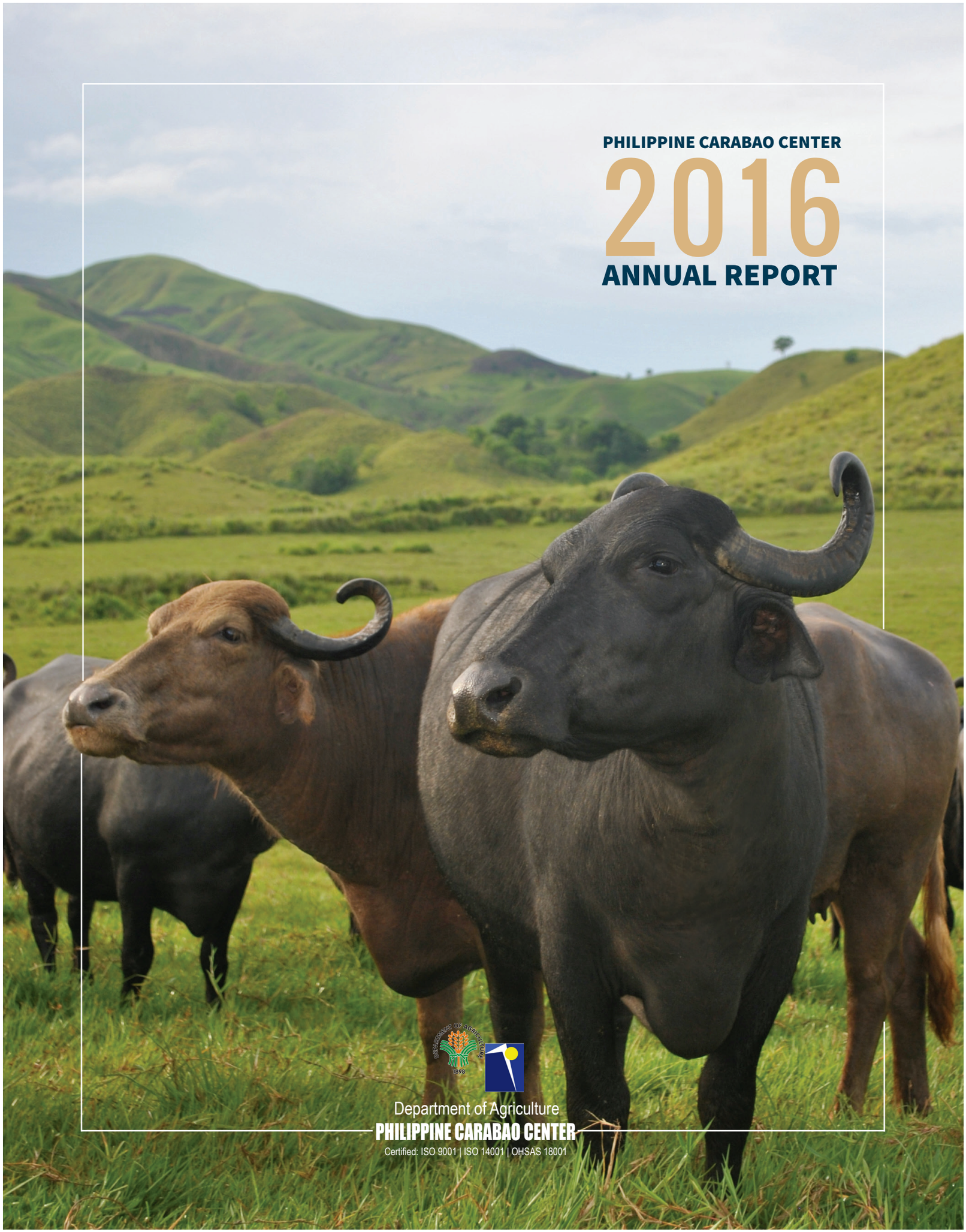

PHILIPPINE CARABAO CENTER

2016 ANNUAL REPORT

Department of Agriculture

PHILIPPINE CARABAO CENTER

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PHILIPPINE CARABAO CENTER

2016

ANNUAL REPORT

C O N T E N T S

PHILIPPINE CARABAO CENTER

The Philippine Carabao Center (PCC) operates as an attached agency of the Department of Agricuture (DA). PCC is mandated under Republic Act No. 7307 or the Philippine Carabao Act of 1992 to conserve, propagate and promote the carabao as a source of draft animal power, meat, milk and hide to benefit the rural farmers.

Per DA Administrative Order No. 9, series of 2008, PCC likewise is the lead Institution in Livestock Biotechnology research and development.

ABOUT US

VISION

To become a premier institution promoting profitable and sustainable carabao-based enterprises designed to improve the income and nutrition of rural farming communities.

MISSION

Improve the general well-being of rural farming communities through carabao genetic improvement, technology development and dissemination, and establishment of carabao-based enterprises, thus ensuring higher income and better nutrition.

POWERS AND FUNCTIONS

RA 7307, which was signed on March 27, 1992 and operationalized on April 1, 1993, provides that PCC's powers and functions are:

- Conserve, propagate and promote the Philippine carabao as a source of draft animal power, meat, milk and hide;
- Enable the farmers, particularly smallholder-farmers and CARP beneficiaries, to avail themselves of good quality carabao stocks at all times and at reasonable prices through an organized program of production, breeding, training, and dispersal;
- Undertake training programs for farmers, particularly smallholder-farmers and CARP beneficiaries, designed to transfer technology on the proper care and reproduction of the carabao and the processing of its meat and milk;
- Encourage backyard dairy development in rural areas by raising carabaos so as to meet the nutritional needs of the smallholder-farmers and their families and reduce dependence on imported milk by-products;
- Undertake research activities in all disciplines that lead to the improvement of the overall productivity of the Philippine carabao;
- Increase the existing annual population growth of the Philippine carabao to keep pace with human population growth;
- Enter into memoranda of agreement and receive donations through the Department of Agriculture from local and foreign sources. Upon the recommendation of the PCC Advisory Board, the individual carabao centers may enter into agreements directly with funding agencies through their respective board of regents or head of agency.

GENETIC IMPROVEMENT PROGRAM

Purebred and Crossbred Dairy Buffaloes

National Gene Pool. The PCC's National Gene Pool (NGP), operates as an "open nucleus herd", i.e., it allows entry of breeding stocks into a herd of purebred (riverine) dairy buffaloes where systematic breeding, selection, and genetic evaluation procedures are being carried out. The purpose of which is to eventually produce an elite herd of dairy buffaloes that would be sources of superior germplasm for future generations. The NGP is nestled on a two-hectare facility and is supported by around nine hectares of improved forage.

As of December 2016, the facility maintains 559 purebred dairy buffaloes (485 Bulgarian, 73 Brazilian, one Italian-Mediterranean) and four crossbred buffaloes for the purpose. Some 274 of these are female breeders with average conception rate of 42.4%, average calving interval of 15.4 months, and calving rate of 61.46%.

Regional Centers. Institutional herds of purebred riverine buffaloes numbering to 1,281 (7 Murrah, 996 Bulgarian, 30 American, 118 Brazilian, and 130 Italian-Mediterranean) and 269 crossbred buffaloes were also maintained at the PCC's regional centers. Performance or production data from these buffaloes are also registered in the PCC-wide recording system for genetic evaluation and selection.

Infusion of Purebred Buffaloes. The PCC also entrusted a total of 90 female purebred dairy buffaloes (Nueva Ecija=7, Bulacan=20, Quirino=16, Batangas=28, Oriental Mindoro=10, Bohol=3, Negros Occidental=2, and Cotabato=4) to selected farmer-trustees, multiplier farm operators and institutions assisted by the NIZ Program Coordinating team, PCC@CSU, PCC@UPLB, PCC@USF, PCC@LCSF and PCC@USM.

National and Regional Impact Zones. Purebred dairy buffaloes were also entrusted to farmer-cooperators in various cities and municipalities in Nueva Ecija, tagged as the "National Impact Zone" or NIZ for dairy buffalo development, and in the "Regional Impact Zones" (RIZs) being stewarded by the PCC's regional centers. Current inventory of purebred dairy buffaloes in these impact areas is 11,843 (Table 1), which represents an increase of 48% from the previous year.

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Table 1 Purebred dairy buffalo inventory in the NIZ and RIZs.

Category	NIZ	RIZ	Total
Pregnant	292	1,468	1,760
Nonpregnant	2,074	4,652	6,726
Female Calves	263	546	809
Male Calves	146	473	619
Junior/Adult Bulls	769	1,160	1,929
Total	**3,544**	**8,299**	**11,843**

Philippine Native (Swamp) Buffaloes

The PCC's regional centers also raise and maintain Philippine native carabaos in their institutional facilities (ex situ) for purpose of conservation, propagation, and selection within breed. As of 2016, a total of 245 native carabaos are raised in the PCC's regional centers, most of which are found in PCC@CSU (n=111) and PCC@USF (n=98).

Breed Development

Dairy buffalo breeding program

Genetic evaluation continued with the use of multi-trait random regression test day model (MT-RRM) for breeding value estimation (EBV) in Philippine dairy buffaloes. This is a refinement in genetic evaluation model from a research on estimation of genetic parameters. Pedigree and performance records of animals from nine (9) enrolled herds of PCC (NGP, UPLB, CSU, MMSU, VSU, USF, CMU, USM, MLPC) up to December 2015 were included in the genetic evaluation run. There were 1,955 buffaloes in the pedigree file extending to six (6) generations with 10,171 monthly milk test day records as well as 5,281 and 4,540 fat and protein test day records respectively. Based on the new model, MT-RRM, 153 bulls (70 of which are island born breeding bulls) were reported with breeding values. This is an additional 15 island born bulls from the previous year. There were also 1,802 cows that were reported with breeding values for milk, fat and protein yields. Top performing centers, cows and bulls (Table 2) based on EBVs were reported to the concerned Center during the GIP Coordinator's meeting on November 16–18, 2016.

