The Bicol University initiated a project aimed to conserve, produce, and commercialize indigenous upland rice in Bicol to support local farmers and their initiatives.
- Series of trainings were employed to capacitate farmer partners on agroforestry production and post-production technologies.
- Agroforestry Learning Model Farms were also established to serve as demonstration farms for the farmer partners.
- Close to 40 farmers in Ligao City, Albay continued and adopted these practices in their contour farmers because it was proven to be effective and efficient.

Production, Field Testing and Commercialization of Boton Pesticide

- Boton (*Barringtonia asiatica*) is popular for the natural poison it produces—saponin. In the Philippines, boton seeds are widely utilized as anti-pest materials especially on golden snails.
- The Aurora State College of Technology embarked on a study on boton as biopesticide to control golden snails on the rice field.
- The study aimed to develop a nursery for a sustainable production of boton's raw materials and produce marketable Boton pesticides in different forms – pellets and extract.
- The research team found that boton as a molluscicide is effective against golden snails.
- After validating the field results, the Boton Biopesticide was marketed through the university's Extension and Training Office.

One Town-One Product Enterprise: Sustainable Fruit Wine Production and Commercialization in Cagayan Valley

- Acknowledging the potential of fruits suitable for wine production, the Isabela State University implemented a project that encouraged agencies producing fruit wines to adopt the standard processing technologies and techniques to improve the quality of their products.
- By offering series of on-site training and coaching, this project helped in the development and fine-tuning of the package of technology on wine production.
- The training paved the way for the creation of an organizing group that will carry the brand name of Northvalley products as part of the standardization process.
- Twelve fruit-based wine recipes were developed in the duration of the project.
- The participating organizations continued the intervention of the project by producing and developing more wine recipes that will utilize the blend of 2-4 fruits as a new product twist.

Commercialization of Selected Agroforestry Technologies in Selected Communities in Albay

- Capitalizing on the rich natural resources of the Bicol region, the Bicol University-College of Agriculture and Forestry implemented a project that would commercialize and promote select agroforestry technologies and products.
- The project aimed to increase farmers' income while enhancing the agroforestry environmental services through capacitating the farmers in a series of training on agroforestry strategies, Bicol strawberry farming, livestock production, and native pig and chicken management.
- Model farms were also put up to uptake agroforestry technologies and be of use in generating products to be commercialized in the market.

National Commodity Programs

Rice

In line with the Philippine Rice Industry Roadmap's "Rice Secure Philippines" whose goal is to enhance resiliency and competitiveness of Filipino rice farmers while ensuring the country's access to safe and nutritious rice, the DA-National Rice Program delves into the productivity, profitability, and betterment of lives of rice farmers through the development and introduction of improved and state-of-the-art rice farming technologies.

Various R4D projects on rice and rice-based farming systems implemented by the bureau's partner institutions on rice RDE were initiated and continually undertaken.

PROJECT INVENTORY

1 Completed 19 New 42 On-going

Total funds released
PhP 407,499,309.33

DA and IRRI R4D Partnership

The Department of Agriculture (DA) and International Rice Research Institute (IRRI) R4D partnership was renewed on February 2019 with the signing of the Memorandum of Understanding for Scientific and Technical Collaboration in support to Enhancement of the Rice Industry Competitiveness. The projects continued under the partnership were:

Pest Risk Identification and Management Efficiency (PRIME)
PRIME aims to reduce crop losses due to pest and diseases thru a standard pest risk mapping, crop health assessment and pest surveillance protocol.

The end products include standard protocol for crop health survey, pest profiles, risk factor analysis for pest outbreaks, pest risk modelling, risk management strategies and tactics to reduce crop losses due to pests, database on incidence of diseases, insect pest and rat injuries, and rice crop and crop management characteristics, and rice crop health indicators extracted from remotely sensed data, among others.

Five pests and diseases, such as the leaf and neck blast, bacterial blight, rice tungro disease/green leafhopper, brown leafhopper, and rodent, that causes major losses in the country were also studied under PRIME.

Significant Accomplishments

- Database on rice pest occurrence in 2,328 monitoring fields updated and generated every semester;
- Standard template for pre-semester and monthly pest bulletins developed and released with pest profiles, risk advisories, and recommended management that will improve farmers practices to attain higher yields and reduce cost and losses;
- Standard pest surveillance protocol developed and used by the Regional Crop Protection Centers throughout the country;
- Risk factor as regards to the effect of extreme weather events and stagnant flooding on the population dynamics of brown plant hopper and its major natural enemies analyzed;
- Online database with analytics tested and was launched on November 2019; and
- Sustainability plan framework and key components developed.

Partners and representatives from rice research institutions convened for the Philippine Rice Information System (PRISM) & PRIME Summit on 18 November 2019 in Quezon City to present the progress, accomplishments, and plans of the projects.

Rice Crop Manager
To provide the rice farmers science-based crop management recommendations for their specific farming situations, the Rice Crop Manager (RCM) continued to improve and upgrade the interoperability of the RCM Advisory Service software and databases, capacitate its next and end users, and improve the yield targeting and nutrient calculation for rice-based system, capacity building, and focus on research leadership.

RCM can be accessed through www.cropmanager.irri.org. An application for download is also available for Android users.

Significant Accomplishments

- 425,983 RCM recommendations generated nationwide and provided to farmes for adoption;
- Applications and databases such as RCM and RCM Advisory Service web-applications, farming practices and recommendations, and database of farmers and georeferenced farm lots were developed;
- Farmer database and georeferenced farm lots were provided to DA to contribute in updating the Registry System for Basic Sectors in Agriculture; and
- RCM also highlighted the following findings: 1) farmers who are typically achieving low yields (below 4 t/ha) can gain an average increase in yield by approximately 21 percent and increase added net income by about PhP 9,600 per hectare; 2) farmers with typical yields (between 4 to 5 t/ha) gained an average yield increase of about 11 percent and added net benefit of PhP 6,940 per hectare; and 3) farmers whose typical yields are higher (than 7 t/ha) get less than two percent yield increases and relatively lower added net income.

DA-BAR, in collaboration with DA-Philippine Rice Research Institute (PhilRice), DA-Agricultural Training Institute, and DA regional offices works, toward the widespread dissemination, adoption, and utilization of the RCM application.

Next Gen PLUS – Increasing access to adaptive rice varieties
The Next Gen PLUS project features the use of advance breeding tools and technologies such as line and variety augmentation, genomic selection, and Rapid Generation Advance.

It has developed breeding lines introgressed with resistance traits to biotic (e.g. tungro, bacterial leaf blight, and blast) and abiotic stresses (e.g. drought, submergence, and salinity) using advanced breeding technologies.

The major components of the Next Gen Plus are: 1) validation of provincial variety profiles, recommendation domains and seed delivery and access modalities, 2) development of new improved lines and identification of adaptive varieties, and 3) development of accelerated variety delivery support mechanisms.

Significant Accomplishments
- Initiatives in support to harmonization of regional variety and seed requirements conducted;
- Provincial variety profiles generated and conducted, while gaps and inefficiencies in seed delivery and access validated and analyzed;
- Training on Genomic Selection, Line and Variety Augmentation Protocols, and breeding Breeding4Results database platform conducted;
- Upgraded PhilRice Breeding Facilities for Rapid Generation Advance and Hybridization Protocols; and
- Results are being used by DA regional offices as basis of varieties for seed production in stations.

Next Gen technologies is continuously being enhanced to increase the seed growers' and farmers' access to high quality seeds of recommended adaptive varieties of seed channels and harmonize regional seed systems with national seed delivery and access support mechanisms and systems.

Through their seed production support activities, access to adaptive rice varieties also grew among seed growers. Other component activities include seed supply chain analysis, participatory performance testing and validation, and multi-location testing.

Water Efficient and Risk Mitigation Technologies (WateRice)
To improve water productivity and reduce production risks, the WateRice works at the core of development, dissemination, and adoption of crop management technologies in the irrigated and rainfed environments.

Its major tools and technologies include irrigation advisory service, which features the AutomonPH, mechanization technologies, and integrated crop management technologies.

AutomonPH tool provides various farmers with real-time field monitoring of irrigations systems and water levels. It acts as a transmitter by recording the water level and sending the data to the server, which will send a text message to the farmers.

Significant Accomplishments
- Continued testing and improvement of AutomonPH and development of the e-Damuhan;
- Inclusion of the developed weed management module to RCM;
- Demonstrated using farm models, the high production efficiency through water management, mechanization, appropriate variety, integrated weed management, and laser levelling improved net income to 11 percent for the rainfed environment; and
- Weedy rice and its management practices documented.

While it also develops Information and Communication Technology tools for the decisions involving best management practices recommendations, the WateRice project also recommends an enabling environment for the adoption of various interventions and innovations.

Strategic Rice RDE

The DA-BAR has been supporting rice projects that are vital to information generation and technology development. Among these R&D projects of rice are as follows:

Climate Change-Adaptive Schools
Due to the negative impacts of climate change to rice (i.e. yield decreased), the goal of this project is to develop agriculture technical-vocational high schools as information hubs on climate change-related information where schools and students would act as infomediaries (information providers) in disseminating climate change-adaptive rice production technologies to farmers in the community.

Significant Accomplishments

- Created a complementary extension mode by mobilizing schools as nucleaus of climate-smart rice agriculture information;
- Case-specific presentation is written in the book “What is a climate change-adaptive school?”;
- While most of the components were patterned after the Palayamanan Plus of DA-PhilRice, participating teachers did plenty of innovations to ensure that the components are suited to their context;
- Success in mobilizing young people as infomediaries in the context of a climate change-adaptive school rests on meeting the requisites for a climate change-adaptive school (e.g. driven teachers, enabling environment in the school);
- Best-fit teaching strategic gravitate around localization of the lectures, showing that technologies really work, use of visuals and creative teaching methods.

The RDE agenda addressed were low adaptation and utilization of technologies and low productivity and resiliency owing to climate change in different ecosystems.

Rice Seed Information System
Integrating the use of smartphone, internet, GPS data, and servers with seed industry players like producers, growers, coordinators, and inspectors in the monitoring, collection, and processing of rice seed availability estimates on a seasonal basis, this new project by DA-BPI and DA-PhilRice aims to pave way towards a mobile-based collection and automation of field data.

Deemed as "rice seed production, distribution, and monitoring information system," the field data could provide accurate and reliable information in the most efficient way to DA agencies and policymakers.

Mechanized Direct Seeding Technology
Achieving higher productivity of rice-based farming in rainfed environments with reduced production costs is the goal of the Mechanized Direct Seeding Technology (MP Seeder) project. Specifically, the project focuses on the mechanized dry direct seeding for rice, corn, and mung bean using multi-purpose grain seeder drawn by a two-wheel tractor or *kuliglig*.

Significant Accomplishments

- Best management pactices (BMP) and the MP Seeder for direct dry seeding rate under rainfed and tail-end of irrigated areas generated;
- MP Seeder Technology Package includes site-specific variety per ecosystem; BMPs for rice, corn, mungbean; and multi-purpose seeder; and
- Technology dissemination pathways such as MP Seeder launching, technology demonstration, field days, and local farmer technician mobilization conducted.

