

R4D *Highlights*



2022 R4D in-house review highlights calibration of agency's R4D priorities

By RHEA MAE RUBA

In continuously fulfilling the mandate of the Department of Agriculture-Philippine Carabao Center (DA-PCC) to be the lead agency in livestock biotechnology research and development, the Research and Development Division (RDD) hosted the 2022 R4D In-House, MFO-Oriented, and Special Projects Review at the DA-PCC national headquarters and gene pool, on September 21-23, 2022.

Aside from its mandate to conserve, propagate, and promote carabao as a source of livelihood and nutrition for rural farming communities, the DA-PCC proves to be a premier institution for livestock research

through its various completed and ongoing R4D initiatives.

"In this activity, there will be active discussion and thorough evaluation of

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(Linnaeus, 1758)” presented by Dr. Sarah Micah Dalisay

- Nutrition category - “Effect of Digestible Lysine to Metabolizable Energy Ratio on Growth Performance, Nitrogen and Energy Balance in Improved Philippine Mallard Ducks (ItikPINAS) from 0 to 8 Weeks of Age” presented by Dr. Julie Ross Datuin

- Disease and diagnostics category - “Persistence and Antimicrobial Resistance of Salmonella in Native Chickens: A Sustainability Challenge in the Free-range Production System” presented by Dr. Lotis Balala

- Production and processing category - “Growth and Sexual Maturity Performance of Crossbred Doe Kids Fed with Different Sources and Levels of Dietary Protein” presented by Dr. Adelia G. Putri

- Undergraduate thesis - “Genotypic Analysis of Kappa-Casein, Beta-Casein and Beta-Lactoglobulin Polymorphisms in Siquijor Native Cattle and Sahiwal x Holstein Hybrid Cattle Stocks in the Philippines” presented by Luis Alfonso Pefianco

Business meeting was also held, which updated the members on the current status of the society through the president’s report and financial report. Induction of new regular PSAS members and online election of new PSAS officers followed.

Newly elected officers include Dr. Claro Mingala as vice president, Dr. Maria Cynthia Oliveros as secretary, Dr. Ione Sarmago as treasurer, and Dr. Noel Lumbo as auditor. Meanwhile, new PSAS governing council members include Dr. Undine Hurtada-Quimio, Prof. Julie Ross Datuin, Dr. Mary Joy Cañolas, Dr. Manuel Gacutan Jr., and Dr. Paul Limson.

Outgoing PSAS President Dr. Jesus Antonio G. Derije handed over the gavel (symbol of authority) to Dr. Salces

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59th PSAS convention underscores growth of the animal industry

BY RHEA MAE RUBA

Once again, the significant role of science and technology (S&T) in the animal industry was highlighted during the 59th Scientific Meeting and Annual Convention of the Philippine Society of Animal Science (PSAS), hosted by the Department of Agriculture-Philippine Carabao Center (DA-PCC) on October 19-20.

Said event featured plenary and parallel sessions, which are anchored on the theme: “Inclusive Growth of the Livestock and Poultry Industry through Future-ready S&T Innovations”.

Plenary speakers included Dr. Claro Mingala for the topic “Innovative Livestock Tools for Inclusive Growth”, Dr. Noel Lumbo for the topic “Innovative Energy and Protein Substitutes for Swine and Poultry Diets”, and Dr. Ramon Maluping for the topic “Understanding the use of bacteriophage to tackle Antimicrobial Resistance”.

In his message as the Convention Chair, DA-PCC Deputy Executive Director

Dr. Caro Salces said that scientific paper presentation is the lifeblood of PSAS and that the latter is the society of choice for the researchers, extension workers, and industry key players in the livestock and poultry sector.

Meanwhile, the parallel sessions featured competing scientific papers in various categories. The winning papers include the following:

- Socio-economics category - “Measuring Economic Efficiency of Dairy Buffalo Farms in Nueva Ecija Using Data Envelopment Analysis” presented by Dr. Eric Palacpac

- Breeding and genetics category - “Development of Selection Indexes for Milk Production Traits in Dairy Goats in the Philippines” presented by Dr. Nora Cabaral-Lasaca

- Biotechnology category - “Evaluation of the Cryopreservation Protocol for the Blood Primordial Germ Cells (bPGCS) from Gallus gallus domesticus

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Kardeli's potential in the S&T and business industry

By RHEA MAE RUBA

In underpinning the collaboration of science and technology (S&T) in the business world, the DA-PCC National Headquarters and Gene Pool (DA-PCC NHQGP) showcased Kardeli carabao meat products in the Agri-Aqua Innovation Pitch Fest (AIPF) 2022 at Acacia Hotel, Alabang, Muntinlupa City, Metro Manila.

Kardeli represents a nutritious brand of meat sourced from ethically grown carabaos in an environmentally sound and hygienic production system. Its branding is derived from the words carabao (for kar) and delicacy (for deli).