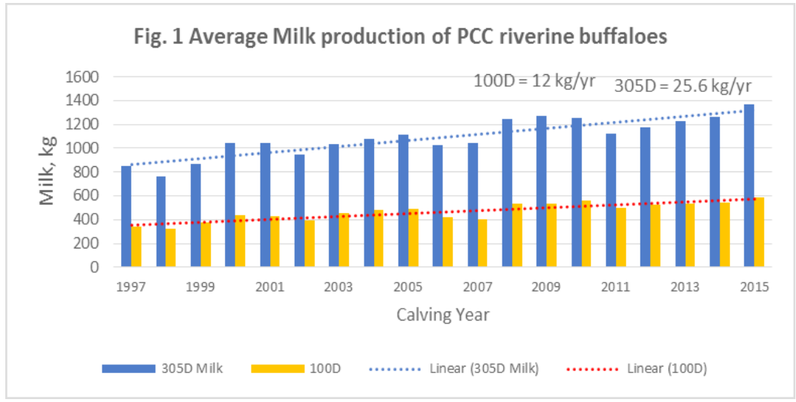
Table 2. Five top ranking riverine buffalo bulls

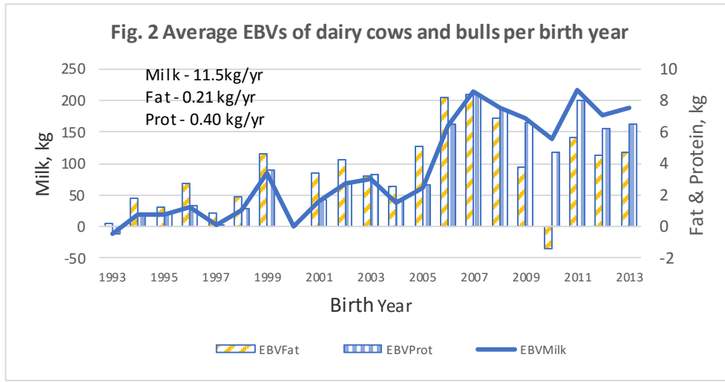
ID	Sire	Dam	No. of Daughters	Milk yield		Fat yield		Protein yield	
				EBV	Acc	EBV	Acc	EBV	Acc
2LSC02001	B19	2LS98439	17	642.1	0.8	26.1	0.7	24.6	0.7
2CM08049	2GP03017	2CM05046	6	630.6	0.6	18.4	0.5	23.6	0.6
2GP01102	MAPEL	2GP97103	37	548.0	0.9	22.3	0.8	21.9	0.9
2GP03017	MAVROS	2GP93405	23	498.4	0.8	3.2	0.7	18.7	0.8
2GP03020	MEMO	2GP97103	8	479.0	0.7	19.7	0.5	17.9	0.6

A full list of available semen donor bulls and their genetic merit per the 2016 genetic evaluation run is reported in the 2016 Sire Directory. This publication was prepared by the agency's Knowledge Management Division with information and/or content provided by the GIP.

The phenotypic (Fig. 1) and genetic trends (Fig. 2) for milk, fat and protein yield are positive and consistent with each other, indicating genetic progress. Phenotypic and genetic trends for milk yield per lactation (305D) are 25.6 kg and 11.5 kg, respectively. While we see a positive trend for fat and protein yield, this is a correlated response due to selection for higher milk yield. The result of selection for fat and protein has just started in 2015 hence, a bigger response or a more positive trend will only be evident after a couple of years.

Fifteen (15) young bulls were selected for training to become semen donor bulls. The actual number of bulls to become semen donor will depend on these 15 young bulls passing the semen quality evaluation. At the same time, eight (8) currently active young semen donor bulls were nominated for progeny testing.





It is also the first time that the Brazilian buffaloes were included in the genetic evaluation by way of milk test day records of daughters of the original Brazilian cows out of mating with BMB bulls. Reciprocal mating was also done, however, the daughters of Brazilian bull out of BMB cows have not started milking yet. The production of daughters out of BMB bulls is necessary in order that a genetic linkage can be established for the two groups as well as enable across breed evaluation. The genetic merit is, on the average, higher on daughters compared to their dams. The average unadjusted 305D lactation record of the daughters and their dams is also given on Table 3 and appears to be almost similar. However, the dams calved at a later age compared to their respective daughter hence, when this is taken into account in evaluation, the daughters will have a slightly better performance. A young Brazilian bull born in the Gene Pool herd has been selected and brought to Digdig for training to become semen donor bull.

Table 3. Summary of average performance of island-born daughters of brazilian buffalo cows sired by BMB bulls

Breed grp	No. of cows	Estimated Breeding values, kg			Unadjusted 305D lactation record, kg		
		Milk yield	Fat yield	Prot. yield	Average	Highest prod'n	Lowest prod'n
Island born Daughters	18	214.4	3.2	7.4	1,258	2,299.9	264.6
Brazilian buffalo Dams	18	52.9	2.0	1.9	1,271	2,271.6	214.8

This year also marks the first time the crossbred cows with at least 87% riverine blood, a product of continuous backcrossing to produce the Philippine Dairy buffalo breed, has been included in the genetic evaluation run together with purebred BMB cows. There is a strong genetic linkage with the purebred animals as all were sired by BMB bulls with daughters in both the purebred and crossbred cows. All crossbred cows with pedigree and production records are from PCC@UPLB herd. Generally, the milk production increases with increasing riverine bloodline (Table 4) such that the crossbred with 93% riverine blood has a very similar milk production performance as that of the purebred. Nevertheless, it will be worth noting that CB87 (87% riverine bloodline) has lower average milk production than CB50. This could probably be due to the loss of heterosis or dominance at this percentage of bloodline. The higher performance with CB93 (93% riverine bloodline) is most likely be due to a) "sampling error" as there are only two animals on record; b) dams that remained in the herd to produce the CB93 crossbreds are only those with good milk production; c) the daughter cows benefitted from better bulls relative to the previous generation.

Table 4. Average milk production of purebred bmb and crossbred cows from 2010 to 2015 in PCC@UPLB.

Breed group	N	Total milk prod'n	LL	305D milk
CB50	45	1340.0	258.4	1255.2
CB87	8	1059.2	226.7	969.3
CB93	2	1456.9	296.0	1413.6
BMB	91	1532.0	256.6	1441.1

The daughter-dam comparison of performance suggested that the daughters are generally better than their dams indicating that higher riverine blood and better sires are more important in increasing milk production potential with continuous backcrossing to produce dairy buffaloes. There is only one crossbred daughter with positive milk EBV (7UP12028) and appears to have better milk production performance at a younger age relative to the other three crossbred daughters. The crossbred daughters' lactation is still on-going hence, once completed lactation records are updated in the nest evaluation run. It is highly likely that their EBVs will change but not substantially. The result in Table 5 suggests the need to select breeding bull for inter-se mating with crossbred heifers. This will now be the first step for the launching of the "Philippine Dairy Buffalo" breed - an end result of the PCC's backcrossing system. The daughter 8UP10014 also had good first lactation performance but had negative EBVs because there are no other crossbred daughters to compare it with. Information used in the genetic evaluation run most likely came from its half-sisters aside from its own performance. It is planned that the male calf of 8UP10014 will be selected for training to become semen donor and shall be used for inter-se mating with other crossbred heifers to produce the first generation "Philippine Dairy Buffalo" breed.

Table 5. Dam-daughter performance of crossbred cows that were included in the genetic evaluation

Dam	305D Milk prod'n				Daughter	305D Milk prod'n				Remarks	Age at first calving mos.
	EBV	Milk/ Lact'n	LL	Milk/d		EBV	Milk/ Lact'n	LL	Milk/d		
5UP09001	245.8	960.8	167	5.8	7UP12028	269.2	1410.8	305	4.6		29.0
		1361.2	231	5.9			165.7	36	4.6	on-going	
		1392.5	300	4.6							
5UP98003	-120.8	1586.4	295	5.4	6UP12029	-19.3	295.7	146	2.0	on-going	39.7
		265.4	41	6.5							
		1188.46	179	6.6							
5UP03016	-123.5	1124.9	190	5.9	7UP12007	-78.9	372.8	126	3.0	on-going	43.7
		1649	288	5.7							
		1504.5	283	5.3							
5UP06025	45.0	1104.2	139	7.9	7UP12030	-43.2	595	195	3.1	on-going	35.8
		1988.6	305	6.5							
		656.2	305	2.2							
5UP07012	-123.6	433.5	94	4.6	8UP10014	-74.4	1399.26	305	4.6		29.0
		223.4	52	4.3			1427.8	249	5.7		
		769.2	166	4.6			570.8	104	5.5	on-going	
		206.4	58	3.6							

Swamp buffalo breeding program

The genetic parameters and phenotypic trend for growth traits of the gene pool for swamp buffaloes in PCC@CSU was also estimated/analyzed in 2016. There was a substantial increase in average weight and average daily gain across different age category and a very positive phenotypic trend across the years. To continue with the breeding program, two selected swamp buffalo semen donor bulls were included in the Sire Directory 2016. Aside from their pedigree, the average daily gains (ADG) at 6, 12 and 18 months are also given. The ADG is a measure of growth rate, which is the primary selection criteria for breeding bulls. The ADG400 (ADG at 12 mos.) of sires "Kardo" and "Ikong" were 460gm and 410gm, respectively. This was communicated to the Luzon, Visayas and Mindanao AI forum to expand the utilization of swamp buffalo frozen semen. In anticipation, four young swamp buffaloes from PCC@CSU were selected for training to become semen donor bulls to be brought to the Digdig bull farm. This will add to the number of swamp buffalo semen donor bulls.

The PCC@CSU herd, where these two swamp buffalo bulls came from, has been implementing a breeding program to increase the meat production potential of the swamp buffaloes through selection for faster growth rates expressed as ADG. For the first 12 months, on the average, the growth rate of the swamp buffaloes is very similar to the Riverine buffaloes in the same herd (Table 6). It is only when the calves are yearlings that the riverine buffaloes grew faster than the swamp buffaloes. For the selected swamp buffalo semen donor bulls "Ikong and Kardo", their respective growth rates are above average and approximates that of the average riverine buffaloes.

Table 6. Average growth rates of swamp buffaloes (Philippine Carabao) at PCC@CSU herd at different age categories.