Users of this technology are smallholder farmers in rainfed areas, local manufacturers and providers, farmer associations, and local extension staff.

Small-Scale Irrigation Project (SSIP) Suitability Mapping

In support to the R4D component of the DA's SSIP Masterplan, DA-BAR in close collaboration with the DA-Bureau of Soils and Water Management (BSWM), initiated and supported the R4D project on "Identifying Suitable Sites for Small-Scale Irrigation Projects in the Regions through GIS-based Water Resources Assessment" that is implemented nationwide by 17 partner state universities and colleges across the country.

The development of these SSIP Suitability Maps on a regional and provincial level were generated from these SSIP R4D projects.

Significant Accomplishments

- Regional and provincial SSIP suitability maps submitted, which would be turned over to the DA-BSWM in 2020;
- Handbook developed by Central Luzon State University (CLSU) Water Resources Management Center on GIS-based suitability mapping for SSIP; and
- Training activities by the partner SUCs on the development of SSIP Suitability Maps for the regional partners and SSIP planners and implementers conducted.

Brown rice quality, shelf life and engineering technologies

In partnership with the National Food Authority, DA and DA-PhilRice forged a collaboration as way of ensuring the affordability and accessibility of brown rice in various markets. In line with the promotion of responsible consumption through brown rice among local consumers, the project "brown4good" which aims to commercialize brown rice among the general public, was initiated.

With the goal of making the brown rice accessible and available for local consumption, the "Improving Brown Rice Quality, Shelf-life, and Engineering Technologies" project focuses on improving and pilot testing brown rice engineering technologies.

Significant Accomplishments

- Brown rice from NSIC Rc160 was polished for 0, 5, 10, 15, 20, 25, and 30 seconds, and were evaluated for color values, proximate composition, Instron hardness, and sensory properties;
- A total of 234 NSIC and PSB approved rice varieties were used to identify the optimum amylose and gelatinization temperature combinations for brown rice;

- Four stabilization techniques, specifically oven-drying, steam heating, microwave, and infrared heating, were employed to improve the quality and shelf-life of brown rice.
- Improved prototype of motor-driven brown rice machine, four units of motor-driven brown rice machine, and improved prototype of village-type brown rice mix were fabricated at DA-PhilRice Rice Engineering and Mechanization Division workshop;
- One set of component assembly for retrofitted brown rice machine was fabricated and prepared for installation; and
- Potential cooperating users for the pilot testing of brown rice machines and SACLOB (airtight storage of rice seeds) were identified through key informant interview.

CPAR on Rice-based Farming Systems

To ensure the utilization and adoption of technologies from research to by farmers and fishers, the Community-based Participatory Action Research (CPAR) is one of the approaches promoted by the bureau. CPAR is designed to empower the community with knowledge, tools, and technologies towards a dynamic and inclusive R4D approach to agriculture and fisheries.

In 2019, three new and four on-going CPAR projects were funded under the National Rice Program. These CPAR rice-based farming system projects and technologies focused on farming system levels and showed support to rice-based farming areas by integrating and diversifying other high-value crops.

As such, the package of technologies being promoted and verified through these projects include the combination of rice and vegetables or mungbean cropping system; saline rice, legumes, and cattle; rice, corn, vegetable, and livestock; and other integrated farming systems and integrated crop livestock production in rainfed lowland rice growing areas.

Corn and Cassava

Corn and cassava are major commodities in the country. As DA shifts to a new perspective, food security and profitability among farmers and fishers are put on top of priority. Hence, the importance of the two commodities as alternative staple food to rice is highlighted.

In 2019, the program boasts progress on nutrient management, pest resistance, and cultural management practices that helps in cassava production; and on the collection, conservation, and development of stress-tolerant traditional corn varieties.

PROJECT INVENTORY

15 Completed 1 New 93 On-going

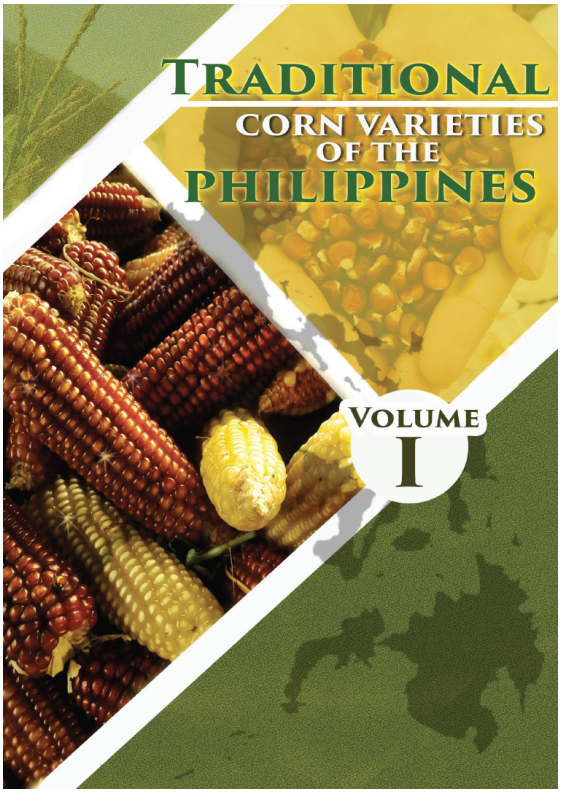
Total funds released
PhP 79,310,180.00

Traditional Corn Varieties

The Corn Germplasm Utilization through Advanced R&D (CGUARD) project team in coordination with the 16 DA regional field offices across the country, the Institute of Plant Breeding of the University of the Philippines Los Baños (IPB-UPLB), and the DA-National Corn Program has now collected a total of 3,384 traditional corn varieties.

Western Visayas obtained the highest number of varieties with 576 collections. These collections were stored at the National Plant Genetic Resources Laboratory of IPB-UPLB. Currently, the regions will continue to collect, characterize, and seed increase their respective collections of traditional corn varieties.

Five traditional corn varieties were found to be tolerant to drought (sources: MIMAROPA and SOCCSKSARGEN); five varieties tolerant to high pH (sources: Bicol, Western Visayas, Central Visayas, and Caraga); six tolerant to low pH (sources: MIMAROPA, Central Visayas, SOCCSKSARGEN, and Caraga); five tolerant to waterlogging (sources: Cagayan Valley, Western Visayas, CALABARZON, and Caraga); and six resistant to Asian Corn Borer (sources: Ilocos, Northern Mindanao, SOCCSKSARGEN, and NPGRL). The project has not developed a new variety yet, but the identified varieties with high potentials will be further tested for yield performance.



The traditional corn varieties that have been evaluated with good quality traits and with high yield will be seed increased and distributed in the regions to augment rice for food especially in poor provinces.

The CGUARD-IPB team has also crafted a catalogue of traditional corn varieties (Volume 1) with detailed descriptions, including morphological and agronomic characteristics. Volume 2 will also be crafted featuring the characteristics of additional corn varieties collected in the coming year.

National Survey and Early-warning on Cassava Arthropods Pests and Diseases

Progress on the National Survey and Early-warning on Cassava Arthropod Pests and Diseases includes the development of a database and an early warning system for emerging and existing insect pests and diseases that heavily affect the production of cassava in the country, based on distribution maps, time of occurrence, and severity and spread of cassava arthropod pest and diseases.

As such, the top three most prevailing diseases were recorded across regions, namely: brown leaf spot, blight leaf spot, and bacterial diseases. Additionally, cassava phytoplasma diseases were also observed. Pest advisories and control management methods are continuously being given out by DA regional offices, in coordination with the DA-Bureau of Plant Industry, to the respective local government units of affected areas.

This project was conducted in collaboration with DA-Bureau of Plant Industry and DA-Regional Crop Protection Centers (RCPCs).

The RCPCs in collaboration with local government unit extension workers, will continue to conduct pest monitoring of emerging pests and diseases in order to prevent widespread of important pests and diseases in the regions.

The cassava industry was severely affected by CPD first in Northern Mindanao followed by Davao Region, Cagayan Valley, and Central Luzon in 2011. Fortunately, the further widespread of CPD was controlled through the use of TapioGard.

Further, the VERCA Agro Chemical Incorporation (the sole distributor of TapioGard or Streptomycin sulphate) is very active in selling TapioGard (pre-planting treatment applied to control Cassava Phytoplasma Disease or CPD) in all regions. As of December 2019, VERCA was able to sell 26,142 packs in all regions (Northern Mindanao with 4,650 packs, Central Visayas with 4,197 packs, and Cagayan Valley and Central Luzon with 1,970 packs).

Optimization of SSNM for Closing Yield Gap in Cassava Production

Through the “Optimization of Site-Specific Nutrient Management (SSNM) for Closing Yield Gap in Philippine Cassava Production through Farmer’s Participatory Evaluation” project, the yield of cassava was increased significantly by adjusting fertilizer recommendation based on factors, including: variety, soil fertility, cassava management practices (variety, crop residue management, crop rotation and organic nutrient inputs), climate, water availability, fertilizer source, and price. Continuous hands-on training and coaching were organized by DA regional offices accordingly.

Based on the last SSNM trial done in the regions, the utilization of SSNM in cassava production can increase yield by 4.86 t/ha (SSNM=24.7 t/ha versus Farmers Field Practice=19.9 t/ha) and increase in income by 24.7 percent (SSNM=PhP 247,630 versus Farmers Field Practice=PhP 199,030).

High-Value Crops

To enhance agricultural productivity and increase the income of farmers and rural communities, high-value commodities are also given priority by the DA. The DA-High Value Crops Development Program through the bureau funds research initiatives and technology commercialization projects focused on priority commodities such as plantation crops, fruits, vegetables, legumes and nuts, allium, and alternative staple crops.

Applied technologies

Off-season mangosteen production

- In 2019, off-season mangosteen production was made possible through the rain shelter technology developed by DA-Davao Agricultural Research Central Experiment Station. Off-season mangosteen fruits had the same fruit size and taste quality compared to in-season fruit. Through this, all-year round production of mangosteen is made possible. The production of off-season mangosteen will enable farmers to earn as much as ten times during its in-season price.

Cacao varieties

- DA-Caraga explored the yield performance of different cacao varieties and clones under its regional condition. NSIC-registered and farmer's variety were tested during the trials. Through this project, W10, K1, and UF18 were identified as the top three potential varieties that are suitable in Caraga region.
- OPTIONS, Inc. evaluated the combined effect of genotype, fermentation method, and roasting temperatures and duration in flavor development. This research has significant commercial implications and could serve as a starting point for future studies on varietal development, postharvest, cacao-based products and chocolates.

PROJECT INVENTORY

27 Completed 20 New 45 On-going

Total funds released
PhP 101,090,601.34

Pest and disease management

- University of the Philippines Los Baños (UPLB) developed chemical and cultural control for mango cecid fly through Insect Resistant Management (IRM), application of appropriate mulching material to reduce survival of pupa/ prevent pupation of cecid fly, and setting up cecid fly traps to monitor its population.
- To protect the developing mango fruits against insect attack and reduce pesticide utilization, DA-Ilocos Integrated Agricultural Research Center adopted the IRM principle to formulate pesticide strategy and fruit bagging technology with the addition of close monitoring of adult mango cecid fly as a complementary strategy. Trials made in seven mango farms owned by farmer-cooperators showed that IRM treatment (spray window + fruit bagging) has lesser damage on the crop compared to the controlled trial and farmer's practice.