DA-PCC NHQGP team, Eufrocina Atabay, Zadieshar Sanchez, Hannah Jalotjot, Alfred Sayson, Patrizia Saturno, and Jan Czarina Salas, attended the event to promote the benefits of Kardeli products, as well as to explain the network of its market which assured its possible investors.

The potential of Kardeli products in the market was introduced by the DA-PCC NHQGP team, such that it has different variants of carabao meat sausage that provide a variety of choices for consumers. It can also be utilized in various dishes, particularly for papaitan, and it can be produced as tapa and tocino.

The primary goal of AIPF 2022 is to provide the opportunity for technology innovators of the agri-aqua sector to present their research-based inventions

to potential investors, businessmen, and other stakeholders which adhere to its theme of “make science and technology (S&T) their business edge”.

It was participated in by the 21 state universities and colleges (SUCs) and five research and development institutes (RDIs) that featured their research-based inventions in the technology pitching approach that encouraged them to engage in modern business communication.

Said technology pitching also unlocked the capabilities of technology innovators in effectively communicating their developed inventions which enlightened them not to limit themselves as researchers and technology innovators.

“Delivering a concise technology and investment pitch can be extremely nerve-racking, but my genuine belief in all the attributes and causes embodied by our Kardeli brand made the pitch more manageable. To be truly proud of Kardeli and its journey as a commercial technology is something you cannot just fake. The Kardeli pitch reminded me how proud I am to belong to this institution,” underscored by Sanchez, head of BDCU and OIC of AFMD at DA-PCC NHQGP.

Kardeli is one of the research-based technologies products presented in the AIPF 2022 last December 06, 2022, that was supported by the 15 regional consortia members.

PH Livestock Expo highlights carabao as good source of meat

By MA. CECILIA IRANG-MARIANO

In dispelling the myths and misconceptions that carabao's meat is tough and darker in color, thus hindering market acceptability, the DA-Philippine Carabao Center's (DA-PCC) experts stressed that buffalo meat can be equal to, if not better than, the more popular and widely accepted beef.

Attesting to this are results of a series of studies conducted by the research team of the DA-PCC to compare the slaughter yields and carcass characteristics of crossbred buffalo and crossbred cattle at the same age and diet. It was found out that based on carcass quality evaluation, buffalo meat is comparable to beef in terms of carcass yields, processing traits, and sensory characteristics.

Dr. Arnel Del Barrio, former DA-PCC executive director, reechoed such findings in his presentation on “Potential of Buffalo Meat as Beef” during the Livestock Philippines Expo 2022.

“The DA-PCC promotes buffalo as a good source not only of milk but also of quality meat. If the male buffaloes are not fit for breeding, then they are qualified to be fattened and marketed for a good quality meat. The agency already has initiatives to develop a breeding program for buffalo meat production as well,” Dr. Del Barrio said.

As for the economic viability of carabao's meat, the Head of DA-PCC's Business Development and Commercialization Unit Zadieshar Sanchez assures potential investors of carabao fattening and Kardeli retail business that, through collaboration and available technologies, there is a ready market for their products and

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ASEAN researchers convene for livestock biotech innovation

BY RONALINE CANUTE AND GRANDE SATURNO

Understanding the use of livestock biotechnology in speeding up livestock food production to satisfy the demand of the world's growing population was the focus of the recent month-long intensive training at the DA-PCC National Headquarters and Gene Pool (NHGP) participated in by researchers from ASEAN member countries.

Said activity was conducted under the project titled "Capability building of ASEAN Biotechnology Researchers for Livestock Resiliency and Sustainability," which was held from July 4, 2022 to July 29, 2022.

Outputs of this development intervention all lead, ultimately, to boosting farmer's incomes, enhancing productivity as well as discovering better ways to manage livestock production amid climatic changes that affect the dynamics of the livestock industry.

Said training is also seen as an avenue to foster regional cooperation among ASEAN Member States (AMS) on biotechnology research for livestock resiliency and sustainability by creating an enabling scientific environment for young researchers engaged in livestock innovations.

The participants include 14 researchers (one participant each from Brunei, Indonesia, Malaysia, and Thailand; two from the Philippines; two extra slots prioritized for Cambodia, Myanmar,

and Vietnam; and two researchers from Japan). The participants underwent a screening process, while the two participants from Japan were selected in consultation with the Ministry of Agriculture, Forestry, and Fisheries (MAFF).

The activities include orientation on the general objectives of the program and current developments in the livestock biotechnology in the Philippines, in Japan, and other countries; two-day research proposal writing workshop; training on different laboratory techniques; research proposal writing for the research collaboration; and presentation of significant findings or knowledge and skills gained during the training.

Experts from DA-PCC research units and other local and international PCC collaborators who have relevant knowledge on Livestock Biotechnology were invited. Dr. Satoru Konnai from the Laboratory of Infectious Diseases, Department of Disease Control, Graduate School of Veterinary Medicine in Hokkaido University served as a resource person on the current status of livestock biotechnology research in Japan.