Growth Parameter	Sex	Birth weight	3 Mos.	6 Mos.	12 Mos.	18 Mos.
Average ADG, kg						
	Male	29.6	0.50	0.49	0.38	0.32
	Female	29.6	0.53	0.51	0.38	0.32
Average weight, kg						
	Male	29.1	73.1	113.7	179.6	217.8
	Female	29.5	80.1	123.1	182.3	233.6

Milk Test Day (Performance) Recording

Institutional Herd. Establishment of performance recording for dairy buffaloes in the various cooperatives of Nueva Ecija and selected Dairy buffalo multiplier farms is continuous. The Javier Dairy Farm, Rommel Agustin, and Italian Riverside multiplier farms have started milk test day recording along with another cooperative enrolled in DHI in 2015. Thus in 2016, aside from seven (7) cooperatives/associations, three (3) multiplier farms underwent milk test day recording with an average of 250 cows sampled per month. On the other hand, an average of 98 cows were sampled and recorded per month for Gene pool. There were eleven (11) Institutional herds that also submitted monthly milk samples as part of their performance testing activity. Thus, for the whole year 9,116 milk test day sampling was done consisting of 6,352 samples from institutional herds, 1,943 samples from various cooperatives and 821 samples from multiplier farms.

Average milk yield, fat and protein percentage is 5.1kg, 7.3% and 4.3% respectively. The highest average test day milk yield is PCC@USM at 6.1kg while the highest test day Fat% is PCC@UPLB at 8.8% while PCC@USM had the highest average test day protein% at 4.7%. Fat% is generally higher with herds that are grazing as cows can have access to good pasture such as PCC@USF with 8.0% average milk Fat%. The high average Fat% of PCC@UPLB is not because their cows have access to pasture but is most likely due to good choice of quality forage given to the herd. The average for the three milk components is not just a reflection of the herd performance but is also heavily influenced by the stage of lactation and parity of the herd as these is an average of all animals regardless of lactation period and age of cow. The average somatic cell count is 171,000 cells/ml. This is below 200,000 cells/ml, which is the industry standard. However, two herds are above this standard cut-off value, i.e., PCC@CLSU dairy herd and the Gene pool. Both are two of the oldest and biggest herds hence, these could be the reason. Another more probable reason for the higher than average somatic cell score for the two herds is that there are some cows that had very high scores at one or two test day periods which could have really pulled their averages up. Identification of the cause for these very high scores is an area to focus on in mastitis control program. Other herds seldom have very high scores.

Farmer-Cooperatives. The average milk test day performance of cows in the various cooperatives was also reported during the R&D review held in May 2016. The average performance is generally lower than the institutional herds as most enrolled cooperatives milk their cows only once a day. Likewise, the average fat% and protein% were notably lower even though the milk volume is also generally lower. (Note: Normally, there is an inverse relationship between milk volume and milk fat/protein). This is a reflection of the need to improve the quantity and quality of forage that the farmers give to their cows. This is especially true during the dry season as milk yield is generally lower in this season compared to the rainy/wet-cool season.

National Crossbreeding Program

The aim of the PCC's crossbreeding program is to ultimately develop a Philippine dairy breed adaptable under local conditions. The production of crossbred buffaloes is done through artificial insemination (AI) and natural mating via the Bull Loan Program.

Artificial Insemination (AI). There were 66,293 AI Services, out of which 46,405 heads were artificially inseminated covering 6,946 barangays, 885 municipalities and cities, and 73 provinces of the 17 regions across the country. These AI services were carried out by 911 AI technicians (371 village-based, 475 from LGU, and 65 from PCC).

An additional 121 AI technicians (VBAIT and LGU) were trained this year in the five (4) PCC Training centers (PCC@CLSU, PCC@CMU, PCC@UPLB, and PCC@USF), which added to the pool of trained AI Technicians in the country.

As of December 2016 field report, there were 12,270 monitored calves born out of the 2015 AI services.

Frozen semen production and distribution. The agency produced a total of 287,333 doses of frozen semen at its semen processing facilities managed by PCC@CLSU (n= 204,975 doses) and PCC@UPLB (n=82,358 doses), which were deposited in the PCC's semen bank. Of this total, 200,381 doses were distributed to the PCC regional centers and other partner agencies and individuals for the conduct of nationwide AI for water buffaloes. The remaining doses were stored for reference and/for future research work. To maintain the quality and viability of the frozen semen for AI, PCC distributed a total of 2,414 dewars of liquid nitrogen to its regional centers and partner-entities nationwide.

FROZEN SEMEN PRODUCTION AND DISTRIBUTION

287,333 Agency produced **DOSES OF FROZEN SEMEN**

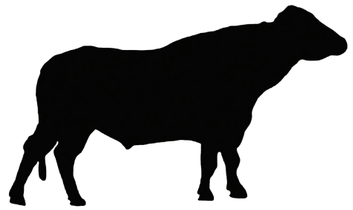
200,381 doses distributed to the PCC regional centers and other partner agencies and individuals

nationwide AI **water buffalo**

2,414 DEWARS liquid nitrogen distributed to PCC's regional centers and partner-entities nationwide

Natural Mating via Bull Loan Program. To complement the AI program and in areas where it is not practical to implement, natural mating by way of Bull Loan Program was offered to the farmers. As of December 2016, a total of 138 bulls were loaned out to farmers. These added up to the population of 957 purebred breeding bulls in the villages across the country. Out of these bulls, 429 are active breeders and have registered 1,801 services and benefitted more than 1,305 carabao raisers (owners of the female carabaos naturally serviced and bull handlers). As of December 2016, there were 1,130 monitored calves on the ground from the 2015 bull services.

NATURAL MATING VIA BULL LOAN PROGRAM



957 purebred breeding bulls

138 loaned out to farmers

429 active breeders

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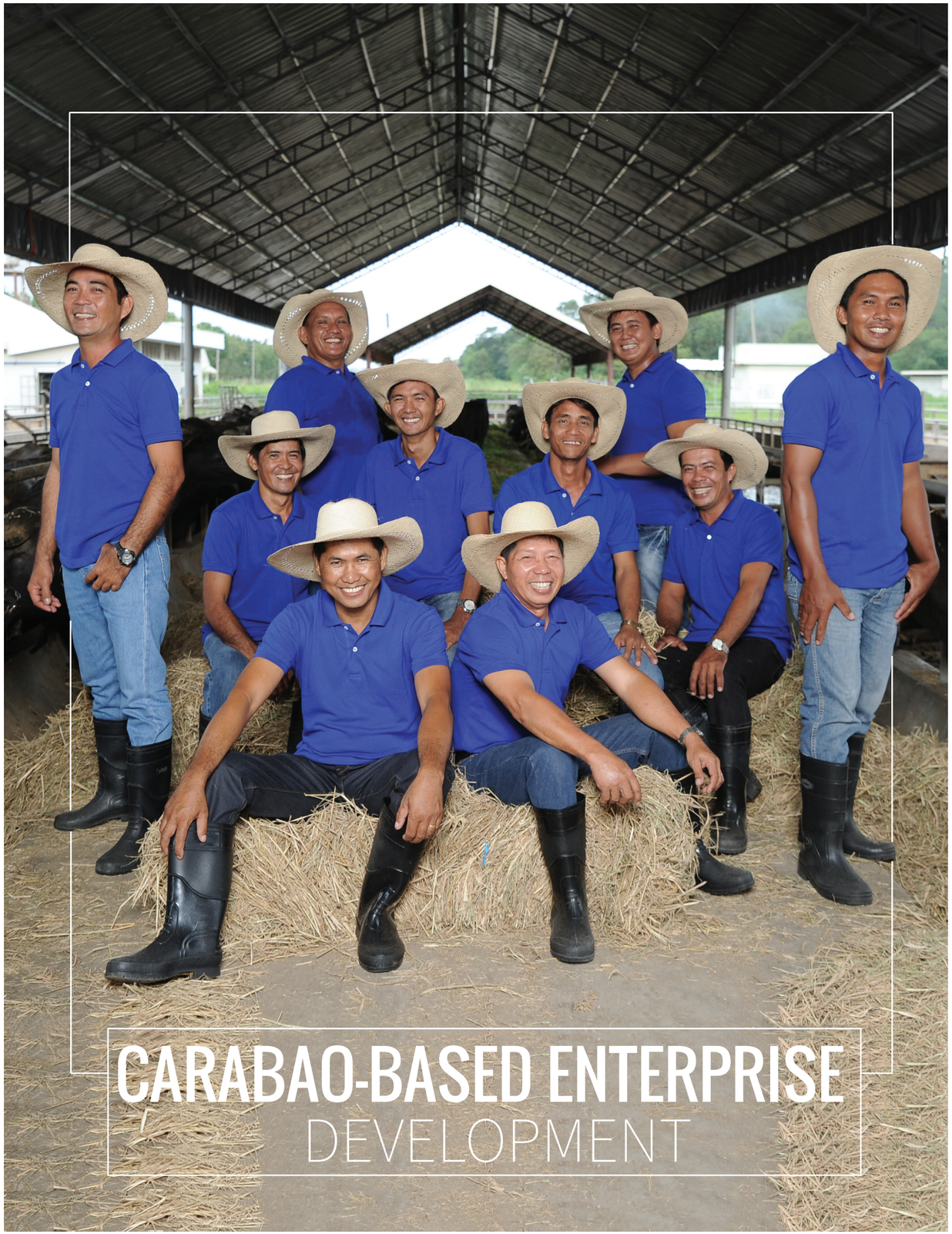


CARABAO-BASED ENTERPRISE DEVELOPMENT

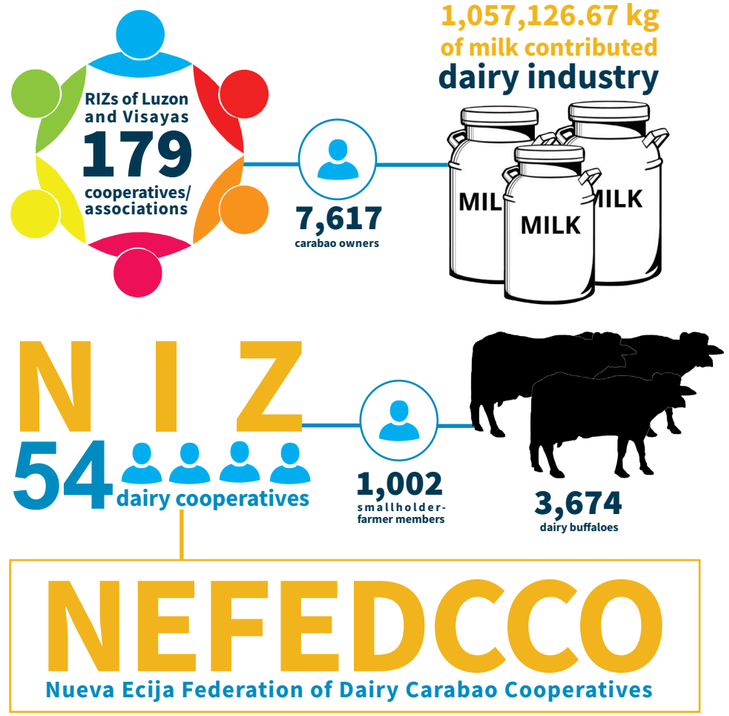
Newly Created Carabao-Based Modules

In order to expand the development reach of the carabao-based enterprises (CBE), the PCC mobilized and helped organize more farmers, particularly the owners of crossbreds produced out of AI and bull loan programs in the RIZ. The CBED program aims at creating more income-generating opportunities for the smallholder carabao raisers. There were 10 newly organized cooperatives or associations in 12 regions of the country.