Other applied technologies that address agricultural productivity:

- UPLB-Institute of Plant Breeding has generated the technology to produce true-to-type and certified virus-free planting materials for garlic. The technology utilizes tissue culture technique to micropropagate; serology, molecular markers, and cytology. The project focused on the optimization of the protocol, field testing of the tissue cultured planting materials, development of virus indexing protocol, and development of molecular markers for genetic fidelity tests of the different garlic cultivars.
- UPLB-Postharvest Horticulture Training and Research Center improved the postharvest handling technologies of select vegetables (i.e. bitter gourd, finger pepper, sprouts, water spinach, and Chinese cabbage).
- DA-Palawan Research and Experiment Station found that pineapple and banana are compatible intercrops for cashew growers. Cashew is a highly seasonal crop and one of the priority commodities in Palawan. This integrated cashew-based farming system will provide cashew growers additional income within the span of one to two years.
- DA-Davao Region explored the potential of breadfruit and has generated information on breadfruit management practices from nursery to bearing stage. This information could help farmers and nursery owners as well as researchers.
- With the aim of increasing vegetable consumption, the University of Southern Mindanao determined the nutritional values and minerals, and proximate analyses of indigenous vegetables and wild edible fungi as affected by occurrence of pests, diseases, and weather factors of indigenous vegetables and wild edible fungi.
- DA-Bureau of Soils and Water Management conducted land resources evaluation and suitability assessment of strategic production areas for major commodities (i.e. rubber, abaca, and cassava) as well as for cacao and coffee. The comprehensive soil and land information generated through these initiatives would serve as the basis for a sound development planning for the commodities mentioned. Results will be turned over to DA-Philippine Council for Agriculture and Fisheries in 2020.
- UPLB-National Institute of Molecular Biology and Biotechnology developed natural phenolics powder and antioxidant-fiber-rich speciality flours from mango peel and seed wastes. Standardized process protocols for production of phenolic powders were established. The natural antioxidant phenolic powders were found to have great potential in the cosmetics industry; and the project team are in talks with potential investors. Meanwhile, enzymatic modification reduced the hydration properties of mango peel powder making it more suitable as a baking ingredient.

PHOTO COURTESY OF OPTIONS, INC.

Technologies commercialized

Mature technologies generated through research for development projects are ultimately promoted and commercialized for the benefit of the agriculture and fishery sector. With the commercialization of mature technologies, specific attention is given to strengthening a market-driven approach.

Cacao

- OPTIONS, Inc. introduced a community-based cacao production and processing enterprise, developed through previous projects funded by the bureau, to the Mutia Cacao Farmers Association in Zamboanga del Norte. The project team adopted the modality "learning by performing and cross training" as the strategy in transferring the technology for making cacao-based products and by-products to the partner community.
- Isabela State University-Echague Campus developed research-based package of technology on cacao fermentation and roasting, developed and promoted new cacao products, improved existing packaging of processed cacao products, and secured Certificate of Registration (utility model) from the Intellectual Property Office of the Philippines.

Mango

- To encourage farmers to grow carabao mangoes in Cagayan Valley, the Isabela State University enhanced the farmers' capabilities to implement integrated crop management, integrated pest management, postharvest quality management while incorporating good agricultural practices. The research-generated interventions and technologies shared to partner farmers have been proven to improve the yield from five to 10 tons per hectare of exportable quality mangoes.

Seed Production and Planting Material

- With the end goal of improving farmers' income, UPLB-IPB produced and commercialized the good quality seeds of open-pollinated varieties of selected vegetables. These seeds were distributed to farmers and households in disaster and needy areas. Farmers were also trained on seed production, processing, and storage.
- Capitalizing on the scarcity of *achuete* seed production as an enterprise, the DA-Zamboanga Peninsula evaluated the production performance of *achuete*, rehabilitated the existing trees and established a nursery for mass propagation, multiplication, and distribution. Through the project, 8,000 pieces of *achuete* seedlings were distributed while 1,100 pieces were given for tree planting activities in Zamboanga City. The *achuete* seed production as an enterprise is financially viable with 59 percent return on investment and approximately four years of payback time.
- DA-Zamboanga Peninsula also established a breadfruit nursery to produce disease-free planting materials. The research team also explored value-adding technologies through the development of breadfruit flour and cookies. Breadfruit is an alternative staple food of the indigents especially during the dry season.

Product development and improvement

- The Provincial Local Government of Ifugao improved the appearance and shelf life of the processed products, namely, coffee, *tinawon* rice, and taro. Promotional activities followed the improvement of the products.
- The Municipal Local Government Unit of Quezon improved the quality and packaging of the coconut sap sugar. Meanwhile, taking advantage of the demand in the local market, the production of coconut sap sugar was expanded to neighboring barangays and municipalities. Private individuals have also adopted the said technology.

Livestock

Despite the spread of the African swine fever and other concerns in this sector, the livestock and poultry industry consistently thrived to contribute to uptrend growth of agriculture especially in terms of food production.

In line with DA's mission, the bureau supported its R4D priorities across the whole value chain—from improving animal health through enhanced and diversifying feed resources, breeding, to value-adding through product development and marketing tied with the cross cutting programs of the department linked to livestock and poultry.

PROJECT INVENTORY

3 Completed 3 New 2 On-going

Total funds released
PhP 12,476,417.68

Utilization of Soybean (*Glycine max* L.) to Enhance Growth, Health, and Estrus among Native Pigs in Pampanga

- Developed a feed protocol using soybean as ingredient for improved growth, respiratory, gastrointestinal, and reproductive performance of native pigs
- Discovered that using 10 percent fermented soybean meal as replacement for purely ordinary soybean meal improved the growth performance of sucking native piglets ages 7-28 days due to the Lactobacillus species, essential amino acids, and proteins contained in the fermented soybean meal. As such, this has improved the intestinal function, nutrient digestion and absorption, and regulated immune function of the native pigs.
- Discovered that using roasted soybean for feeds enhances the pig's average daily gains, milk production and protein, and nutrient digestibility and absorption especially for fatty acids
- Claimed that both fermented and roasted soybean mixed with corn effects high blood estrogen level which improves the fertility and reproductive performance of native pigs

Feeding Value of Banana (*Musa Sapientum*) stalk and water lily (*Eichhornia crassipes* [Mart.]) in Dairy Cattle

- Identified and formulated appropriate ration for dairy cattle feed utilizing banana stalks and water lily—which are considered agricultural wastes—to make both ingredients suitable as feed ingredient for the growth, milk production, and profitability of dairy cattle
- Discovered that fresh and ensiled water hyacinth had better nutrient content compared to Napier grass (both fresh and ensiled) making the former good sources for potential feed for ruminants. Ensiled freshwater hyacinth is more preferred because of its longer shelf life due to high lactic acid content and improved nutritional profile.
- Recommended that pre-ensiling procedures for banana stalks and water lilies such as semi-drying, wilting, and adding water-soluble carbohydrates source such as molasses can improve its ensiling properties or the storage and preservation prior its conversion to silage

Adoption and Commercialization of Green Corn, Green Corn-based Silage, Haylage and UMMB Production for Dairy Cattle/Buffalo in Cagayan Valley

- Developed nutrient-rich feed mix and supplements from green corn that will increase milk production from 2 to 4 liters for dairy buffalo milk and 4 to 10 liters of dairy cattle milk
- Conducted profitability financial viability analyses which identified that planting corn for silage is more profitable than producing corn for grain, ensiling is more profitable that selling green corn for silage, feeding the developed green corn silage and supplements increased income on milk production which can be a profitable independent and complementary enterprise in the long term
- Developed and introduced four package of technologies (POTs) to the members of Malaya Development Cooperative and Sinaongan Sur Dairy Association of San Agustin Dairy Cooperative
- Facilitated capability building (experiential learning, mentoring, and coaching workshops) for the small-scale dairy farmers for the promotion, adoption, and commercialization of the developed POTs which can lead to ownership and sustainability in technology adoption

Commercialization of Chevon Value-adding Technologies in the Province of Isabela

- Developed nine variants of chevon meat products: six of which are canned while three are packaged as microwaveable products
- Tested all products which were evaluated satisfactorily for taste, commercial sterility, shelf-life, and were proven to have lower levels of peroxide value (lower levels of peroxide value indicate longer storage stability of oil in the meat) and lower than recommended fat intake
- Applied eight Intellectual Property Rights under Utility Model: five of which are approved with registration certificates to be released while three are still under evaluation
- Facilitated two license agreements for commercialization with two private companies: AgriComponent Corporation and ISU Multipurpose Cooperative—whose market are within Isabela and Metro Manila, respectively
- Established Chevon Marketing Center and Food Card to market chevon products

Philippine Native Animal Development Program

The bureau also supported the conservation and utilization of domesticated native animals through funding R4D-generated information and technologies generated.

Since the program's launch in 2010, the bureau has been supporting the Philippine Native Animal Development (PNAD) Program by establishing research collaboration among state universities and colleges and other research institutions in formulating, promoting, and implementing policies and programs for the conservation, production, and marketing of native animals—this, through the close collaboration with the DA Livestock and Poultry Program and the DA-Bureau of Animal Industry.

PROJECT INVENTORY

3 New

Total funds released
PhP 4,040,836.00

Dissemination of Technology Information Materials in Support to the Philippine Native Animals Development Program

- Produced information materials on production technologies of native swine, native chicken and ducks; and on value chain analysis of native *lechon* in Luzon and Visayas—both used by farmers raising native animals in rural and remote areas across the country

Market Exploration and Commercialization of Native Pig Products in Selected Municipalities in Quezon Province

- Produced and processed native pig technologies into marketable products such as *longganisa*, patties, native pig Spanish style meat, and *lechon paksiw*
- Started a native pig roduction and processing enterprise empowered by the Native Pig Raisers Association of Tagkawayan, Quezon
- Expanded markets of native pork *longganisa* through direct selling in the several markets in Tagkawayan, Lucban, and Lucena City, Quezon; Pio Duran, Albay; Malvar, Batangas; and Parañaque city pricing each 320-gram pack for PhP 100-120

Development of Breeder Farms for Philippine Native Chicken (Paraoakan, Banaba, and Joloano) for Meat and Egg Production

- Produced breeding technologies for improving native chicken through developed lines and strains suited for commercial production

National Thematic Programs

Organic Agriculture Program

As the lead coordinating arm of DA for R4D, the bureau was tasked to establish a sustainable support scheme for the Organic Agriculture Program when Republic Act No. 10068 was enacted on 2010. The act provides for the development and promotion of organic agriculture in the country. Organic agriculture promotes ecologically sound, socially acceptable, economically viable, and technically feasible production of food and fibers.