The participants showed their key findings, newfound knowledge, and presented their own written proposals at the end of the training. They were also required to complete a pre- and post-evaluation to identify potential learning subjects and assess new information,

abilities, and understanding they acquired over the month-long program.

"I hope that the Philippines not only imparted with you some breadth of scientific knowledge about the technologies that we have here, but also our own brand of hospitality. We are one as an ASEAN community, so we should act as one in development when it comes to sharing our knowledge and talents," said Dr. Claro Mingala, DA-PCC's Deputy Executive Director for Production and Research and Director of DA Biotech Program Office.

The final report and training results will be posted on the ASEAN-Japan Comprehensive Economic Partnership (AJCEP) website. In order to maintain the initiatives and outputs of the training, DA-PCC will also work to establish ongoing collaboration with and among AMS taking off with the research proposals generated during the training. Participants were also encouraged to submit their research proposals to AJC to continue building up meaningful scientific collaborations.

59th PSAS convention...

(From page 2)

through a short ceremony proclaiming that he will hold the duties and responsibilities as the new head of the organization from 2022-2023. Some 55 new regular members pledged an oath to share an effort in learning and engaging with the overall activities of the society. It signifies that PSAS shall continue to spread the value of S&T to the R&D community and to the animal industry.

"Let us never forget to contribute ideas and skills as it is not just about serving the economy and preventing health risks anymore. It deals with redesigning our roles as effective partners of policymakers and key decision-makers. Let us aim to be better than who we are than yesterday," Dr. De Jesus underscored. Next year, the 60th PSAS convention will be held in Bohol, hoping to have face-to-face interaction among its members.



NBW symposium tells difference of bench to business research

BY MARAH ARQUERO

Aligned with the 18th National Biotechnology Week (NBW) theme, "Responding to the Challenges: Business Opportunities in Biotechnology", today's symposium is an (NBW) build-up activity bearing its own theme entitled, "From Bench to Business: Bridging Biotechnology Updates for the Philippine Livestock Industry" on November 25-26, 2022 via a hybrid set-up at the Eusebio-Castillo Halls, DA-Philippine Carabao Center (DA-PCC) National Headquarters and Gene Pool and through virtual meeting platform.

The goal of the event's organizers, the DA-Livestock Biotechnology Center and DA-PCC's Research and Development Division, is to highlight cutting-edge biotechnologies, products derived from them, or industry-specific biotechnology applications. They also hope to explore business, trade, and investment opportunities and to educate the general public about the

advantages of biotechnology in terms of both the economy and the society.

The symposium underscored the opportunities through biotechnology and its products and by-products, which contribute immensely to agriculture and food security, equitable health care services, development of industries, business enterprises, sustainable environment, and economic development. This activity also highlighted the goal of promoting judicious use of biotechnology and bringing the scientific advancement it carries in helping improve Filipino lives.

With the challenges and opportunities presented by biotechnology to researchers in both the government and private industry stakeholders, Dr. Liza G. Battad, Executive Director of DA-PCC, calls for, "strengthened policies and advocacy for strengthened research activities" to policy analysis

and development as critical aspects of biotechnology development.

Featured presentations and open forum further highlighted how biotechnology applications can progress from laboratory benches to commercialization.

Resource persons include representatives from Technology Application and Promotion Institute, Ms. Cecil Dyann C. Daniel and Ms. Mylene A. Alano, Blitzkrieg Animal Diagnostic Center owner and veterinary medicine professor, Dr. Clarissa Yvonne J. Domingo, Commercialization and Extension Division Head of the Small Ruminant Center, Mr. Neal A. Del Rosario, Chief Technical Officer of Bionova Livestock Group, Dr. Alfonso E. Serrano, apiculture practitioner and owner of Pia's Bee Farm, Mr. Lee S. Gaitana, and Dir. Battad.

PH livestock expo highlights carabao... (From page 3)

the economic potential of this venture is very promising.

Kardeli is the DA-PCC's brand of premium carabao's meat. It is available at the Milka Krem in the Science City of Muñoz, Nueva Ecija.

Sanchez was also invited as one of the resource persons in the expo wherein he tackled the economic viability of value-added carabao meat products. "According to our ongoing study, there is a ready market for carabao's meat and opportunities for this commodity are many. To fully realize this potential, more carabao fattening farms need to be raised," he stated.

The DA-PCC has also conducted studies and breeding technologies for the purpose and ensures that the market is ready to absorb fattened animals that are about to be produced in the future.

To further prove the agency's claims on the good quality of carabao's meat, a cooking demo hosted by DA-PCC was

also held at the Livestock Expo with Chef Francis Sibal, Executive Chef of CZ Ranch Restaurant.

The Livestock Expo is considered to be the premier international trade

platform for industry stakeholders. It is organized by international exhibition expert group Informa Markets and is hosted by the Department of Agriculture.



2022 R4D in-house review... (From page 1)



the researches that will be made, reassessment, and refocusing on research priorities in directly addressing the industry problems, strategizing for a more holistic approach in doing research, and establishing connection or collaboration, especially with the peer evaluators," underscored by DA-PCC Scientist and RDD OIC Chief Dr. Marvin A. Villanueva.