Existing Carabao-Based Modules

There were 179 cooperatives/ associations comprising of 7,617 carabao owners engaged in CBEs, which were mostly located in the RIZs of Luzon and the Visayas. The most notable dairy cooperatives particularly based in Cavite, Batangas, Bulacan, Laguna, Leyte and Isabela contributed 1,057,126.67 kg of milk to the dairy industry.

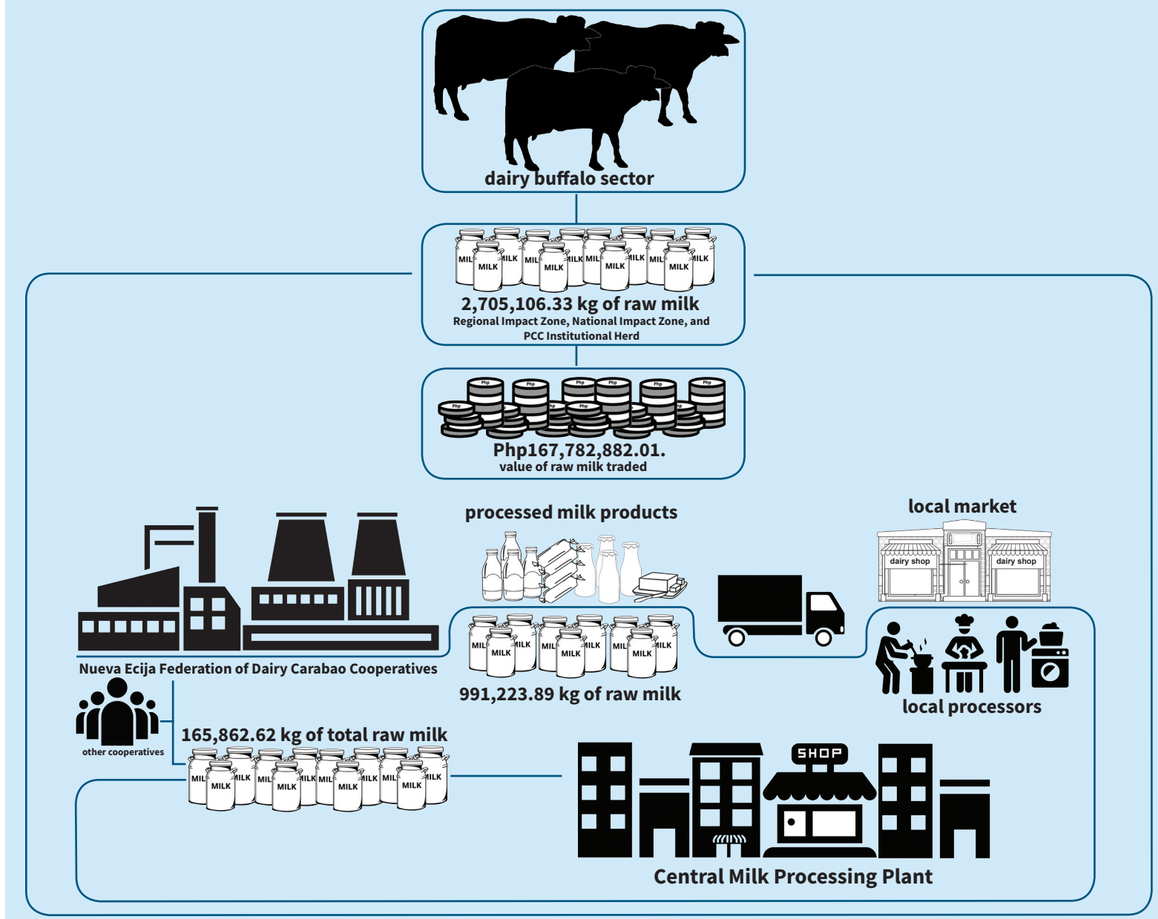
At the NIZ, there were 54 dairy cooperatives consisting of 1,002 smallholder-farmer members handling a total population of 3,674 head dairy buffaloes (comprising of 1,249 cows; 1,081 heifers; 316 female calves; and 969 males of various ages). These cooperatives constitute the Nueva Ecija Federation of Dairy Carabao Cooperatives (NEFEDCCO).



Milk Production and Marketing

The NEFEDCCO posted a total of 991,223.89 kg of raw milk. Portion of which was sold to the local processors while the rest was sold as processed milk products (basically, pastillas, kesong puti and flavored milk) to the local market. In addition, 165,862.62 kg of total raw milk produced from NEFEDCCO and other dairy cooperatives was sold to the Central Milk Processing Plant (CMPP) in Nueva Ecija for processing and subsequent marketing. All in all, the dairy buffalo sector, as stewarded by PCC, contributed a total of 2,705,106.33 kg of raw milk to the domestic milk supply. The milk came from the Regional Impact Zone, National Impact Zone, and PCC Institutional Herd. The value of raw milk traded was Php167,782,882.01.

Milk Production and Marketing



Dairy Buffalo Multiplier Farm (DBMF)

The PCC explored the concept of partnering with qualified farmers operating a dairy farm and/or with private individuals who have the capacity to manage a dairy farm. The DBMF was initiated in order to improve efficiency in the multiplication of good quality genetics and to establish a viable commercial buffalo-based dairy farm. In 2016, the PCC entrusted 48 heads of Italian Mediterranean buffaloes to two DBMF Operators of PCC@CLSU and PCC@UPLB bringing the total number of DBMF operators being assisted nationwide to 10.

Capability Building and Strengthening Support to the Farmer-Clients and Other Stakeholders

The PCC's regional centers conducted 124 trainings in support of the assisted cooperatives and associations. These trainings were participated in by 3,376 participants from Luzon, Visayas and Mindanao (Appendix 1).

Likewise, the PCC's NIZ Coordinating unit conducted 15 types of trainings for the farmer-trustees of cooperatives and associations in Nueva Ecija, which were attended by 456 participants (Appendix 2).

A participatory learning modality called Farmers Livestock School for Dairy Buffalo Production (FLS-DBP) was also piloted in three sites in Nueva Ecija (San Jose and Guimba) and Ilocos Norte (Marcos) involving 36 farmer-participants. The FLS-DBP, a first in the country, was implemented once a week for 34 weeks in these sites and facilitated by two teams of facilitators comprised of progressive dairy buffalo farmers and some LGU and PCC personnel. The FLS modules (on improved dairy buffalo production and postproduction practices) were developed previously by focal persons from PCC and PCAARRD. The pilot FLS-DBP is expected to produce its first batch of graduates in early 2017.

Other Major Support to CBED Operations

Opening of the Second Branch of Dairy Box. The PCC's Business Development and Commercialization Unit (BDCU) under the Planning and Information Management Division (PIMD) spearheaded the operationalization of a One-Stop-Dairy-Delicatessen-Shop called "Dairy Box". A year after opening the very first Dairy Box in Muñoz, Nueva Ecija, the Catalanacan Multipurpose Cooperative (CAMPC) has ventured into branching out and established its second branch at Brgy. Valdefuente, Cabanatuan City, Nueva Ecija. Securing a promising ROI of 20% for the first Dairy Box, the Cabanatuan branch was put up to serve as entry portal in the huge Cabanatuan market aiming to reach major city malls and schools in the long run. The Planning and Interior Management Division (PIMD) through the BDCU developed the shop's interior design, brand development and product packaging and labeling. Financial analyses and business consultancy services were also provided to assist CAMPC's board and management team to secure profitability in the set location.

Technomart Project for CAMPC. The PCC project proposal entitled "Enhancing the Buffalo Milk Production in Brgy. Catalanacan, Science City of Muñoz, Nueva Ecija" was approved by the Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (PCAARRD) with a PhP400,000.00 fund grant. The main objective of this project is to increase milk production in the area via implementation of twice-a-day milking along with provision of milk cans to all identified buffalo dairy raisers in the area, milk collection equipment and vehicle, milk testing kits, milk replacer, recordkeeping materials, and capability building.

Business Talk. The BDCU led the conduct of a series of "Business Talk", a strategic learning tool designed to activate and enhance the business and financial literacy of all PCC employees, particularly those in the regional centers, which maintain institutional herds and perform management functions in its Business Demo Modules. This approach is believed to trigger a more responsive, transparent and accountable public expenditure among PCC's spending units because it will capture their returns and spending to identify the efficiency by which public resources are used by way of computing the Return on Investment (ROI). A major output of the Business Talk sessions is the formulation of interventions to improve each center's ROI via streamlining of animal movements and development of specific action plan to improve breeding and health management.

Draft of Portfolio Analysis for Buffalo Dairy Farming Business. The BDCU also submitted the draft report of the 'CARABOU' Farm Business Portfolio Analysis. A business research was conducted amongst Carabao-based business entrepreneurs in Central Luzon to determine the plausibility of different farm types to serve as industry reference for existing and potential investors. Carabao dairy business analyses and investment requirements were made for smallholder farms, family businesses, semi-commercial and commercial farms. These entail a 10-year operational and cash-flow projection. Internal Rate of Return of buffalo dairy business module ranges from 21%-25% which connotes safe investment with reasonable profitability. Payback Period ranges from 4-6 years and all modules posting positive Net Present Values. A major finding is that the most profitable starting dairy farm module is 5-cow heads. Meanwhile, 4-cow heads module will take roughly three years to start recuperating income. This portfolio analyses are intended for publication in 2017 for official distribution to other DA offices, agencies or bureaus and direct PCC clients for enterprise development reference purposes.