Tapping its partner R4D institutions and agencies, the bureau coordinated and supported activities for the formulation and implementation of a systematic and integrated organic agriculture RDE plans and programs. The following projects were among those completed in 2019:

Protocol for Pollinator Diversity Assessment and Valuation of Pollination Services in an Organic Farming System

- The University of the Philippines Los Baños (UPLB) implemented the study which introduced the benefits and impact of pollinators, specifically native and stingless bees, in improving the productivity and profitability of organic vegetable and fruit tree farming systems.
- Empirical data on appropriate pollinators of the selected crops were given to partner stakeholders through the project. This greatly helped bee farmers in monitoring the pollinators on specific fruit sets.
- In a trial, the carabao mango fruit saw significant increase in productivity by more than 12 times compared to the trial without visitation from the pollinators.
- Stakeholders were also further capacitated with appropriate methods for the propagation, care, and maintenance of plants to sustain the project.

PROJECT INVENTORY

11 Completed 9 New 2 On-going

Total funds released
PhP 47,108,000

Development of Organic Complete Ration Mix (OCRM): Adoption, processing and commercialization for organic dairy goat production

- Anticipating the high demand for goat milk and meat, the University of Southern Mindanao implemented a project to increase the production of milk through the formulation of an appropriate feeding regiment on dairy goat hybrids to serve as additional suppliers of goat meat and milk aside from pure breeder stocks.
- ORCM–the feeding regimen is composed of forage, fodder, legume, and cereals.
- Through ORCM, milk production increased. Milk and meat produced are still in good quality but can be bought at a cheaper price.
- Every peso invested gets PhP 1.20 in return. Thus, making it a profitable for partner farmers.

Development of Microbial Inoculants for the Production of Improved Fermented Biological Extracts (Phase II)

- The UPLB-National Institute of Molecular Biology and Biotechnology (BIOTECH) embarked on a project to improve the quality of fermented biological extracts through the incorporation of molecular and conventional techniques.
- For fermented plant extract, different biological concoctions were conducted using *madre de cacao* leaves with brown sugar, distilled water, and inoculum
- For fermented fruit extracts, banana, *okra*, and mango peelings were used in three different mixtures together with brown sugar, distilled water, and inoculum for each.
- Sixteen strains during the screening were found to be compatible and were introduced immediately in the extracts. These were then set out for testing trials.
- Using the extracts, there is a significant increase in the yield of okra and soybean with 4.74 tons/ha and 0.40 tons/ha respectively.
- Other crops like hot chili pepper, eggplant, corn, cucumber, and bitter gourd also exhibited promising increases with a dropping number in the use and practice of chemical fertilizers in the field.

Yeast as Biocontrol Agent of Postharvest Diseases of High-Value Vegetables – Eggplant (*Solanum melongena*) and Pepper (*Capsicum sp.*) and Fruit – Mango (*Mangifera indica*) and Banana (*Musa sapientum*) Crops

- The UPLB-BIOTECH developed a yeast biocontrol agent to avoid or even eliminate further usage of chemical-based treatments on postharvest diseases.
- Yeast antagonists were isolated, characterized, and screened, and later on, underwent selection for the best yeast antagonist. This selected yeast will then be one of the key players for the development of a biocontrol product.
- Of the five yeast isolates, HWTY showed the best results with cornstarch as its carrier. It did not show any rotting and was proven to suppress the growth of the anthracnose disease which suggests that it can significantly extend the mango's shelf life as per field trials in Batangas.

Adoption and Utilization of Organic Vegetable Farming Technology for Smallholder Farmers in Barangay Kapatagan, Digos City, Davao del Sur

- The main goal of the project is to provide demonstration of organic farming as a sustainable livelihood and source of income in farming communities.
- The project employed community participatory approach for the development and management of proposed facilities, the use of good agricultural practices through the partnership with other agencies, and the adoption and promotion of organic farming package of technologies that will aid in the organic certification for vegetables.
- The demonstration was proven effective through organic farming methods and the use of only organic fertilizers, pesticides, and bio pest control.
- Results show that initial farm crops yield of organic farm are lesser compared to conventional farming. Farmers continues the organic farming practice because of the increased demand and strong preference of the market towards organically grown crops.
- Overall, the practice was considered good for the environment especially to the groundwater resources of this watershed area. Farmers' continuous use of organic fertilizers and pesticides in the cropping systems improved the soil's component.

Upscaling of Nipa Palm Sugar Processing Technology in Selected Coastal Barangays in the Province of Surigao del Sur, Agusan del Norte, and Oriental Mindoro

- Following the success of the project, "Adoption and Utilization of the Nipa Palm Sugar Technology," the Foundation for Rural Enterprise Ecology Development of Mindanao (FREEDOM), Inc. undertook this study to sustain the interest and presence of nipa palm sugar in the market.
- The project aimed to provide additional and viable income for the tappers, fishers, and wine processors in the project locations.
- Sitio Ipil Wine Makers Association, the beneficiary of the initial project, handled the training of other communities and interested parties for a structured marketing and production system while continuously receiving technical guidance from FREEDOM Inc. for quality assurance and marketing service.
- The quality of the nipa palm sugar produced in Butuan City improved in terms of texture, color, and taste compared to the sugar produced in Lanuza.
- The project has established linkages and partnerships with local stores in Davao, Calapan City, Butuan City, and Metro Manila.
- Information materials in English and Visayan were developed and a multilingual processing video was produced.

Climate Change R4D Program

To address the challenges and threats posed by the changing weather patterns affecting agricultural productivity, the Climate Change (CC) R4D Program funded research initiatives that focused on short- and long-term adaptation strategies and mitigation options that strategically targets issues connected with climate change.

The program followed the policy thrust of the DA CC Program which is anchored on two pillars: mitigation and adaptation, with adaptation as the anchor strategy and mitigation measures as a function of adaptation.

The CC R4D Program is in support of the Republic Act No. 9729, otherwise known as the Climate Change Act of 2009, which mandates the mainstreaming of climate change in policy formulation of programs and projects, plans and strategies, and policies.

PROJECT INVENTORY

11 Completed 8 New 4 On-going

Total funds released
PhP 12,594,489.47

Climate risk vulnerability assessments

Assessing the climate risk vulnerability of agricultural areas is critical to identifying the necessary measures to be taken and implemented. Thus, the following research institutions with funding support from the bureau have assessed climate risk vulnerabilities across the country:

International Center for Tropical Agriculture (CIAT)

- Conducted climate risk vulnerability assessment (CRVA) in seven provinces, namely Benguet, Oriental Mindoro, Agusan del Norte, Lanao del Sur, Zamboanga Sibugay, Western Samar, and Cebu. The project team have identified key climate risks for the agriculture and fisheries sector; assessed vulnerability target farming system and agricultural landscapes; and analyzed the relationship of pest and disease, crop, and climate through data science approach.
- Updated the country profile through the inclusion of additional information from seven regions and the CRVA summaries by priority commodities, systems and sectors based on the country's three major island groups—Luzon, Visayas, and Mindanao. These climate risk profiles define value chains, farming systems, and geographic areas that are highly sensitive and exposed to climate factors, and then assess the programmatic interventions and institutional capacity to deliver adaption options to help farmers cope with climate risks and vulnerabilities.
- Developed 10 CRA technical briefs that highlight the benefits of adopting climate-resilient agriculture (CRA) practices over conventional non-CRA measures; and 10 CRA investment briefs which present a visual comparison of farm scenarios with(out) CRA coupled with indicators of profitability and estimates of investment requirements.

University of the Philippines Los Baños Foundation Inc. (UPLBFI)

- Documented and assessed the existing upland farming systems and practices in Benguet. The research team examined the farming practices with emphasis on soil conservation measures employed.
- Validated the climate change adaptation strategies of the local and indigenous agriculture and fisheries communities while harnessing the potential of local communities and their knowledge.

PHOTO COURTESY OF CIAT

Climate adaption protocols and tools

UPLBFI has developed a protocol on participatory climate change adaptation using watershed approach. The protocol includes process-based technology: 1) critical process in watershed management, particularly in sustaining ecosystem services that the watershed provides; 2) recommended methods in assessing biophysical, institutional, and socio-economic aspects of the watershed, particularly its risk and vulnerability to climate change; and 3) process in setting-up pilot communities to develop and implement community-based adaptation strategies and suggestions on scaling it up.

This project could contribute to the development of local plans of concerned local government units and to enhance the implementation of the guidelines in the preparation of the integrated watershed management plan.

UPLBFI also developed the Increasing Community Awareness and Resilience Enhancement (ICARE) tool to capacitate the fishing communities and enable them to collaborate on strategies to improve community resilience. This project was implemented in the major lakes in Luzon—Laguna de Bay, Taal Lake, Naujan Lake, Buhi Lake, and Bato Lake.

The ICARE tool consists of the following: 1) community characterization (socio-economic, KAPP); 2) awareness-raising on effects of climate change; 3) problem identification, prioritization and developing strategies; and 4) participatory resiliency action planning. CIAT, on the other hand, have developed monitoring and evaluation methodologies, management systems and results to systemized efforts in monitoring and evaluating CRA outcomes.

The development of a systematized M&E system can help in the decision making process, learning and scaling of the interventions like CRA. Scaling CRA could then build climate resilience in agriculture and fisheries communities.

CIAT also came up with a cost-benefit analysis to determine the relative profitability of alternative cropping practices, involving the comparison of the annual flow of incremental net benefits with that of incremental costs. It ensures evidence-informed investment planning and decision-making by key stakeholders.

Further, the CRVA framework was translated into CRA Practitioner Guide to help the DA regional offices to implement the CRVA in the remaining provinces.

CRA practices

With adaptation as the anchor strategy of DA CC Program, CRA technologies are crucial to enhance the capacity of the community to adapt to climate risks.

The CRA practices introduced to the farmers in Cagayan Valley region are the alternate wetting and drying with observation wells, direct seeding, adoption of hybrid seeds, dragon fruit production at embankment of the Small-water Impounding Project (SWIP), SWIP-based tilapia production, and crop diversification. Meanwhile, farmers in the Central Luzon region were taught to use stress tolerant varieties and observe crop rotation, crop diversification, and water conservation technologies.

Further, the UPLB developed and produced good quality biochars as soil amendment to improve soil quality and soil health. It includes: 1) slow-release biochar fertilizers which is a pelletized biochar embedded with fertilizers that will supply nutrients throughout the growing season and avoid leaching losses, and 2) enriched biochar-fertilizer blend to improve soil properties and enhance soil resilience to climate change and reduce greenhouse gas emission.

UPLB found that the production and application of biochar have great potential in carbon sequestration, biofuel production, and improvement of soil fertility, quality, and health.

Livestock gas emission contributes to the greenhouse gas emission warming the planet. Caraga State University has developed a feeding system and identified cattle breeds that are efficient, cost effective, and low in greenhouse gas emission. They also looked into the effect of indigenous microorganisms, bio-charcoal, and carbonized rice hull in mitigating greenhouse gas.

Aside from producing environment friendly cattle, the project can be used as evidence in crafting or amending environmental policies, laws, and guidelines. It could also serve as a starting point for other research and innovation on green agriculture technologies.