Dr. Villanueva pointed out three things that the researchers must inculcate:

the focus that helps in assessing the most important, the innovation that generates continuous development including the technology transfer, and the collaboration inside and outside the agency for a more holistic approach to the projects.

Said event presented 28 R4D studies with the seven thematic areas of reproductive biotechnology, animal nutrition, institutional development, breeding and genetics, animal health,

socio-economics dimensions of CDP Implementation, and product development, wherein 13 are completed and 15 are still ongoing.

The papers were evaluated by the research experts and notable professors from the different campuses of the University of the Philippines (UP), namely Dr. Jessica D. Rey, Assistant Professor from UP-Diliman; Dr. Lotis E. Mopera, Director and Associate Professor VII from UP-Los Baños, and Dr. Pedcris M. Orencio, Associate Professor from UP-Open University. Along with them is another research wizard, Dr. Santiago T. Peña, Dean of the College of Veterinary Medicine at the Visayas State University (VSU).

Through the in-depth critiques of the evaluators, the winners for Best Completed Paper and Best Oral Presenter in the 2022 In-House Review were declared on the third day of the event.

Best Completed Papers were awarded to Ms. Laarni Parungao for the development category, Ms. Jonalyn Delos Santos for the biotechnology category, and Ms. Lilian Villamor for the student thesis category. Also, Ms.

DA-PCC has new career scientist

By MA. CECILIA IRANG-MARIANO



Dr. Marvin Villanueva, Senior Science Research Specialist and OIC Chief of the Research and Development Division/Chief of the Livestock Biotechnology Center, has joined the DA-PCC's growing pool of career scientists after he was conferred a Scientist I rank under the Agricultural Sciences Division of

the Scientific Career System (SCS) effective May 20, 2022.

The conferment of Dr. Villanueva makes him the 8th active career scientist of the agency.

The SCS is "a system of recruitment, career progression, recognition and reward of scientists in the government

service as a means of developing a pool of highly qualified and productive scientific personnel". Its program is being administered by the National Academy of Science and Technology (NAST) under the Department of Science and Technology (DOST), and the Civil Service Commission.

An Outstanding Young Scientist awardee in 2021, Dr. Villanueva is a graduate of Doctor of Philosophy in Veterinary Medicine at Hokkaido University in Sapporo, Japan with a specialization in Bacterial Zoonotic Diseases.

Dr. Villanueva, together with his team, developed advanced/molecular-based diagnostic tests for sensitive detection of livestock diseases such as interferon-gamma release assay for bovine tuberculosis, and loop-mediated isothermal amplification (LAMP) test for bovine leptospirosis. These sensitive and rapid diagnostic tests are currently used in the country for faster disease detection and initiation of treatment and control measures.

In his desire to address immediate problems in the livestock industry particularly in animal health, he is currently collaborating with local and international experts and institutions

Villamor was acknowledged as the Best Oral Presenter.

The event also recognized Dr. Lawrence Belotindos as the earliest researcher to submit a paper; for that, he received the Early Calf Awardee. This additional recognition encourages all participants to submit their papers on time.

Meanwhile, DA-PCC Deputy Executive Director Dr. Caro B. Salces also inspired young and prominent researchers by sharing strategic plans to continuously align the R4D studies until the next generation, in which he mentioned the significance of career growth and economic growth.

"We have the opportunity to review our works. We need to analyze these studies to acquire change and improvement, as well as answering the industry questions," said Dr. Salces.

The R4D in-house review is annually conducted to track the statuses and showcase the achievements of the DA-PCC's studies, which benefit its stakeholders, clients, and partner agencies.

on the development of autogenous vaccine and pen-side nanosensor-based diagnostic tool, antimicrobial resistance, solidification of biosecurity protocols using smart technologies, and development of rapid diagnostic kits and novel therapeutics against economically imperative diseases in the Philippines.

His recent involvement is the development of KBGAN iHealth mobile app as part of the Extension and Advisory Services Information (EASIS) Project between the DA-PCC and the Grameen Foundation.

Dr. Villanueva's scientific journey and passion are also heavily influenced by his commitment to work and uphold the mission of his agency, which is to serve the Filipino farmers and promote the improvement of their welfare, particularly those in the livestock sector, in order to create a food-secure, economically sustainable, and safe Philippines.

The DA-PCC recognizes Dr. Villanueva's accomplishments, specifically in developing technology to prevent and mitigate buffalo diseases. His significant research outputs have been and will continue to be a crucial contribution to the development of the livestock sector.

Benchmarking for Efficiency

BY ERIC PALACPAC AND ERWIN VALIENTE



Measuring the productivity of dairy buffalo farms helps in determining which are performing less efficiently than the others in the same geographical location. This is important to develop benchmarking strategies to improve the performance of inefficient dairy buffalo farms.