RESEARCH FOR DEVELOPMENT

Research for Development

Research for Development (R4D) is one of the major thrusts of PCC. It helps propel the agency to work towards a better understanding of the foundation and dynamics of genetic improvement, animal health and nutrition, buffalo-based enterprises, and the underlying socioeconomic issues related to program implementation.

Following the agency's rationalization plan, its R&D mandate was strengthened and formalized further with the creation and staffing of its Research and Development Division (RDD), which now oversees the activities of various sections under its umbrella. The sections are categorized according to disciplines or thematic areas as indicated in the agency's R4D Agenda.

Completed and Ongoing Researches

The PCC has continued conducting researches in various disciplines and particular thematic areas as determined under the agency's R4D Agenda. Many of the researches have applied the concepts and methodologies in biotechnology. This is in keeping with the designation of PCC by the Department of Agriculture as its lead agency for livestock biotechnology R&D. The latter is complemented by relevant researches that explore and address problems or issues that are being encountered in the course of the agency's implementation of the Carabao Development Program (CDP).

In 2016, 22 researches were completed while another 64 were still being conducted (Table 7, Appendices 3a, 3b and 3c). These researches were also presented in the agency's Pre-In House and Annual R4D In-House Reviews held at the PCC National Headquarters.

Appendix 4 shows abstracts of some completed researches in 2016.

Table 7. Type, number, and status of researches.

Field	Completed	Ongoing
Production Management System	6	5
Biosafety	4	17
Genetic Resource Utilization	1	6
(Breeding and Genetic Evaluation)		
Genetic Resource Utilization	1	18
(Reproductive Bio techniques)		
Product Development	2	4
Enterprise Development	2	5
Socio-Economics	6	5
Technology Transfer	0	2
Institutional Development	0	2
TOTAL	22	64

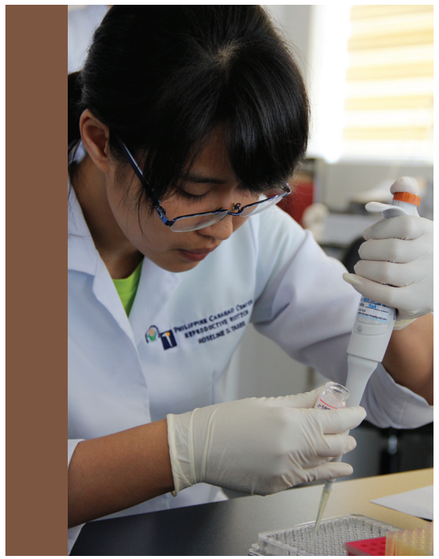
R4D Annual In-House Review

The PCC's R4D pre-in-house and in-house reviews were organized as a monitoring and evaluation tool that ensures alignment of R4D efforts with the R4D Agenda. It is a continuing activity that demonstrates and recognizes the PCC's research initiatives. Likewise, it helps create opportunities for researchers and scientists to present their notable accomplishments, and more importantly, to interact and share learning with one another.

There were 26 research studies presented during the in-house review held last 27-28 June, 7 of which are completed, 15 are on-going and 4 are commissioned researches. The researches presented are under the thematic areas of biosafety, genetic improvement-reproductive biotechnology, genetic improvement – animal genomics, socio-economic dimensions of CDP implementation, production management system and nutrition, and product development.

Three experts served as panel of external evaluators, Dr. Jose Arceo N. Bautista, Associate Professor IV, Reproductive Physiology and Pathology, University of the Philippines Los Baños; Dr. Virginia M. Venturina, Dean, College of Veterinary Science and Medicine, Central Luzon State University; and Mr. Zosimo G. Battad II, Instructor I, Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University.

Among the completed researches presented, research titled "Molecular Characterization and Comparison of Phospholipase C Zeta (PLCzeta) Between Swamp type (Bubalus carabanensis) and Riverine type (Bubalus bubalis) Buffaloes" presented by Ms. Roseline P. Tadeo won as the Best Paper Award and Best Presenter Award. Also, the research titled "Tetracycline and Sulphonamide-Resistance Genes in Respiratory and Gastrointestinal Bacterial Isolates from Pig, Small and Large Ruminants" presented by Dr. Gemerlyn G. Garcia won as the Best Student Thesis Award.



Conference Presentations and Journal Publications

Consistent with the norm of sharing R&D outputs to wider research and scientific communities, the PCC researchers have actively participated in local and international scientific conferences (see part of Appendix 6). Likewise 21 papers were published in refereed journals while another 21 were included in scientific proceedings (Appendices 5a and 5b).

Technical Seminars Conducted and/or Facilitated

The PCC thru the R&D Division has also conducted or facilitated series of Technical Caucus or Seminars on various topics (Table 8). Its aim is to improve and sustain awareness of PCC staff and other invited researchers and students from the academe and government institutions on technical matters and issues relevant to the livestock industry in general and PCC operations in particular.

Table 8. List of Technical Caucus/Seminars conducted for CY 2016.

Date (2016)	Title and/or Topic Presented	Resource Speaker
14 March	Training on Methods and Procedures on Conservation of Animal Genetic Resources for Cryobanking Management	Ms. Lilian P. Villamor
29 March	PCC-PSAS Lecture Series: Sustainable Control of Gastrointestinal Worm Infection in Goats toward Increased Productivity Pag-iwas at Pagsugpo sa Fasciolosis	Dr. Virginia M. Venturina Dr. Elizabeth C. Molina
6 May	Publishing in International Journals Seminar	Dr. Siu Seng See **Dr. Roberto Pagulayan**
31 May	Training on Ultrasonography and Hormone Assay Relative to Fixed Time AI and Early Detection of Pregnancy in Water Buffaloes	Dr. Seiji Katagiri Dr. Yojiro Yanagawa
1 August	In-Vivo Analysis of Anti-Bovine PD-L1 Antibody for Clinical Application in BLV Infection	Dr. Asami Nishimori
23 August	How Effective is DNA Barcoding? Testing the Utility of DNA Barcodes on Selected Taxa	Dr. Ian Kendrich C. Fontanilla
30 August	Development of Leptospiral Vaccine Using Protein Recombinant Technologies	Dr. Claro N. Mingala
13 October	Generating a Molecular Toolbox for Animal Research through Genomics PGC-DSCF and Its Capillary and Next Generation Sequencing Capabilities	Dr. Anita Bautista Mr. Juan Miguel Recto and Ms. Kris Punayan
21 November	Pregnancy Specific Protein-B (PSPB) and Pregnancy Associated Glycoproteins (PAGs) for Early Detection of Pregnancy in Bovines	Dr. Peregrino G. Duran
13 December	Genomic Prediction in the Age of NGS	Dr. Cerdic Gondro

Awards and Recognitions

The PCC researchers continued to gain recognition from various award-giving bodies in 2016 (Table 9a). Several PCC researchers were also cited in their paper or poster presentations in scientific conferences (Table 9b).

Table 9a. Recognitions received by PCC researchers.

Awardee	Title of Recognition	Award-Giving Body
Excel Rio S. Maylem	Outstanding Researcher	Philippine Carabao Center National Headquarters and Gene Pool (awarded during the 23rd PCC Anniversary Program)
Danilda H. Duran	Life and Work Award	International Buffalo Federation (awarded during the 11th World Buffalo Congress in Colombia)

Table 9b. Citations for PCC researchers who presented papers or posters in scientific conferences.

Awardee	Title of Recognition	Award-Giving Body
Excel Rio S. Maylem	Best Full Research Work in Master or Specialization	International Buffalo Federation (awarded during the 11th World Buffalo Congress in Colombia)
Jesus Rommel V. Herrera	Best Full Research Work in Doctorate Degree	International Buffalo Federation (awarded during the 11th World Buffalo Congress in Colombia)
Eric P. Palacpac	Best Full Research Work in Independent Research	International Buffalo Federation (awarded during the 11th World Buffalo Congress in Colombia)
Roseline P. Tadeo	Best Presenter Award	Philippine Carabao Center National Headquarters and Gene Pool (awarded during the 2016 PCC R&D In-House Review)
Eufrocina P. Atabay, Edwin C. Atabay, Roseline P. Tadeo, Emma V. Venturina, Claro N. Mingala	Best Paper Award	Philippine Carabao Center National Headquarters and Gene Pool (awarded during the 2016 PCC R&D In-House Review)
Peregrino G. Duran, Danilda H. Duran, Felomino V. Mamuad, Matt Daniel B. Peralta, Emma V. Venturina, Fe A. Venturina, Hernando V. Venturina	Best Paper Award	International Society for Southeast Asian Agricultural Sciences

Highlights of Accomplishments by Disciplines or Thematic Areas

Genomics and Bioinformatics

The Genomics and Bioinformatics Section (GBS) spearheaded researches on animal breeding and genetics, molecular genetics, and swine genomics. In doing so, it collaborated with other sections or laboratories in PCC and other institution like the Philippine Genomic Center (PGC).

Animal breeding and genetics. The pedigree and performance records of breeding animals enrolled in the genetic improvement program of PCC is transformed into secondary data for analysis to generate or estimate genetic and phenotypic parameters needed for running the genetic evaluation run every year as basis for ranking and selecting replacement breeders. Under the DOST-funded project entitled "Genotyping the water buffaloes using 90k medium density SNP panel", stocks of Philippine Carabao and different riverine breeds available in the country were genotyped using the 90k SNP panel to determine if the SNP panel is suitable for these breeds. The SNP panel works well in all riverine and swamp breeds, however, for the swamp buffalo samples, the heterozygosity rate was below 20 and the percentage of polymorphic SNP markers were below 50% indicating that not all markers in the SNP panel work well for the breed. Nevertheless, the population structure of the local riverine and buffalo breeds were elucidated. The suitability of the panel for the downstream analysis, specifically, development of genomic prediction model was determined and reported.