Biotechnology Program

Biotechnology is an essential and innovative tool that can be utilized to address pressing challenges of the agriculture and fisheries sector by developing and improving current technologies and methodologies that increase agricultural productivity and efficiency. Apart from these opportunities, biotechnology has also paved the way for farmers and fishers to apply advanced tools and practices that promote food security, competitiveness, and resilience to climate change, and inclusive development.

Seeing the potential of biotechnology in the agriculture and fisheries sector, DA-BAR, through the DA-Biotechnology Program Office (BPO), provides support in funding priority R4D projects and activities of various partner research institutions and implementing agencies including the National Academy of Science and Technology, UPLB-National Institute of Molecular Biology and Biotechnology, state universities and colleges, and private organizations.

While DA-BAR handles the program's fund management, the DA-BPO facilitates coordination, monitoring, and evaluation of biotechnology projects and activities under the program components: Biotechnology Research and Development; Institutional Capacity Enhancement; Policy Research and Advocacy; and Information, Education, and Communication.

PROJECT INVENTORY

5 Completed 12 New 36 On-going

Total funds released
PhP 127,412,020.37

Biotechnology R4D

Molecular Markers for Identification of Philippine Bemisia tabaci Biotypes and their Associated Endosymbionts

- Identified molecular markers and identifications for Philippine *Bemisia tabaci* (silverleaf whitefly) and its associated endosymbionts to help design proper management tactics to control pests and its infestation to crops for biosecurity and increased yield for corn farmers

Proficiency Testing and Validation of the Developed PCR-based Detection Protocol of Salmonella in Meat Samples

- Produced proficiency-validated protocol to detect Salmonella in meat products to prevent and manage its infestation for minimizing its effects in the market that may harm the consumers purchasing meat and related agricultural products

Harnessing Philippine Actinobacteria for Natural Organic Insecticide Production through Utilization of Coconut Waste Phase II

- Discovered possible insecticidal compounds and economically feasible production technology which can be used as a substitute for imported insecticides in the local market
- Can expand the range of controllable measures for containing emerging insect pests and managing insect resistance in conventional and transgenic crops

Policy Research and Advocacy

Apart from the technologies produced through Biotech R4D, the DA Biotech Program enabled DA regulators and officials to participate in various local and international policy conferences, fora, and related activities. Activities included the FAO Genetically Modified Food Platform, ASEAN Genetically Modified Food Testing Network, and High Level Policy Dialogue on Agricultural Biotechnology—all of which have been venues for discussions to be abreast with updates and trends on the field. The DA-BPO also conducted research and inventory of pending legislative measures relevant to agricultural biotechnology.

Institutional Capacity Enhancement

In 2019, the DA Biotech Program Office initiated steps toward strengthening the capability of R&D and regulatory agencies of DA as well as other partner institutions implementing agri-biotech research and innovation. These included the development of Progressive Manpower Enhancement Program (PMEP) and Non-Degree Support Program (NDSP).

The Program's PMEP aims to institutionalize a continuing training program for researchers, technology managers, science communicators, policy officers, and regulators on agricultural biotechnology. The pilot implementation of the regulatory track, which focused on genetically modified animals' regulations, commenced in early 2019. The trainees of the pilot implementation included 27 regulators from 10 agencies.

Meanwhile, NDSP aims to enable participation of DA scientists and researchers in international scientific conferences on agricultural biotechnology. Participation in such should aim to present research outputs for peer review and information-sharing, advance knowledge, expand R&D networks, and establish research collaborations. The NDSP guidelines is under review for further refinement.

Recognizing the importance of preparing the next generation of experts on the use of agricultural biotechnology, the DA Biotechnology Undergraduate Scholarship Program provides financial assistance to academically gifted but financially challenged students who are pursuing agricultural biotechnology and related courses from UP Los Baños, UP Visayas, University of Southern Mindanao, Visayas State University, and Central Luzon State University.

In 2019, a total of 64 scholarship grants were provided and 27 scholars graduated with honors, of which three were *magna cum laude* and eight were *cum laude*.

Information, Education, and Communication

At the ground level, seminars were implemented to promote biotechnology awareness among DA officials and regional field officers, farmers, policymakers, and high school and college students. IEC materials in major dialects were also developed and distributed.

The 15th National Biotechnology Week was held on 25-29 November 2019 with the theme, "*Bioteknolohiya para sa Kalikasan, Kalusugan, Kagandahan, Kabuhayan, at Kaunlaran–Biotek: Makabagong Solusyon sa Kalusugan*." An exhibit at the DA main office lobby showcased current biotech R4D initiatives and supported technologies.

R4D Grants and Support Services

Human Resource and Development Program

To enhance the capabilities of the R4D workforce, the bureau through its Human Resource Development Program (HRDP) offers grants to members of the National Research and Development System in Agriculture and Fisheries (NaRDSAF) who want to pursue an undergraduate, graduate, or postgraduate degree. HRDP constitutes the Degree Scholarship Program, Non-degree Support Program, Thesis/Dissertation Support Program, and Undergraduate Scholarship Program.

In 2019, six researchers and employees were supported through the Degree Scholarship Grant.

Table 1. List of researchers and employees supported through the Degree Scholarship Grant

Name	Agency	Degree
Clarissa B. Jamilo	DA-Central Visayas	PhD Horticulture
Marry Joy P. Flores	DA-Zamboanga Peninsula	PhD Plant Pathology
Gari Pellinor U. Hernandez	DA-Bureau of Agriculture and Fisheries Standards	MS Animal Science
Dario M. Huelgas	DA-CALABARZON	PhD Soil Science
Marie Joy M. Daguro	DA-Central Luzon	PhD Agricultural Entomology
Alvin L. Fontanil	DA-Bureau of Agricultural Research	MS Horticulture

Further, the bureau has provided financial support to 40 researchers and employees for their attendance and participation in agriculture-related R4D conferences, seminars, training, symposia, workshops held locally and internationally.

Meanwhile, four dissertations were supported:

1. Genetic Diversity of Viral Nervous Necrosis (VNN)–T4 Region Sequence in Commercially Important Aquaculture Species in the Philippines
2. Assessment of the Climate Change Impacts on Dependable Flow and Potential Irrigable Areas in Selected Regions in the Philippines using the SWAT Model
3. Effects of Commercial Feed Containing Cadmium on Haematology, Plasma Metallothionein, Gastrointestinal Tract of Philippine Native Pigs (*Sus scrofa* L.) and the Potential Mitigation by Trichanthera (*Trichanthera gigantea* (Humb. & Bonpl.) Nees)
4. Optimum Fertilization Under Innovative Water Management of 3 Peanut Varieties Towards Attainment of Optimal Yield Under Light Soil Condition of Region 2

Through the Undergraduate Scholarship Program, 16 scholars received their degrees from the Colleges of Agriculture and Food Science and Development Communication of the University of the Philippines Los Baños. Five of these scholars finished with latin honors.

Table 2. List of DA-BAR scholars who graduated with latin honors

Name	Degree	Latin Honor
Samantha Johanna T. Timbreza	BS Development Communication	*Magna Cum Laude*
Stephanie Edora P. Manrilla	BS Development Communication	*Cum Laude*
Marleth B. Temporal	BS Agriculture	*Cum Laude*
Vanessa Kate I. Alvarez	BS Agricultural Biotechnology	*Cum Laude*
Lermarie S. Bautista	BS Agricultural Biotechnology	*Cum Laude*

Gawad Saka Search for Outstanding Agricultural Scientist and Researcher

The bureau annually facilitates the conduct of screening, field validation, deliberation, and evaluation, as well as the presentation of Gawad Saka Search for Outstanding Agricultural Scientist and Researcher nominees to the Board of Judges.

In 2019, Engr. Roger O. Bagaforo, chief science research specialist of DA-Zamboanga Peninsula, won the Gawad Saka Search under the Outstanding Agricultural Researcher (OAR) category.

OAR finalists were Agapito N. Regulacion, agricultural center chief of DA-Davao Region; Lorena V. Duna, senior science research specialist of DA-Northern Mindanao; and Librada L. Fuertes, senior science research specialist of DA-Zamboanga Peninsula.

R4D Facilities Development Program

In 2019, 11 R4D facilities were inaugurated: Nanotechnology R&D Facility at Central Luzon State University, Nueva Ecija; Cacao Processing Center, Artificial Insemination Center for Dairy, and Multipurpose Facility in Support to Climate Change R&D at Isabela State University, Isabela; Bio-organic Waste Conversion Facility at Benguet State University, Benguet; Organic Agriculture Research, Development, and Extension Center (OARDEC), Technology Hub and One-Stop Shop, and Plant Health Clinic at University of the Philippines Los Baños, Laguna; three Plant Genetic Resources (PGR) centers in Davao, CALABARZON, and MIMAROPA regions; and at Isabela State University, Isabela.

The country's first ever Nanotechnology R&D Facility contains state-of-the art equipment, sample products, and prototypes for nanotechnology in the Science City of Muñoz, Nueva Ecija.

The PGR Center will serve as a repository of crop germplasm for the management and conservation of plant genetic diversity in every region. With the goal to strengthen plant breeding efforts, the said facility also aims to build the capability among scientists, researchers, and other stakeholders.

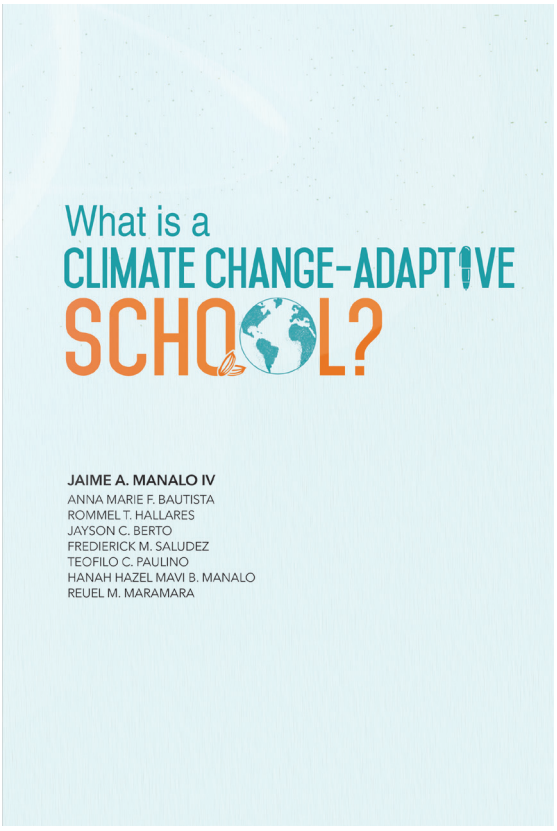
Aside from being a "one-stop-shop" that caters to the promotion of technologies to the public, the UPLB OARDEC also serves as a training ground for partner-beneficiaries, as well as a venue for the conduct and practice of capability building, strategic RDE, among others related to organic agriculture. The same goes with the university's other Technology Hub and One-Stop Shop whose goal is to promote and process information as regards to the housed agricultural technologies and products of UPLB—especially those generated through R&D.

As part of the initiatives of BSU to boost the productivity and improve the organic practices of stakeholders, the newly-established Bio-organic Waste Conversion Facility of BSU aims to improve and increase the quality and production rate of bio-organic compost in the area.