Along this premise, a research study by Eric Palacpac (Chief of DA-PCC's Knowledge Management Division or KMD) and Erwin Valiente (former KMD researcher and current Instructor at the Central Luzon State University) employed a nonparametric linear programming method called Data Envelopment Analysis (DEA) in measuring the efficiencies of 75 dairy buffalo farms in Nueva Ecija.

Given that these farms run at different scales of operation, the researchers employed a variable return to scale-input oriented DEA (VRS-IODEA) model. The VRS helps to have an autonomous data analysis of the variables as the increase in input would not reflect a proportional increase in output. Also, in developing countries like the Philippines, the input-oriented DEA model helps to save agricultural resources and services, as it intends to distinguish efficient guidelines and practices

in using entire assets such as farm equipment, machinery, labor, etc.

With this VRS-IODEA model, only farms, referred to as decision-making units or DMUs, of similar characteristics (i.e., homogeneous) in terms of inputs and output were examined. The inputs are the available resources and services provided to the farms, such as biologics, feeds, forage, and labor. On the other hand, the output was the milk produced by the buffaloes.

Measures of Efficiency

In applying the DEA, three measurements of efficiency were considered in estimating the performances of dairy buffalo farms, namely technical efficiency (TE), allocative efficiency (AE), and economic efficiency (EE). The TE refers to the ability of the DMU to produce the largest possible quantity of output from a given level of inputs (output-oriented) or produce a given level of output with the smallest possible level of inputs (input-oriented). The AE measures the ability of a technically efficient DMU to use inputs and produce outputs in optimal proportions given their respective prices. Economic efficiency (EE) denotes the entire computation of the performances and is calculated as $EE = TE \times AE$.

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Pursuing accelerated dairy buffalo milk productivity

BY ZADIESHAR SANCHEZ, RHEA MAE RUBA, ANTONIO JESUS QUILLOY, NORA CARAMBAS, AND MARK DONDI ARBOLEDA



Sustainable milk production through dairy farming is crucial in developing countries as it significantly contributes to food security and nutrition. It also provides livelihoods for the farmers and community-based organizations such as cooperatives and agencies since milk is seen as a lucrative source of income.

The Philippines, which is considered a third-world country, only has a milk production of 20.39 million liters in Liquid Milk Equivalent (LME) according to the Philippine Statistics Authority's (PSA) Dairy Industry Performance Report in 2016. It only supplies 1.12% of the total milk demand in the country. Hence, 98.88% is imported through powdered and ultra-high temperature (UHT) milk products. The report signifies Philippines' low productivity growth in milk production, which implies that it is an import-dependent country.

To address this concern, the government exerted efforts to help dairy farms improve their operations. The National Dairy Industry (NDA)

under the Department of Agriculture (DA) is mandated to create policies and programs that will sustain the development of the Philippine dairy industry. It intends to promote dairy farming in acquiring safe and quality milk and milk products.

Before setting up the NDA, the Philippine Carabao Center (PCC), an institution under the DA, was first established with the same objective of fostering milk production in the country, particularly by nurturing buffaloes. Aside from the milk operations, the PCC is also responsible for improving buffalo meat and draft power, as well as serving as the headquarters in helping rural dairy farmers.

The mandate of both agencies is to ensure the productivity of farms through technology utilization for improved dairy production. Factors that significantly impact the quantity and quality of milk produced by buffaloes are thus a researchable area. PSA (2016) recorded that buffaloes only contributed 34.93% in the country's total milk production. It

led the researchers to identify the best situations for increasing the productivity growth of dairy buffalo milk production.

The researchers analyzed three measurements, including technical efficiency, scale efficiency, and technological change. Technical efficiency locates the capability of the inputs being used to produce the most desirable outputs. While scale efficiency, which is also known as returns to scale, refers to the change in outputs after the amounts of all inputs in production have been changed by the same factor. Moreover, technological change identifies the effectiveness of the variable's support system, such as the PCC's research and development program.

Said assessments were applied to the 44 randomly selected dairy buffalo milk production in Nueva Ecija, Philippines. It aimed to determine the potential of these farms to increase their productivity growth, specifically in measuring the factors that significantly affect their entire performance. Farms were systematically evaluated with a