Other areas in animal breeding research were started, which focused on (a) improving meat production potential and meat quality traits in riverine and swamp buffaloes; and (b) establishing baseline parameters for "eye muscle area" by real-time ultrasound scan. Initial activity in the scanning "eye muscle" area in growing swamp and riverine buffaloes has been done. To date, there were 107 scan measurements generated. To determine the accuracy of the scan, some buffaloes were slaughtered and the actual carcass measurements collected. Initial results of "eye muscle area" measurement, the accuracy and correlation with growth traits are available for presentation. The scan data on swamp buffaloes is also being gathered by PCC@CSU as a collaborative research.

Molecular genetics research. Related to the research on improving meat yield and quality, a research proposal on looking at DNA markers for meat quality traits that can be used for selection was crafted entitled "Association of bovine genetic markers with marbling and tenderness in buffaloes (Bubalus bubalis)". Phenotypic data will come from the data output of the research on real-time ultrasound scan as well as growth data on buffaloes. This research will be fully implemented in 2017. Another research relates to the screening for A2 milk entitled "Molecular Characterization and Screening of β-casomorphin gene (β-casein milk variants) in different breeds of Buffaloes in the Philippines", which wil be fully implemented in 2017. Meanwhile, the research entitled "Screening of MS markers for 2nd stage validation protocol for parentage testing in water buffaloes" is continuing with a total of 13 new markers optimized to add to the previous 12 markers. The next stage is to do multiplexing to simplify the protocol.

Swine genomics. Although the research program is not in the priority list of the agency, the Section was engaged by PCAARRD to handle this research. The DOST-PCAARRD funded research program on swine genomics entitled "Private-Public Partnership in the Application of Animal Genomics to Increase Productivity and Improve Efficiency of the Philippine Swine Industry", with two projects, was completed in June 2016. Protocols for genetic testing of swine for the selected genes as spelled out in the projects were established together with the opening of the Swine Analytical Service Laboratory with a trained laboratory staff to run the genetic testing for the swine industry. The projects were initially aimed at the breeder farms raising parent and grandparent stocks. To expand the reach and promote the developed genetic testing technology to more breeders and commercial raisers, a follow-up project, which will run for two years (2016-2018), was approved by PCAARRD in October of 2016 entitled "Utilization of DNA marker Selection in Breeder and Commercial Farm".

Collaborative researches. There are a number of collaborative research undertakings that the section is currently engaged with other sections/laboratories within the agency such as (a) detection of foreign body in the rumen using real-time ultrasound scan (in collaboration with the NIZ veterinarians). Early detection and surgical intervention will minimize mortalities. Assistance has been provided to regional centers as well with specific cases; (b) recent development is to expand the research to include mineral and liver profiling to complete the diagnostic picture. This expanded collaborative research will be implemented in 2017 together with the Biosafety section and the NIZ team; (c) the use of fixed-time AI in selected institutional herds and multiplier farms initiated in 2016 was a research primarily being led by the Reproductive and Physiology Section in coordination with the GBS. Favorable results have been reported by the regional centers that participated in the research, which was corroborated by the lead Team. PCC Regional centers that requested FTAI for their institutional herds/multiplier farms were MMSU, UPLB, NGP, CSU, USF, VSU, CMU and USM.

Animal Genetic Resource

The Animal Genetic Resource Section (AnGRS) comprises three units, namely, the Cryobank, Gene Pool Farm and Livestock Biotechnology Research and Facility. The Cryobank Unit and the Gene Pool Farm are located in the National Headquarters' compound at the Science City of Muñoz while the Livestock Biotechnology Research and Facility is based in Brgy. Saranay, San Jose City.

The section spearheads the conservation and utilization of the carabao genetic resources by way of in vitro and in vivo preservation. Generally, the functions are to (1) secure cryogenic storage and cryopreserved animal genetic resources; (2) maintain and produce an elite herd of dairy buffaloes that would be sources of superior germplasm for future generations; and (3) serve as research and testing station for the development of new technologies and practices in different aspects of dairy buffalo production and management. Specifically, the Cryobank Unit is tasked to do the in vitro (thru cryopreservation and cryobanking) conservation covering not only the carabao species but other domestic species like cattle, goats, sheep, pigs and poultry. It may also cover some wildlife species like tamaraw, wild pigs and indigenous birds as well. The Gene Pool Farm will specifically be undertaking live conservation and utilization of the water buffalo species following the genetic improvement scheme. On the other hand, the Livestock Biotechnology Research and Facility will be handling research animals and to some extent, rehabilitated carabaos/buffaloes from farmer cooperators following the biosafety regulations. All of the units are involved in R4D activities, which are being conducted by the AnGRS and other RDD sections as well.

Cryobank Unit. The unit, currently has cryopreserved 474 blood and 438 DNA samples of swamp buffaloes of the Luzon population. In line with the collection of these blood samples, a total of 350 whole blood samples were submitted to PCC-Biosafety Unit for disease screening analysis. In the absence of pedigree record of animals (especially from the backyard), molecular analysis is one of the effective approaches to establish the identity of the specimen, at least to the species level. Optimization of genetic markers is necessary to be validated and optimized in the number of species. The unit had established the database on mitochondrial DNA cytochrome c oxidase (COI) sequences as the genetic markers to establish the two types of water buffaloes, swamp-type and river-type. A total of 165 swamp-type and 2 river-type buffaloes were identified.

In addition to cryopreservation, the unit was able to craft the Cryobank Operations Manual to provide the guidelines on establishment and management of the Cryobank facility in the Philippines. The Cryobank brochure was revised to promote the utilization of Cryobank facility to various sectors and stakeholders, thus, served as a tool in the unit's information dissemination campaign.

Gene Pool Farm (GPF). The farm maintains a herd population of 588 heads, comprised of 290 breedable females. On the average, conception rate through AI was 42.4%, producing 179 calves (92 males, 87 females) at a calving interval of 15.4 months. From January to December, the farm released 39 bulls for the bull loan program, nine (9) of which were sent to National Bull Farm (6 buffaloes, 3 Girolando cattle) and thirty (30) were loaned out to different cooperatives and municipalities around Luzon. Also, 15 cows were dispersed to Quirino Province under the Paiwi Loan Program supervised by PCC@CSU.

Moreover, the farm has produced 200,037 kg of milk in 2016. Around 133,294 kg was traded having a value of Php6.66 M pesos. The farm was also able to sell 34 culled animals both male and female. Furthermore, the farm produced 2, 474 bags (50kg/bag) of vermicast through its waste management program, 82.98% (2,053) of which were sold amounting to PhP487,226.

The GPF also served as a training ground for college students taking BS in Agriculture (Major in Animal Science) and Doctor of Veterinary Medicine. There were 109 students coming from ten (10) different Universities in the country that did their internship program and specialization in the GPF. Likewise, farmers who were venturing and planning to venture in dairy production were trained to have basic knowledge in dairy animal management and proper milking and milk handling.

Livestock Biotechnology Research and Facility. The research facility is currently under construction and this will be operationalized in early 2017. Although, not fully operational yet, it is being used as a temporary rehabilitation center/shelter for animals that were retrieved from the farmers due to nutrition and management issues; those recovering from surgery/disease; and animal payments for loaned animals.

Reproduction and Physiology

Under the PCC Rationalization Plan, the Reproductive Biotechnology Unit was renamed into Reproduction and Physiology Section (RPS) in congruence with the expansion of the agency's program and research activities. The core function of the section covers the physiological system of the carabao in relation to the utilization of reproductive biotechnology. Particular emphasis is on the development and use of applicable reproductive biotechnologies in support to the Genetic Improvement Program (GIP) of the agency towards increasing milk and meat productivity of water buffaloes. The Section's pioneering works are the development and utilization of in-vitro techniques for embryo production. Recently, the Section strengthens its technical capability on reproductive physiology focusing on underlying events and biological mechanisms in an effort to increase the efficiency of various reproductive biotechnologies. Another area recently initiated by the Section was on the molecular aspect of reproduction with particular interest on molecules or genes that are associated with semen quality and fertility. Essentially, the research and development activities are inclusive of other livestock species, which covers basically the following areas: reproductive biotechnology, reproductive physiology, developmental and molecular reproduction, and general physiology.

The RPS main contribution along the Major Final Output (MFO) of the agency is the pregnancies produced from fixed time artificial insemination (FTAI), which was initiated in the later part of 2014 and is directed towards increasing AI efficiency. The FTAI technology basically is preceded by hormonal synchronization of ovulation among animals followed by timed AI. FTAI activities in 2014 were focused at dealing with the hard-breeders at the National Genepool (GP) farm. In 2015, the technology was introduced to the National Impact Zone (NIZ) and some regional centers (PCC@CLSU, PCC@UPLB, PCC@CSU, PCC@USM) resulting in total pregnancies of 160 head breedable dairy buffaloes. For 2016, FTAI services were expanded further to more regional centers (PCC@MMSU, PCC@CMU, PCC@USF, PCC@VSU), and to a certain extent, to Multiplier Farms resulting in 270 pregnancies of dairy buffaloes, detailed as follows: Genepool (n=43), NIZ (n=110), and Regional Centers (n=117). The pregnancy rate achieved with the current optimized FTAI protocol is around 50%.

Biosafety and Environment

The Biosafety and Environment Section (BES) in collaboration with other research agencies, has produced six disease diagnostic protocols. Application of Polymerase Chain Reaction (PCR), in particular, in both research and diagnostics contributed to surveillance of diseases whether caused by virus, bacteria, or protozoa. These protocols were adopted and used as routine methods in the BES laboratory and even in other research and diagnostic agencies collaborating with PCC. The same protocols were also applied in the screening of diseases in samples submitted for cryobanking, bull loan, and animal dispersal project. The results generated have helped veterinarians and other animal practitioners in disease diagnosis, control, and proper treatment and management of the animals.

The BES has also organized seminars on the fields of microscopy, molecular biology, animal diseases diagnostics, animal health biotechnology and others which were participated in by the regional centers' staff, farmers, academe and students. The BES Team likewise, conducted information dissemination campaign to educate the farmers regarding Fasciolosis, Trypanosomiasis, bloat and foreign body syndrome. The staff have established strong linkages with several research institutions like the academe, regional animal diseases diagnostic laboratories, the PAHC and others in which they are invited as speakers, lecturers, experts in the fields of disease diagnostic methods and disease surveillance.