Scientific Publication Grant

The bureau supported 16 R4D undertakings for the agriculture and fisheries sector initiated by institutions, organizations, and scientific and professional societies under the Scientific Publication Grant (SPG). These include: nine conferences, symposia, and workshops; four knowledge management (KM) projects; and three book projects.

Among the KM projects that received funding support through SPG were the following: support services with the Philippine Agricultural Journalist; documentation and telecast of CPAR activities; production of video documentaries and information, education, and communication materials for research for development projects; and the compendium project of DA-Cagayan Valley.



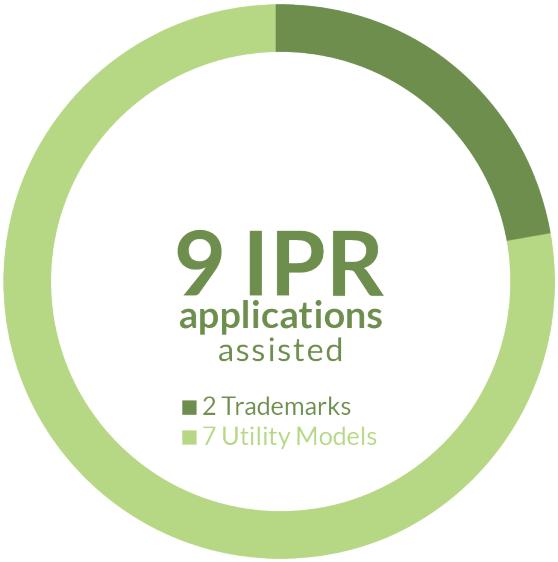
The completed book project "What is a Climate Change-Adaptive School?" is an account of the success of the DA-Bureau of Agricultural Research-funded project titled "Development of Agriculture TecVoc High Schools Offering Crops Production as Information Hubs on Climate Change-ready Rice Production Technologies for Improved Agricultural Productivity."

Twelve high schools located across the country were engaged to conceptualize a climate change-ready school. A climate change-adaptive school was then defined as "schools that are able to offer ways to adapt to the impacts of weather extremes, such as drought and floods."

Intellectual Property Support

In order to protect and safeguard the intellectual properties (IPs) developed by partner R4D institutions, the bureau offers assistance on securing IP rights (IPR). IP management includes novelty spotting, evaluation of projects with IP potential, drafting of applications that follow Intellectual Property Office (IPO) requirements, compliance with the IPO findings, and corrections of findings to meet the examiner's preferences.

In 2019, assisted IPR applications were awarded during the 15th Agriculture and Fisheries Technology Forum and Product Exhibition on 16 August 2019.



Trademarks

Registration No.: 4-2018-007433
MECHANEW
Jose Rizal Memorial State University
Tampilisan, Zamboanga Del Norte

Registration No.: 4-2018-008923
Jo's Chocolate
OPTIONS, Inc.
Sto. Tomas, Batangas

Utility Models

Registration No.: 2-2017-000046
Process of Eliminating Fishy Flavor from Tilapia *(Oreocheomis niloticus)*
Central Luzon State University

Registration No.: 2-2017-000796
Process for Making Shelf Stable Citrus Fruit Leather
Nueva Vizcaya State University

Registration No.: 2-2017-000797
Process Producing Citrus-Tomato Juice
Nueva Vizcaya State University

Registration No.: 2-2017-000798
Process Producing Carrot-Citrus Juice
Nueva Vizcaya State University

Registration No.: 2-2017-000799
Process for Producing Conserve with Mandarin Pomace and Rind
Nueva Vizcaya State University

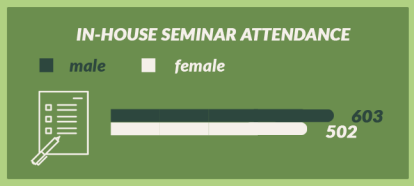
Knowledge Management

The bureau's KM program focused on information and technology dissemination in collaboration with technology generators and adopters in the field. As such, knowledge products were disseminated using different media platforms to hasten and maximize dissemination.

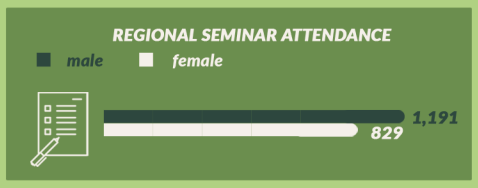
Seminar Topics

JAN FEB MAR APR MAY JUN JUL

SEP OCT NOV DEC



REGIONAL SEMINARS



Publication & IEC Materials

- 201 articles written
- 48 media releases sent
- 12 speeches written
- 419 media engagements
- 134,489 IECs produced and distributed
- 13 regular & 12 special publication
- 53 articles published in major dailies
- 29,748 publications mailed

Social Media Fast Facts

- 3,548 photos posted
- 186 photo releases published
- 37 articles shared
- 41 technologies featured
- 47 videos produced
- 237 announcements created

Institutional Updates

About the Bureau

The **Bureau of Agricultural Research** is an attached agency of the Department of Agriculture (DA) tasked to coordinate agriculture and fisheries research and development and ensure the application of its full potential to improving the sector. It was created in 1987 through Executive Order 116 to ensure that agricultural research is coordinated and undertaken for maximum utility to agriculture. It is mandated to tap farmers, farmers' organizations, and research institutions, including state universities and colleges in the conduct of research for the use of the DA particularly, the farmers and fishers.

Vision
The Department of Agriculture-Bureau of Agricultural Research is the lead Research for Development (R4D) coordinating agency towards a technology-empowered agriculture and fishery sector contributory to inclusive growth.

Mission
We coordinate, integrate and manage the Research for Development (R4D) system to ensure its optimum utility for the agriculture and fishery sector.

Values
Integrity
To always put the public's interest at heart at the same time act with honesty and transparency

Accountability
To acknowledge and take appropriate actions for every error made whether big or small

Commitment
To continuously find a purpose in the work we do for the common good of our stakeholders—researchers, scientists, farmers, and fishers

Professionalism
To exhibit proper work ethic by focusing on what's ahead and recognizing each other's differences as significant input to operationalize the goals of the bureau, the department, and the nation

Innovation
To ensure that the learning environment and the collaboration space allow its people to learn and be creative, even with ideas and practices beyond the status quo

2019 Financial Overview

Php 1,005,552,000

total funds received out of the **2019 General Appropriations Act** in support to the bureau's operations and R4D programs, activities, and projects

OBLIGATIONS

Php 1,005,012,410 incurred and committed to be paid by the bureau from the total fund allotment

DISBURSEMENTS

PhP 965,008,840 released by the bureau as payment for the obligated fund allotment

PROGRAM FUND

Distribution (in Php millions)

allotted | obligated | disbursed

National Rice Program
includes rice basic and applied researches, CPAR rice-based researches, and rice-related IEC materials and activities

407.50 M
407.49 M*
377.20 M

Various Research and Development
allocated under DA-BAR's AFMA funds and includes projects under NTCP, CPAR, Research Facilities Development Grant, livestock and poultry, aquaculture and fisheries, climate change, policy researches, and scholarship grants

225.59 M
231.02 M*
227.55 M

Biotechnology Program
allocated under DA-BAR's AFMA funds and includes basic researches on biotechnology

135.00 M
129.57 M*
133.32 M

High Value Crops Development Program
includes high value crops basic and applied researches and NTCP high value crops-based researches

105.36 M
105.34 M*
101.09 M

National Corn Program
includes corn, cassava, and sorghum basic and applied researches as well as NTCP and CPAR corn, cassava, and sorghum-based researches

85.00 M
84.99 M*
79.31 M

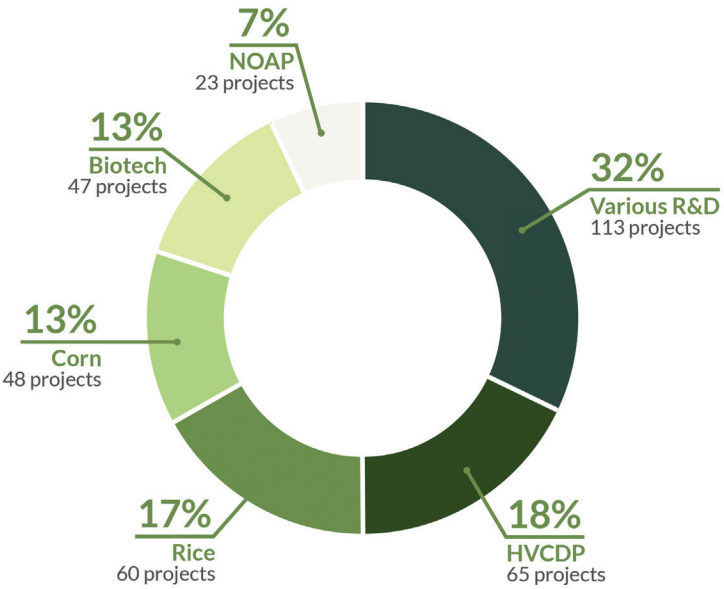
National Organic Agriculture Program
includes organic agriculture basic and applied researches, NTCP organic-agriculture based researches, organic agriculture research facilities and equipment, and organic agriculture-related IEC materials and activities

47.11 M
46.59 M*
46.53 M

** annual obligations incurred as computed in Finance Division's Summary Sheet of 2019 Fund Utilization Status*

356 R4D projects funded nationwide

which include both new and and ongoing projects under banner programs and national commodity programs



DA-BAR receives award for financial accomplishments

The Department of Agriculture-Bureau of Agricultural Research (DA-BAR) is one of the awardees for the 'CY 2019 Subproject (I-BUILD and I-REAP) Financing Disbursement Target' on 16 January 2020 at the Bureau of Soils and Water Management Convention Hall, Diliman, Quezon City.

DA-RFO 1 (Ilocos Region) and DA-BAR were placed first in disbursement with percent accomplishments of 95.3 and 92.6, respectively.

Regions 1, 2 and BAR got 100 percent obligation of their respective budgets. (Source: DA Region 2 - Cagayan Valley)

Quality Management

On 13 August 2019, the bureau officially received its ISO 9001:2015 Quality Management System Certification from TÜV Rheinland. This strengthened the bureau's commitment on consistently providing quality services for the agriculture and fisheries sector.

Strategic Planning Workshop

To revisit its current vision and mission and assess collectively whether the same statements will represent the direction and path the bureau would like to take for the next five years, the DA-BAR conducted its first Strategic Planning Workshop on 2-3 December 2019 in Clark, Pampanga.

The workshop was attended by key officials and selected staff of the bureau. Audie Masigan, subject matter expert on strategic planning management of the Civil Service Commission–Civil Service Institute, served as the workshop resource and facilitator.

Part of the said workshop included the discussion of perceived strengths, opportunities, aspirations, and results of the bureau, as well as the analysis of its strengths, weaknesses, opportunities, and threats. Further, the lead and lag indicators of each division were also discussed, while a pre-test and post-test were given to all DA-BAR's officials and staff as part of measuring their stock knowledge and understanding of the topics discussed.

To further chart its future direction and path, an internal workshop and outputs consolidation served as the closing activity of the Strategic Planning Workshop. The activity was conducted in preparation for the crafting of the Strategic Plan 2020-2025 in compliance with the ISO 9001:2015's and oversight's requirements.