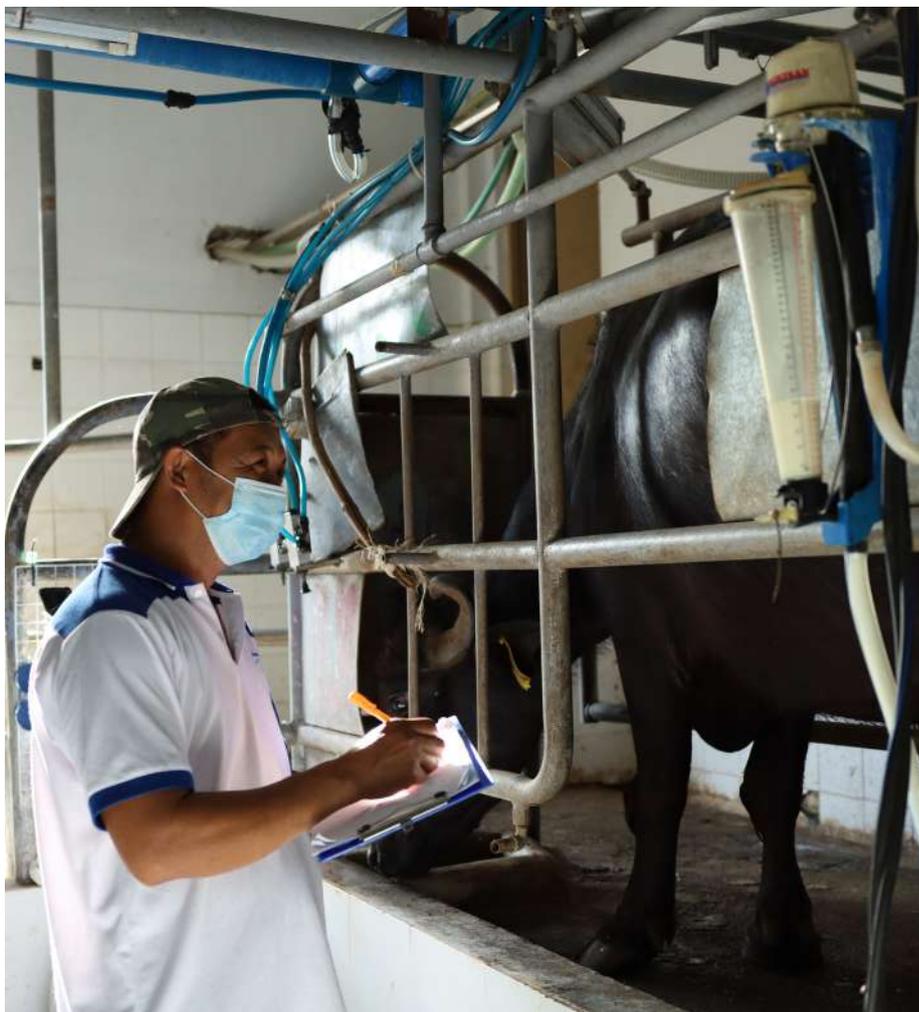
gap of three years in data collection and examination from 2017 and 2020. The ample time helped the researchers have factual and feasible data in determining the change in the efficiency of inputs in attaining outputs.

The researchers also applied the parametric stochastic frontier analysis to a Cobb-Douglas production function with an inefficiency effects model further assuming that the inefficiency error-term follows an exponential distribution.

Using the stochastic frontier, results identified that a small portion of distinct resources and services for the years 2017 and 2020 were utilized by the farmers, significantly affecting their operations. In 2017, three factors significantly impacted on their production: buffalo cows, forage area, and dairy feeds. In comparison to 2020, only two factors significantly affected their production: buffalo cows and dairy feeds. Also, the number of buffalo cows has increased by 10%, which reflects a good outcome to the increased of 6.9% in milk production.

For technical efficiency analysis, it was found that cleaning frequency had better effect in improving the actions and decisions of the farmers for fulfilling their daily farm duties. Wherein technical efficiency scores were 0.65 for 2017 and 0.64 for 2020, showing no technical change between the two periods. It also indicates that farms are constantly productive in maintaining their farms' cleanliness as they want to ensure the safety and health of their buffaloes.

For the scale efficiency analysis, the study revealed a significant change in the outputs produced in the two periods as the ways and strategies of using the inputs differed. Wherein the production shifted from decreasing returns to scale in 2017 with a scale elasticity of 0.8117 to increasing returns to scale in 2020 with a scale elasticity of 1.0268. It illustrates a -0.52% difference between 2017 and 2020 as the farmers became wiser in maximizing their inputs to produce the best outputs.



The study confirmed technological progress for the periods of 2017 and 2020. It shows that 48.60% improved the farmers' operations due to actively engaging in the programs and projects implemented by the PCC. Every year, there is a 12.15% growth in the technological aspects of the farms, which implies that PCC has a positive contribution to the dairy buffalo farms, such as providing support for dairy farm production, market, extension, education, and training.

In attaining the results of technical efficiency, scale efficiency, and technological change, it was revealed that dairy buffalo milk production in Nueva Ecija grew by 48.08% between 2017 and 2020, or 12.02% annually performance growth. The factor that had the most significant contribution

to this development is technological progress. While technical efficiency had the most negligible contribution.

As concluded by the study, to become more productive and competitive in increasing dairy buffalo milk production, farmers can improve their technical efficiency by being observant of their waste management practices. Also, it is recommended that farmers must participate in training and extension services in learning to adjust some resources from technology development to technology adoption. The sustainable development of the farms' production can be achieved by strategically applying resources and services, such as forage areas and dairy feeds. In this way, the management of buffalo cows could be better, resulting in better milk production.