As a strategy to reduce mortalities of carabaos in the dairy villages of Nueva Ecija, together with the Gene Pool, NIZ Team and the GSU has enhanced the Livestock Biotechnology Research and Facility in Brgy. Saranay, San Jose City to serve as rehabilitation area for animals that were recovered from NIZ Cooperatives, those subjected to surgery and intended for research. The Team also ensured the implementation of the Animal Health Program across the network.

Production Systems and Nutrition

The Production Systems and Nutrition Section (PSNS) handles the research endeavours on (a) forage production, utilization and improvement, with the establishment and maintenance of the forage garden as an initial effort to showcase various forage grasses as ruminant feeds for the farmers and other interested clients; (b) feeds and feeding system to include among others the improvement of the nutritive value of conserved feeds and increase digestibility of low quality forages/feeds/farm by-products; and (c) understanding and improving rumen function through rumen biotechnology with the end in mind of addressing the multifaceted issues in nutrition on dairy buffaloes in the villages particularly in the dairy communities of Nueva Ecija and selected areas in Isabela.

Among the initiatives of the section in 2016 were six completed and five on-going researches. There were trainings conducted and distribution of planting materials to the farmers as a commitment to address availability of forage materials to dairy farmers. A total of 75 farmers benefitted from these activities. The section also extended laboratory services such as proximate analyses to in-house researchers and students as well.

Carabao Enterprise Development

The Carabao Enterprise Development Section (CEDS) covers the product development areas in milk, meat, hide and other carabao by-products that may evolve into enterprises.

The Central Dairy Collection and Processing Facility (CDCPF) and the Milka Krem are under the umbrella of the section. These two units serve as the research laboratories for the processing of developed milk products and the avenue for the promotion of such products. Separate research laboratories for the milk and meat product development are currently being equipped with required instruments and materials for use in 2017.

In 2016, the CDCPF received a total of 298,940.62 kg of raw milk, of which 165,862.62 kg (55%) was delivered by the dairy cooperatives and multiplier farms and 133,078 kg (45%) came from the Gene Pool farm. A portion (14.42%) of the raw milk received was sold as frozen raw milk to some processors and walk-in buyers while the remaining raw milk was sold as processed dairy products and used in research activities. These processed products were in form of pasteurized milk (19.88%), choco milk (6.18%), non-fat milk (4.34%), pastillas de leche (6.35%), white cheese (2.85%), gouda cheese (13.91%), ice cream (2.14%), yogurt and other yogurt products (2.6%), paneer (10.96%), and mozzarella (1.82%) while the 14.55% was in research and development. These dairy products were distributed to regular institutional buyers in Tagaytay, Bulacan, Manila, Baguio and in the PCC product outlet, the Milka Krem. The CDCPF and Milka Kreme have gross sales of PhP9,133,389 and PhP22,093,177, respectively, and the combined gross income was PhP31,226,566.

During the year, the section has partnered with the private sector, the Carabao Creamery, Inc., in carabao milk product development under the brand name Calaboo Products. Such innovations were Baby Boo and Mama Boo (acid coagulated kesong puti with melting qualities); and Yogi Boo (set yogurt – plain, with honey at the bottom and coco sweet). These products were launched in Myron's Place, Makati City on November 11, 2016. A number of research endeavours were initiated during the year to include standardization of formulation, process protocols and packaging design of buffalo milk products (choco milk, pastillas de leche and kesong puti) produced across PCC regional centers; and milk quality and safety assurance from farm to milk processing plant of carabaos milk, an initiative to address dairy carabao farmers' compliance to the Food Safety Act 2013.

In the area of technology and products promotion, the section and its units participated in various food exhibits, gatas festival, video shoot in the Salamat Dok TV program of ABS-CBN and presented six knowledge products during the National Carabao Conference 2016. The staff, likewise, attended various seminars and trainings on food business, food hygiene and GMP, operation of the milk analyzer equipment among others to upkeep them with the industry situation. They were also invited as resource speakers in numerous lecture-demo/seminars on milk processing, handling, quality control and regulations.

CalaBoo
taste the love, naturally

Socio-economics and Policy

The Socio-Economics and Policy Research Section (SEPRS) is tasked to cover the socio-economic implications or consequences and forecasting of production, processing, distribution and consumption of carabaos. In 2016, the Section spearheaded the crafting and implementation of researches on Stakeholders' Analysis of the Western Pangasinan Dairy Carabao Sector; Stakeholders' Analysis of San Agustin, Isabela Carabao Sector (under PCAARRD Project "Strengthening the San Agustin Crossbred Carabao-based Enterprise Development (CBED) Model"); and convergence project with DSWD entitled "Pilot Nutrition and Livelihood Interventions Through a Milk Supplementation Program under the Supplementary Feeding Program (SFP) and Sustainable Livelihood Program (SLP) of DSWD in partnership with PCC".

Hand in hand with the PCC@DMMMSU, the Section led in rekindling the partnership with the City Government of Urdaneta, the Shahani Gatas ng Kalabaw, Inc., and selected dairy association or cooperatives in Pangasinan. As a result, the 1st Kalamilk Festival was launched as part of the celebration of the Urdaneta City's 18th charter anniversary held at the Urdaneta Convention and Sports Center on March 15, 2016. The objective of the festival was to stir attention of the communities in Pangasinan on the social and economic benefits of dairy carabao production.

Milk Supplementation Program in Licaong Elementary School, Science City of Munoz, Nueva Ecija. The Section led a 120-day milk supplementation project, which was launched in Brgy. Licaong, Science City of Munoz, on July 29, 2016 in cooperation with the school Parents-Teachers Association (PTA), the City Health Office, City Social Welfare and Development (CSWD), Barangay local government unit (LGU), the Barangay health center and the Majestic Christ Church (MCC). A total of 183 school children received 200ml of pasteurized carabao's milk (toned down to 3.5% fat) on school days under close supervision and monitoring of the PTA. This program was participatory in nature as various stakeholders are expected to contribute for its successful implementation.
Before the actual milk supplementation, the DepEd and the Barangay Health Center assessed the nutritional status of the children and conducted deworming. The MCC provided drinking glasses and cooking equipment. The PCC, on the other hand, capacitated the PTA officers and members on how to pasteurize milk. Farmer-cooperatives sell their milk to PCC which then ensures its quality and the desirable fat content. The assigned PTA and barangay council members is in charge of picking-up the milk from PCC, pasteurizing it in school and serving it to the school children. The PTA monitors the daily intake of milk of the school children. At the end of the project, it is expected that the nutritional status of malnourished children will improve while those of the well-nourished children will be sustained

Pilot Nutrition and Livelihood Interventions Through A Milk Supplementation Program. A Memorandum of Agreement between PCC and the Department of Social Welfare and Development (DSWD) was signed on November 22, 2016 to implement a pilot program that aims to help improve the nutritional status of undernourished children and the socioeconomic conditions of the DSWD-Sustainable Livelihood Program (SLP) beneficiaries and PCC-assisted smallhold dairy farmers. Priority areas are in Regions III, VII and X with high prevalence of malnutrition, which include the municipalities of Aliaga in Nueva Ecija, Talibon in Bohol, and Maramag, San Fernando and Damulog in Bukidnon. The program will be implemented from November 2016 to May 2017, wherein a total of 10,094 children aged 3-5 years old currently registered in the Child Development Centers of the three municipalities will be provided with 200 ml of milk for 120 days in addition to the hot meals or regular meals they receive from the DSWD feeding program.
With the cooperation of the local government units of Aliaga and Talibon, the program was simultaneously launched in the two sites on November 28, 2016. Lauching of program in Bukidnon is set in January 2017. From November to December 2016, a total of 2,773 children and 81 smallhold dairy farmers benefitted from the program.

KNOWLEDGE MANAGEMENT

The agency's Knowledge Management Division (KMD) leads the information dissemination activities of PCC and plays a significant role in promoting the institution in general and its programs in particular. Recent undertakings emanating from the PCC's R&D activities, including scientific collaborations and other related events, were made available to the public through sustained efforts on information dissemination. These matured and verified information about its activities and technologies were packaged, relayed and disseminated using mixed media approaches.

Knowledge Management

The PCC engaged the services of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) to facilitate the strengthening of the agency's Knowledge Management (KM) strategy and program under the project titled "Building Capacity and Strengthening Partnerships for Carabao Development Program". The SEARCA in turn engaged the expertise of Dr. Serafin Talisayon, KM Policy and Planning Specialist, along with Dr. Alexander Flor, professor and dean of the U.P. Open University's Faculty of Information and Communication Studies, Dr. Maria Celeste H. Cadiz, and Ms. Rosario Bantayan, also from SEARCA.

The Carabao-based Enterprise Development (CBED) under the CDP, one of the banner programs of the PCC, is focused on the establishment of village enterprises that promote cooperative development, participative decision-making, and harnessing the potentials of farmers for income generation.

The Knowledge Management for Carabao-based Enterprises (KM4CBE) is a deliberate effort of the PCC to institute a systematic documentation and use of knowledge across the PCC network. A series of workshops on KM4CBE were held during this year. This includes Knowledge Management Workshop on Cross-regional Learning and Thematic Communities of Practice (CoP) held on February 15 to 17. The activity was participated in by 41 PCC staff members across its regional network and headquarters.

A follow through workshop on KM entitled Training of Trainers (TOT) on Writing Effective Knowledge Products (KP) was also conducted among PCC center directors and regional coordinators to formulate a cross regional learning program and to set up thematic Communities of Practice (CoP). One of the major outputs from the latest KM workshop is the identification of KPs by select lead KP writers from the 12 PC network centers.

The one-week TOT workshop reviewed the foundational concepts and principles of KM, tackled various aspects of KP and how to develop it, technically evaluated KPs following PCC guidelines on KP production, and laid out. Through the workshop, the lead KP writers served as study leaders and technical editors during the production of KPs.

The TOT KP outputs were presented during the "National Knowledge Sharing Forum on Carabao-based Enterprise Development activity. It is one of the highlights during the 2nd National Carabao Conference held on November 14-16, 2016. There were 26 KPs presented during the forum. The forum aimed to evaluate the KPs as to their merits, problems, limitations, and opportunities for improvement.

The Knowledge Management Division (KMD) staff also successfully completed an online, 10-week capability enhancement training program on Knowledge Management Practitioner Certification Course facilitated by the Center for Conscious Living Foundation, Inc. The program aimed to ensure effective implementation of the KM basic knowledge management skills in the workplace.