International Partnerships

DA, BAR, AFACI forward agri-tech projects and knowledge-sharing

One of the bureau's international partners that continue to support DA's thrusts, the Asian Food and Agriculture Cooperation Initiative (AFACI) is an intergovernmental and multilateral cooperation body aimed to improve food production, realize sustainable agriculture, and enhance extension of Asian countries by sharing knowledge and information on agricultural technology.

AFACI-ATIN Project

DA-BAR serves as the partner organization for the Philippines in the AFACI-funded project titled, "Establishment of Agricultural Technology Information Network (ATIN) in Asia," that aims to facilitate web-based agricultural information, knowledge, and technology sharing among its 14 member countries: Bangladesh, Bhutan, Cambodia, Indonesia, Kyrgyzstan, Lao People's Democratic Republic, Mongolia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam, and South Korea.

In its third year of implementation, DA-BAR fosters its commitment to the project through its initiatives in communicating technologies and promoting its access to stakeholders which include farmers, fishers, researchers, students, and agripreneurs. The bureau consistently maintains its database of agricultural information; packages for print and uploads information, education, and communication (IEC) materials to its online platforms; and shares information through in-house, regional, and international seminars.

For 2019, DA-BAR coordinated five on-going AFACI projects with DA operating units:

1. Development of Vegetable Varieties in Asia (Bureau of Plant Industry-Los Baños National Crop Research, Development, and Production Support Center)
2. Development of Soil Atlas of Asia and National Soil Information (Bureau of Soils and Water Management)
3. STR Project of Philippines (Philippine Rice Research Institute)
4. Establishing a Cooperative Network of Pest Control in Asia (IPM, Step 4) (Philippine Rice Research Institute)
5. Agricultural Products Processing Technology Development (APPT) (Philippine Center for Postharvest Development and Mechanization

Since 2010, DA through the bureau has coordinated 19 projects under AFACI from which 14 are completed. Dr. Nicomedes Eleazar, DA-BAR director, serves as the AFACI national representative while Julia Lapitan, head of the bureau's Applied Communication Division, serves both as the national contact person and the principal investigator of the AFACI-ATIN project.

DA and IRRI strengthen partnership on rice R4D technologies

DA continues its partnership with the International Rice Research Institute (IRRI), the world's premier rice research organization for scientific and technical collaboration in support of enhancing the Philippine Rice Industry Competitiveness.

The DA-IRRI R4D partnership, which started in 2012, was renewed in 2019. To strengthen this partnership, a Memorandum of Understanding was signed between DA and IRRI on 13 February 2019 in Diliman, Quezon City.

Science-based solutions on integrated crop and nutrient management, pest and disease risk factor mapping and analysis for appropriate management strategies and tactics, water management and decision support tool for irrigation scheduling and advisory service, advancements in breeding tools and methodologies for accelerated introduction and adoption of higher-yielding rice varieties with resistance and tolerance to biotic and abiotic stresses, and embedded capacity building activities for the corresponding R4D were the major activities pursued under the renewed partnership. Correlatively, DA-BAR as the lead R4D arm of the DA, plays a crucial part in this endeavor specifically in the coordination and utilization of these R4D initiatives.

As one of the key partners of IRRI, DA-BAR, together with the DA National Rice Program, DA-Philippine Rice Research Institute, DA-Agricultural Training Institute, DA-Bureau of Plant Industry, DA-Bureau of Soils and Water Management, and the DA regional offices, have been implementing rice R4D projects that are vital and supportive to continuous and technology generation, development, and promotion.

DA-BAR and SEARCA collaborate for R4D innovation, capacity, and value-chain enhancement

The bureau has continuously engaged with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in strengthening institutional policies and capacities for the Philippine R4D community of the sector. This partnership actualized through R4D projects has brought wider opportunities of knowledge acquisition and sharing in the field of the agriculture and fisheries benchmarking from the best practices across the Southeast Asian Region.

Enhancing Innovation in Agricultural Research and Development

Started in January 2018 and completed in December 2019, this policy project is a vital reference in strengthening the bureau's role on agri-fishery R4D with its vision to be the lead R4D coordinating agency towards a technology-empowered agriculture and fishery sector contributing to inclusive growth. It is imperative to examine what should be further pursued by a strategic R4D program in attaining the bureau's long-term goals.

Funded with PhP 6,932,444.95, this policy project was able to identify critical gaps and needs in agricultural research and development vis-à-vis the innovations for the advancement of RDEAP and the Agricultural and Fisheries Modernization Program: capacity gap, incentive gap, demand side/ perception gap, and funding gap.

Apart from the gaps identified, the project also packed policy and program recommendations to enhance agri-fishery research and development innovation which include the following:

1. Knowledge-based innovation systems addressing technology readiness, research commercialization incentives, and match-making capability
2. Network-inclusive policy and development investments for technologies
3. Holistically developed research capacity
4. Research foresight capacity building activities
5. Business-oriented agricultural development programs
6. Government portal or database facilitating collaboration among various sectors

Financial Viability and Profitability Analysis of Agricultural Technologies and Enterprises

Funded by DA-BAR with PhP 9,990,200.00, this ongoing project with SEARCA aims to package monographs with financial viability manual of technologies and enterprises of selected agricultural commodities and equip partner R4D institutions in conducting financial viability and profitability analysis.

To date, 12 monographs on technology and investment profiles for nine commodities with 34 products are being finalized. Along with this, the "Financial Viability Manual of Technologies and Enterprises of Selected Agricultural Commodities: A Training Manual," which was initially launched in 2018 is also being updated for the publication of the second series.

The project was able to conduct a series of training-workshops on financial viability and profitability analysis for more than 180 participants from various R4D implementing agencies and local government units since the program began in 2017.

For 2019, three batches of the training workshops were conducted which were held on 18-23 February, 3-8 June, and 21-26 October in Los Baños, Laguna. Workshop outputs delivered were profitability and financial viability analyses of the technologies developed using the participating agencies' research project data set on high value crops, soybean, livestock, and poultry.

Through these series of training-workshops, DA-BAR provided a capability training enhancement program that packages and shares relevant results to the agricultural sector. This resulted in strengthening the National Technology Commercialization Program that focuses on upscaling and outscaling technologies, and strategically positioning them to areas and communities where they are most needed.

SEARCA continuously serves as one of the active partners of DA-BAR in effectively providing capacity building facilities that translate in helping and guiding agripreneurs on the viable and profitable investment strategy.

DA, BAR, and FAO on conserving agro-biodiversity

To ensure the smooth implementation of the GCP/ PHI/062/GFF project, the DA-BAR and the United Nations Food and Agriculture Organization (FAO) conducted the 4th and 5th Project Steering Committee Meetings in January and July 2019, respectively.

The project titled "GCP/ PHI/062/ GFF: Dynamic Conservation and Use of Agrobiodiversity in Traditional Agroecosystems of the Philippines" is funded by FAO through the Global Environment Facility. DA-BAR, as supported by the Project Management Coordination Unit, serves as the executive partner and lead agency in the overall project implementation.

The project aims to enhance, expand, and sustain the dynamic conservation practices to sustain globally significant agro-biodiversity in traditional agro-ecosystems of the Philippines—specifically, to conserve globally-important crops like rice, mungbean, taro, yam, banana, abaca, among others, in traditional agro-ecosystems nationwide.

Among the meeting components include mainstreaming the agrobiodiversity conservation into policy and legal frameworks, enhancing and expanding dynamic conservation practices for agro-biodiversity in three pilot communities in Hungduan and Hingyon, Ifugao; and in Lake Sebu, South Cotabato, and disseminating the documented good practices to other areas.

As part of the planning activity of the project, DA-BAR conducted the "Research and Development Project Scoping: DA-BAR Initiative for the Municipalities of Hungduan and Hingyon, Ifugao" on 20-21 March 2019 in Ifugao.

The project scoping assessed possible and timely R4D proposals, which can be catered under National Technology Commercialization Program and Community-based Participatory Action Research, from the stakeholders in the municipalities of Hungduan and Hingyon. There is a great opportunity to improve the economic conditions among the communities; hence, resulting in the communities' increased economic opportunities and development sooner or later.

BAR, PRRI, and IRRDB strengthen rubber production and industry

The International Rubber Research Development Board (IRRDB) is a research and development network which brings together natural rubber research institutes in nearly all the natural rubber producing countries, covering 95 percent of the total world natural rubber production. It was established to coordinate the work of national institutes and undertake commercial development of research findings on natural rubber.

DA-BAR, together with the DA-Philippine Rubber Research Institute (PRRI), is the representative of the DA to the IRRDB. As a member, the Philippines has been accessing the benefits of collaboration such as trainings for researchers, exchange of information and expertise, and germplasm collection as part of the multilateral agreement:

2019 International Rubber Conference and Annual Meetings

Organized by IRRDB and held and hosted by a member country, the annual International Rubber Conference (IRC) provides opportunities for rubber stakeholders to deliver on the current issues and future challenges of the natural rubber sector and exchange ideas to devise strategies and recommendations on how to cope with such occurrences. The IRC also creates opportunities to develop market linkages between R4D institutions and private sectors.

The 2019 IRC with the theme “Natural Rubber Industry: Way Forward for Competitiveness and Sustainability” was held and hosted by Myanmar on 30 September-1 October 2019. Part of this activity are the IRRDB annual meeting, the Meeting with Committee Directors and Executive officers and the Meeting of IRRDB—both of which are conducted to discuss, review, and approve plans and budget for the said year.

The IRRDB allotted USD 10,000 for the conduct of Integrated Production Management Training in the Philippines to be spearheaded by DA-PRRI in partnership with DA-BAR. The training is tentatively scheduled in May 2020.

Multilateral Clone Exhange Program

To identify potential rubber clones with higher latex from rubber producing countries adoptive and suited to the Philippine condition, the DA-PRRI, through the coordination of DA-BAR, participated in the Multilateral Clone Exchange Program.

DA-PRRI and DA-BAR facilitated this partnership from which the Philippines received 30 exchange clones from Thailand, Cote d' Ivoire, Myanmar, India, China, Ghana, and Indonesia. Twenty-nine clones were successfully planted at the DA-PRRI budwood garden in Zamboanga Sibugay. The Philippines through the two agencies, in exchange, has successfully sent USM1 clone to Cote d' Ivoire, Myanmar, India, Ghana, Thailand and Indonesia.

Since the local variety of rubber in the Philippines has low latex compared to the other rubber producing countries, this program can help provide our rubber farmers options which can help improve the quality and yield of natural rubber.