About the researcher

Mr. Zadieshar Sanchez finished his master's degree in Agricultural Economics at the University of the Philippines-Los Baños. The full detail of the article can be found in his master's thesis entitled "Total Factor Productivity in Dairy Buffalo Milk Production in Nueva Ecija, Philippines," with Dr. Antonio Jesus Quillooy and Dr. Nora Carambas as advisers and Dr. Mark Dondi Arboleda as a panel member. Mr. Sanchez is currently the OIC-Chief of the Administrative and Financial Management Division (AFMD) and Head of the Business Development and Commercialization Unit (BDCU) at the DA-PCC.

The power of microsatellite markers to unleash the genetic diversity of Philippine Carabao

BY AIVHIE JHOY CUANANG AND LILIAN VILLAMOR



The Gene Pool for Philippine carabao (*Bubalus bubalis*) swamp buffalo for conservation and management is at PCC at Cagayan State University (PCC at CSU). With its current efforts to preserve the live population of swamp buffaloes with superior genetics, the question is whether the conservation at PCC at CSU is enough to represent the Philippine carabao's genetics in the country. Is there a genetic diversity of this indigenous animal? How would we know if the answer is "YES" or "NO"? First, a conclusive molecular-based approach to Philippine carabao genetic diversity using informative genetic markers is necessary.

Molecular markers are powerful tools for understanding evolution and genetic diversity based on the sequence variation of deoxyribonucleic acid or DNA, which contains molecules to code for genetic information needed by an organism to develop, grow, and function. For instance, mitochondrial DNA (mtDNA) has been widely used in understanding the relationship of organisms relative to another organism of the same species. In the Philippines, the COI gene marker revealed its usefulness in discriminating breeds of *B. bubalis* swamp buffalo from the riverine and confirming the identity of Calayan swamp buffaloes into its subspecies level. However, information extracted from mtDNA could be limited to the maternal lineage.

Therefore, another genetic marker from a nuclear gene is vital to support mitochondrial information. This pertains to the microsatellites.

So, what are the microsatellite genetic markers? Each microsatellite tags a particular region in the cell from two copies of genetic material, one inherited from the mother and another from the father. Microsatellites are also helpful because these are abundant in the genome, which refers to a cell's entire DNA instructions. In addition, these have a high degree of variability in the repeat sequence, making them informative markers used to understand population genetics, parentage testing, and individual identification.

The Food and Agriculture Organization recommended 30 microsatellite loci that can be used to assess the genetic diversity and population structure among buffaloes. However, the characterization and optimization of informative microsatellite markers were suggested in developing the genetic maps. These microsatellite markers were previously used to determine the genetic diversity of Southeast

Asian buffalo breeds but have not fully applied to the Philippine carabao sub-populations. Therefore, considering the potential of microsatellite markers, it is necessary first to evaluate the utility of these markers in genotyping the Philippine carabao.

To determine the genetic diversity of PC, the DA-PCC Animal Genetic Resources team evaluated the 30 FAO microsatellite marker for the information content and its potential efficacy for recommending a set of marker panels for genetic diversity and parentage testing of Philippine carabao. In this study, 488 fresh blood samples of Philippine carabao were randomly selected from 27 populations of the Luzon, Visayas, and Mindanao islands.

The overall research findings highlighted the 27 microsatellite markers that are highly and reasonably informative, which confirms their usefulness in determining the genetic diversity of the Philippine carabao sub-populations. Therefore, these markers should be helpful for genetic population analysis, which implies identifying possible population structures that could be a basis for strengthening Philippine carabao conservation management. Moreover, three loci showed potential use in forensic studies with 73.8% combined power of exclusion and 99.5% combined discriminatory power to distinguish samples from different individuals. This implies the potential efficacy of three loci that could be considered for future forensic studies. However, increasing the number of loci is recommended to achieve higher statistical power suitable for forensic applications such as paternity testing in the PC population.

About the researchers

Ms. Aivhie Jhoy Cuanang, a Science Research Specialist I, and Ms. Lilian Villamor, a Senior Science Research Specialist, from the Animal Genetic Resources Section-Cryobank Unit of the National Livestock Cryobank at the DA-PCC, wrote this article from the research entitled "Genotyping and assessment of microsatellite DNA markers for genetic diversity and potential forensic efficacy of Philippine Carabao (*Bubalus bubalis*) swamp buffalo" which was emanated from the DABIOTECH1506.



Benchmarking for... (From page 7)

The analysis were applied to three classifications of DMUs: smallholders or those with 3-5 buffaloes (n=58), family module or those with 6-10 buffaloes (n=12), and semi-commercial or those with 11-20 buffaloes (n=5). Likewise, only farmers with at least three buffalo cows and have at least five years of engaging in dairy buffalo production were considered.

Efficiency Scores

In utilizing the VRS-IODEA model, the level of efficiencies of 75 dairy buffalo farms was measured. Overall, the mean TE and AE were 0.80 and 0.81, respectively. These results signify that if the farms were to be technically efficient in their operations, it could still increase its output by 20%. Also, if the farms were to allocate the costs of its inputs more efficiently, it could still increase its output by 19%. Finally, with a mean EE of 0.65, the farms can still produce 35% more milk if it were to be both technically and allocatively efficient.

Inputs Adjustments

Inefficiencies were more commonly observed among smallholder farms. Smallholder DMUs with low efficiency (scores of 0.3782-0.5854) produced an average of 3,990 li of milk in one production cycle. They need to reduce

their inputs (e.g., biologics, feeds, forages, labor) by 53.31% without affecting the amount of milk produced. Those that are moderately efficient (scores of 0.5855-0.7927) have to reduce their inputs by 40% to attain efficiency. Meanwhile, family module farms and semi-commercial farms were already considered highly efficient (scores of 0.7928-0.9999) and only need to reduce their inputs by 14% and 24%, respectively, to become fully efficient (i.e., score of 1.0000).

Benchmarking

Using DEA also made possible the determination of best practice frontiers (fully efficient DMU peers) that inefficient DMUs can emulate. The DEA software generated lambda values (raw weights) assigned to the peer DMUs in a table format. Those DMUs listed horizontally at the top of the table are the fully efficient ones while those listed vertically in the first column of the table are the inefficient DMUs. Those DMUs that shared lambda values of more than 0.00 are considered peers. Inefficient DMUs can then benchmark with the efficient DMUs if they share the highest lambda values. In other words, the inefficient DMUs can evaluate their practices (i.e. how they allocate resources or inputs, what technologies do they apply, etc.) by comparing with those of the fully

efficient farms, which could serve as their standards. Such benchmarking is seen to improve the production efficiency of the inefficient DMUs.

Ways Forward

The study demonstrated that DEA can serve as a valuable analytical tool in determining efficiency scores of various categories of dairy buffalo farms, in recommending adjustments in inputs of inefficient farms without affecting output, and in benchmarking of inefficient farms with the best practice peer frontiers (fully efficient farms). The researchers recommended providing assistance to the smallholders in particular to increase their animal holding thereby allowing the utilization of more appropriate technological inputs for increased productivity. Likewise, they recommended future studies that can analyze the various socio-economic factors of the DMUs vis-à-vis their levels of efficiency.

About the researchers

Dr. Eric Palacpac is the current Chief of DA-PCC's Knowledge Management Division (KMD) and Mr. Erwin Valiente is a former KMD researcher and current Instructor at Central Luzon State University. The full detail of this article can be found in their research entitled "Measuring Economic Efficiency of Dairy Buffalo Farms in Nueva Ecija Using Data Envelopment Analysis".

OPINION



Strengthen technology utilization, scaling strategies

MARVIN A. VILLANUEVA, PhD
PCC-OIC National R4D Coordinator

Now that the Philippines is slowly returning to the “old normal” after almost three years of lockdown and many different kinds of restrictions brought about by the COVID-19 pandemic, this is also the best time for our PCC researchers to assemble, get ourselves back together to continue in delivering the mission services in support of the agency’s mandate.

For the past 29 years, the PCC has continuously capacitated its human resources with appropriate basic and advanced knowledge and skills through in-house trainings and seminars, as well as collaboration with local and international partners. Our laboratory equipment and field paraphernalia are also advanced, with properly defined protocols/processes in accordance with the International Standards (ISO). Through this, the PCC has developed numerous technologies along the thematic areas of animal nutrition, health, reproduction, breeding and genetics, product development, socio-economic dimension, policy, and advocacy. After the protection of the technologies through the application of Intellectual Property, the said technologies can be rolled out on utilized for public use, extension, and training, as well as for commercialization.

It is true that some of the technologies we developed did not end up being utilized by our clients for several reasons. It can be due to the absence of well-defined processes of how these technologies must be rolled out,

lack of technical know-how, funds, and proper planning along with changing of project leader/staff, and many more. It is not unique to PCC since it is also the dilemma of other government research institutions. What is important is to recognize the problem in the implementation, and correct it accordingly.

Therefore, I call on all the men and women of PCC, especially our scientists, researchers, extension workers, and communicators, to look back, re-assess what we are doing, and re-calibrate some of our plans and activities that will eventually extend our developed technologies to its intended clients. I believe that the PCC Culture and our Core Values (EPICS) that are inculcated within us are still there. We just need to have a “little tweak” on what we are usually doing or what we called “status quo”.

I would like to reiterate that we must do by heart the “Research for Development” (R4D) paradigm. Regular consultation with our stakeholders about their current and recurring problems in the implementation of the Carabao Development Program is critical in identifying simple, practical, and direct solutions to their problems that can be done through R4D. Collaboration with our local and international partners (SUCs, LGUs, GOs and NGOs, CSOs) is one of the key strategies to collectively address some (if not all) concerns of the Carabao Industry.

R4D Highlights[®]

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For comments and suggestions, please write to the Editors-in-Chief in this mailing address:

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