Apart from the enumerated, DA-BAR has engaged in the following international endeavors:

1. Participated as Philippine representative in determining the ASEAN CFAF and Consortium of International Agricultural Research (CGIAR)'s policy directions for global R4D agenda setting
2. Participated in the International Research Conference on Innovation, Technology, and Sustainability held on 24-25 January 2019 in Malate, Manila
3. Participated in the Seminar on Natural Rubber and Production Management in the Philippines held on 28 April-11 May 2019 in Hainan and Yunnan, China
4. Participated in the Regional Seminar on Biomass Energy Promotion in Agricultural Communities and Rural Development in ASEAN held on 24-27 July in Bangkok, Thailand
5. Participated in the AFACI Workshop on Horticulture, Extension, and Food Crops held on Phnnom Penh, Cambodia on 2-6 September 2019
6. Participated in the Global Rubber Conference held on 11-15 December 2019 in Haikou, Hainan, China
7. Prepared the cost-benefit analysis for the CGIAR, IRRI, and Centre for Agriculture and Bioscience International to the DA Foreign Affairs

31st National Research Symposium

"Gearing up the Agri-Fishery Sector through Holistic R&D towards Regenerative Development"

Held annually, the National Research Symposium (NRS) recognizes and highlights the importance of participatory research and science-based innovations in the agriculture and fisheries sector. In 2019, the bureau received a total of 199 research papers which is a 13 percent increase from the 2018's 176 entries. Further, organic agriculture was added as a new category to its roster.

In his opening message, Dr. Nicomedes Eleazar, DA-BAR director, challenges the R&D sector to be more creative and proactive in creating solutions to pursue optimum yields and improved productivity.

31st NRS Best AFMA R&D Papers and Poster

The 31st NRS looked beyond sustainability by highlighting the importance of being able to replenish resources. Incidentally, organic agriculture was introduced as an addition to the roster of categories.

The following are the gold winners during the 31st National Research Symposium:

Table 3. AFMA R&D Best Papers (Gold)

Category	R4D Paper Title	Authors	Agency
Applied Research (TG / IG) – Agriculture			
Crop Science/ Crop Protection	From Functional Genomics to Functional Agriculture: Cacao Functional Genomics to Functional Cacao Production and Varietal Improvement	Edward A. Barlaan, Emma K. Sales, and Antonio C. Laurena	University of Southern Mindanao
Engineering and Postharvest	Pectin from Mango Peels as Biodegradable/Edible Coating to Extend Shelf–life of Mango	Ma. Christina Bautista–Gragasin and Sheryl May Villota	DA-Philippine Center for Postharvest Development and Mechanization
Applied Research (TA / TV) – Agriculture			
Crop Science/ Crop Protection	Piloting of Village– Type Cacao By– products Processing Enterprise in Major Cacao Producing Area	Andres M. Tuates, Mia F. Testa, Aileen G. Carriedo, Ofero A Capariño, Gigi B. Calica, and Aina Marie de Leon	DA-Philippine Center for Postharvest Development and Mechanization
Animal Science	Newcastle Disease Dry RT–LAMP Test Kit with Competence to Differentiate Infected from Vaccinated Animals (DIVA)	Clarissa Yvonne J. Domingo, Lilet C. Cruz, and Rubigilda P. Alili	Central Luzon State University
Engineering and Postharvest	DNA-based Electrochemical Nanobiosensor for Rapid Detection of Salmonella enterica in Poultry Eggs	Francisco B. Elegado, John Edward I. Zapater, Lilia M. Fernando, Mae Joanne B. Aguila, and Florinia E. Merca	UPLB-National Institute of Molecular Biology and Biotechnology
Soils and Water Science	Soil Health Approach of Boosting Rainfed Agriculture in Sariaya, Quezon	Gondelina A. Radovan, Ronald C. Garcia, Emmanuel S. Querubin, and Eraldwin A. Dimailig	Southern Luzon State University

Table 3. AFMA R&D Best Papers (Gold) *cont*.

Category	R4D Paper Title	Authors	Agency
Applied Research (TG/IG)-Fisheries	Acute Salinity Tolerance (96–h LC50) and Growth Performance of Brackishwater Silver Therapon (Leiopotherapon plumbeus, KNER 1864) Under Varying Salinity Conditions	Mark Nell C. Corpuz and Adrian Deil C. Manliclic	Bataan Peninsula State University
Socio-Economic Research	Economic Analysis of Using Biological Control and Biofertilizer in Philippine Highland Farming: Case of Trichoderma koningii	Cheryll C. Launio, Kacy O. Labon, Alladin M. Bañez, and Ruth S. Batani	Benguet State University
Development Research	Community-Based Participatory Action Research on Sustainable Corn Production in Sloping Areas (SCoPSA) in Barangays Divisoria Sur and Divisoria Norte, Maddela, Quirino	Chonalyn A. Pascua, Lovelyn A. Gaspar, Ferdinand V. Cabantac, Archival B. Sabado, Charles Paulino, Mandy E. Yanuaria, Roselle M. Labucay, Dennie Ruma, Ariel Oarde, Fedelino R. Cabantac, and Rolando D. Pedro	DA-Cagayan Valley
Organic Agriculture Research	Increasing Productivity and Value of Heirloom Rice Landraces in the Cordillera Highlands through Variety Evaluation and Organic Production Technologies	Belinda A. Tad-awan, Hector C. Gayomba, Teresita D. Masangcay, Jasmin M. Chomawat, Wilner S. Maunting, Virginia A. Tapat, and Magdalena T. Wanawan	Benguet State University

Table 4. AFMA R&D Best Poster Awardee (Gold)

R4D Paper Title	Authors	Agency
Development of Computer Vision System (CVS) for Mango Sorting and Grading	Arlene C. Joaquin, Richard P. Avila, Maria Elizabeth V. Ramos, and Romualdo C. Martinez	DA-Philippine Center for Postharvest Development and Mechanization

Awards and Recognitions

Top-performing DA agency

As the department's staff bureau tasked to be the lead R4D coordinating agency towards a technology-empowered agriculture and fisheries sector, the DA-BAR—alongside DA-Ilocos Region and DA-Cagayan Valley—ranked first in terms of financial obligations across all DA operating units nationwide. Furthermore, DA-BAR ranked first among staff bureaus and second across all DA agencies in terms of disbursement.

Recognizing the bureau's support to research

The University of the Philippines Los Baños recognized the bureau as one of the institutions who have been providing assistance to the students during the thanksgiving ceremony held on 13 June 2019.

On 24 January 2019, the National Apiculture Research Training and Development Institute of the Don Mariano Marcos Memorial State University recognized the contribution and support of the bureau as one of its partners in the implementation of apiculture R4D.

During the University of the East CAMANAVA Studies International Conference on 8-9 February 2019, the university recognized DA-BAR for its support on science awareness and knowledge management.

Other awards and recognitions received by our partners

The Yamang Lupa Project of the DA-Eastern Visayas won the Regional Outstanding Development Project during the 31st Regional Research, Development, and Extension Symposium on 26-27 November 2019. Implemented in 2014, the project was among the R4D projects funded under the bureau's Yamang Lupa Program in collaboration with the DA-Bureau of Soils and Water Management.

The Benguet State University's project on heirloom rice won the Outstanding Organic Agriculture Research Category during the 16th National Organic Agriculture Congress held on 11-15 November 2019. The DA-Ilocos Region's project on organically grown soybean was shortlisted for the same category. Both projects were funded through the bureau's Organic Agriculture Program.

Highlighting its discussion on natural resource management, the DA-BAR funded book, Science-based Management and Upland Community in the Philippines: The Case of Mount Makiling Reserve, was one of the finalists for the Best Book in Science Category during the 38th National Book Awards held on 23 November 2019.

Dr. Artemio Salazar of the University of the Philippines Los Baños-Institute of Plant Breeding was distinguished as one of the top 100 scientists in the Asian Scientist Magazine—an award-winning science and technology magazine that highlights research and development stories from Asia to a global audience. Dr. Salazar is the program leader of the Corn Germplasm Utilization through Advanced Research and Development, a long-term program supported by the bureau and implemented by the university in collaboration with the DA-Bureau of Plant Industry and DA regional offices.

Annex

Key Officials

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Acronyms

AFACI	Asian Food and Agriculture Cooperation Initiative
AFMA	Agriculture and Fisheries Modernization Act
ASEAN	Association of Southeast Asian Nations
ATIN	Agricultural Technology Information Network
CBA	Cost-benefit Analysis
CC	Climate Change
CGIAR	Consultative Group for International Agricultural Research
CGUARD	Corn Germplasm Utilization through Advanced Research and Development
CIAT	International Center for Tropical Agriculture
CLSU	Central Luzon State University
CPAR	Community-based Participatory Action Research
CPD	Cassava Phytoplasma Disease
CRA	Climate-resilient Agriculture
CRVA	Climate Risk Vulnerabilities Assessment
DA	Department of Agriculture
DA-BAR	Department of Agriculture-Bureau of Agricultural Research
DA-BPI	Department of Agriculture-Bureau of Plant Industry
DA-BPO	Department of Agriculture-Biotechnology Program Office
DA-BSWM	Department of Agriculture-Bureau of Soils and Water Mangement
DA-PhilRice	Department of Agriculture-Philippine Rice Research Insitute
DA-PRRI	Department of Agriculture-Philippine Rubber Research Institute
FAO	United Nations Food and Agriculture Organization
FREEDOM, Inc.	Foundation for Rural Enterprise Ecology Development of Mindanao, Inc.
GIS	Geographic Information System
HRDP	Human Resource Development Program
ICARE	Increasing Community Awareness and Resilience Enhancement
IEC	Information, Communication, and Education
IP	Intellectual Property
IPR	Intellectual Property Rights
IRC	International Rubber Conference
IRM	Insect Resistant Management
IRRDB	International Rubber Research Development Board
IRRI	International Rice Research Institute
ISU	Isabela State University
KM	Knowledge Management
M&E	Monitoring and Evalation
MP Seeder	Multi-purpose Seeader
NaRDSAF	National Research and Development System in Agriculture and Fisheries
NDSP	Non-degree Support Program
NPGRL	National Plant Genetic Resources Laboratory
NRS	National Research Symposium
NSIC	National Seed Industry Council
NTCP	National Technology Commercialization Program
NTF	Agriculture and Fisheries Technology Forum and Product Exhibition
OAR	Outstanding Agricultural Researcher
OARDEC	Organic Agriculture Research, Development, and Extension Center

Acronyms

OCRM	Organic Complete Ration Mix
OFW	Overseas Filipino Worker
OPTIONS, Inc.	Organization for Partnerships, Teamwork & Initiatives on Opportunities for Nature Steward, Inc.
PCR	Polymerase-chain Reaction
PGR	Plant Genetic Resources
PMEP	Progressive Manpower Enhancement Program
PNAD	Philippine Native Animal Development
POT	Package of Technology
PRIME	Pest Risk Identification and Management Efficiency
PRISM	Philippine Rice Information System
R&D	Research and Development
R4D	Research for Development
RCM	Rice Crop Manager
RCPC	Regional Crop Protection Centers
RDE	Research, Development and Extension
RDEAP	Research and Development and Extension Agenda and Programs
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SPG	Scientific Publication Grant
SSIP	Small-Scale Irrigation Project
SSNM	Site-specific Nutrient Management
SUC	State Universities and Colleges
SWIP	Small-water Impounding Project
UP	University of the Philippines
UPLB	University of the Philippines Los Baños
UPLB-BIOTECH	University of the Philippines Los Baños-National Institute of Molecular Biology and Biotechnology
UPLBFI	University of the Philippines Los Baños Foundation, Inc.

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