Production and Distribution of Information, Education, and Communication (IEC) Materials

Six issues of “NIZ Balitaan” were produced. Written in Filipino, it utilizes the tabloid format. With farmers as the specific intended readers, it is produced and released bi-monthly focusing on the PCC’s National Impact Zone. The NIZ Balitaan publishes significant news and feature stories about people and technologies involved in buffalo-raising by smallhold dairy farmers in Nueva Ecija and NIZ-related undertakings of PCC. It seeks to inspire and empower dairy farmers as well as current and future program partners, and ultimately contribute to the improvement of the Philippine dairy industry.

Four issues of the Karbaw Magasin were produced in 2016. The other regular publications that were circulated to the general public were four issues of Roundup Newsletter and one issue of R4D Highlights. Six other IEC materials were produced, such as: corporate packet, updated FAQ’s, sire directory, annual report, souvenir program and farmer’s calendar.

A total of 89,938 copies of these IEC materials were distributed by the KMD and regional centers to identified PCC stakeholders, visitors, and partner institutions.

Three audio visual materials were produced entitled F2F, IMS info graphic video, and Iskolar ng Gatasang Kalabaw.

A total of 89,938 copies of these IEC materials were distributed by the KMD and regional centers to identified PCC stakeholders, visitors, and partner institutions.

Benefiting from other Media Forms

In 2016, continued effort was made to introduce the Carabao Development Program of PCC to different media outlets. To maintain regular media exposure, two media fora were organized and held during the PCC 23rd Anniversary and the 2nd National Carabao Conference, respectively.

The PCC gained better media mileage thru 30 television and radio interviews and guesting this year. The various activities of PCC that highlighted PCC’s programs, services and dairy products were monitored in DWIZ usapang GOCC, Sunstar, 702 DZAS Maunlad na Magsasaka, DZMM interview, DZEC, PNA, News Monitor, My Puhunan with Karen Davila, Matanglawin segment, NDBC Bida Balita, Unang Hirit Segment, iWonder GMA News TV, Red Alert ABS-CBN, DWAD Noonbreak Balita, DZRB Radyo ng Bayan, Promdi Mirror, CabTV16, CLTV36, UNTV Benguet, TV48, DZXO, Novo Chronicle, DA Press Corp and DWAY.

The agency also gained exposure through regular news releases in the Philippine Daily Inquirer, DA FB page, PhilRice web team, business mirror, manila bulletin, edgedavao, people’s journal, Panay News Philippines, filipinewsph.com, globalnews.favradio.fm, Pangkat Kaunlaran, newsphilippines.net,

pressreader.com, foodevolution, AggieTrends, Lamb magazine, manila times, dobolp.com, news.pia.gov.ph, PNA.

The PCC’s website with URL www.pcc.gov.ph serves as a venue to publicize articles about the current undertakings of the agency. A total of 49 web articles were uploaded while 121 scoured press releases related to PCC were monitored. The PCC online and print press releases recorded totaled 170 this year.

Regular placements of PCC advertorials in souvenir programs of various entities were published in 9 advertisements. Aside from the use of the traditional and digital media, the PCC co-sponsored several trade fairs and exhibits that served as venues for program and product promotion. Such were the Agro Industrial fair 9th Gameng Festival, Agro industrial fair dingras Ani Festival, MMSU Foundation anniversary, Kalamilk Festival, WVSU University week celebration, 2nd national rice technology forum, Capiz State University Agriculture week and Foundation Day, Bohol Tropics Display, Ubay Agri Fair, HEAT Caravan, Madrid fusion, Dairy Conference and Expo, 5th Karabag-o Festival", Wow Carabao Valladolid, Haw-haw de Karabao", 5th Sinigayan Livestock and Poultry Fair & Exhibits", 37th Pasalamat Festival" (Agro-trade Fair), Philippine Harvest Exhibit, Binatbatan Festival, Farmer's Festival, USM Farmers and Fisherfolk celebration, VSU Agri-aqua and Machineries Fair, Organic Product Marketing Ormoc City Agri Aqua Trade Fair, Pintados Kasadyaan Trade Fair, Katigbawan Festival, National Academy of Science and Technology Exhibit, 4th Farm Tourism Conference, Sandugo Trade Expo 2016, Agri Food Fair 2016, CSI San Fernando City, DOST, USM Agri Tayo Dito 4th Agriversary Celebration, Philippine Harvest Exhibit,

2016 PAVVURULUN Festival, DA-BAR exhibit, 10th Gatas ng Kalabaw Festival, Pagkaing Pinoy Expo, Kalivungan Festival, 28th CLSU in-house review of completed and on-going research development projects, PSAS 53rd Scientific Seminar and Annual Convention, 6th Health and Wellness and Farm Tourism Expo, Sipag Fiesta, WVSU Research and Extension Center, Rural Women's month celebration, Dingle Festival, Dingle Farmers' Day VSU Leyte landing in palo, Ormoc Charter, 2nd NCC exhibition, 12th national biotechnology week at BSWM, and Uhay Festival.

Prioritizing Customers' Satisfaction

A total of 5,784 scheduled and walk-in visitors were received, oriented, and toured to the PCC facilities in 2016 following the standards of the Integrated Management Systems. A majority of the visitors were students and farmers, the others were either government officials or employees and researchers.

With the purpose of continually improving its systems in receiving visitors, the ACS conducts a Visitors Satisfaction Survey quarterly. In 2016, the Visitors Bureau, which is composed of the ACS staff members and security guards, were able to sustain its good rating. The bureau earned a satisfaction rating of 4.66 (very good to excellent), which is above the agency's Quality Management Systems (QMS) target rating of 4.25 percent.

A total of 5,784 scheduled and walk-in visitors were received, oriented, and toured to the PCC facilities in 2016 following the standards of the Integrated Management Systems.

Scientific Library Services

The PCC's Knowledge Resources Management Center (KRMC) or Scientific Library is in the process of initiating a web-enabled information system that supports a faster and more efficient means of handling and monitoring of all the existing knowledge resources.

The library in-charge is proactively encouraging the participation of the agency's scientists and researchers to recommend titles of books, references, international refereed journals/articles, and multimedia materials that they use frequently in the course of their research.

Consequently, the KRMC sourced out additional 64 reference materials on its web-based Electronic Integrated Library System (EILS) and additional 604 titles of buffalo researches on its web-based International Buffalo Knowledge Resource Service (IBKRS) which can be accessed thru URL: www.ibkrs.net. A total of 47 active linkages to external journal databases for sources of buffalo and livestock information have been established which can be accessed through an Online Public Access Catalog (OPAC) for ease of locating and retrieving library materials.

The KRMC has an active subscription to Science Direct Journal which enables researchers and scientist to access over 1,600 journal titles from 24 subject collections. It also facilitates the publication of research papers of PCC's researchers and scientists in appropriate scientific journals. Likewise, it assists in the renewal of their memberships in various international scientific societies and associations. It also manages the web administration of the agency's website that can be accessed thru URL: www.pcc.gov.ph.

Information Management System

The Information and Communications Technologies Section (ICTS) assisted in the deployment and maintenance of the newly enhanced Information System of the Electronic National Government Accounting System (e-NGAS) v2.01 to the PCC headquarters and regional centers and the introduction of the COA-led Budget System v1.0. The section continuously improved the Human Resource Management Information System (HRMIS) which includes the automation of Daily Time Record. The section also continuously improved Document Tracking System.

The ICTS continuously enhanced and upgraded several Central Processing Units (CPUs) and laptops at the PCC operating units/section with the assistance of the Medium-Term Information and Communications Technology Harmonization Initiative (MITHI) fund. The upgrading has ensured making workstations up-to-date. Continuous maintenance and patch upgrading of Windows Server Enterprise 2008 R2 edition Operating System, and Microsoft Forefront Threat Management Gateway, regular maintenance of Microsoft Windows 7 32 and 64-bit Operating System and Microsoft Office 2016 was also achieved.

Regular updating of Symantec End Point Protection Server and Client-based anti-virus were conducted to ensure a virus-free Local Area Network (LAN). This also ensures protection to all computer units joined in the LAN- Active Directory from any fortuitous computer viruses.

Upgrading of internet services from 6 Mbps to 14 Mbps to PLDT iGate fiber optics and Globe Communications was provided to the PCC personnel in line with their research and collaborative activities with international and local agencies. The ICTS also maintains wireless internet connectivity at the PCC Hostel, Training Halls, Gene Pool, Dairy Processing Plant, Milka Krem, Main Building, Livestock Innovations and Biotechnology Complex and Annex building.

PLANNING AND INSTITUTIONAL DEVELOPMENT

Approval of PBB

The PCC etched its mark on the national government's Performance-Based Incentive System (PBIS). It is the only operating agency in the Department of Agriculture certified by the Department of Budget Management (DBM) on May 13, 2016 to receive appropriate incentive by way of Performance-Based Bonus (PBB) for its personnel after a thorough and stringent evaluation by an Interagency Task Force (IATF). The said incentive served as a direct manifestation of the agency's inherent commitment to excellence in planning, implementation, evaluation and continuous development.

Through the agency's organizational congruence (vertical) and interfacing (horizontal) strategies, all units from its national headquarters to the regional centers were made connected across the year - a fundamental agency's core trait. The compliance was anchored on the 107% physical accomplishment, 97% budget utilization rating, and Integrated Management System's (IMS) continued certification.

Performing iREB the Value Chain Way

Since the paradigm shift in 2015, which accentuated transition of strategies from Research and Development to Research for Development, the agency has committed to perform an Intensified Research-based Enterprise Build-Up (iREB). This shift simply means prospective researches must be directed towards addressing the enterprise development concerns of the rural communities.

In support of the iREB, the PIMD collaborated with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in the conduct of Value Chain Analysis (VCA) of carabao and carabao-based products. The VCA aimed to identify key players of the emerging Carabao sector, understand the product and market flows including the enabling environment that facilitated business engagement, and critically identify specific strategies to sustain and upscale sectoral reforms.

Begetting familiarity with the entire value chain, the PIMD proactively responded through the following outputs:

> ***(1) Approval of PCC-ACPC Value Chain Credit Facility.*** A fund amounting to PhP100 million was approved by the national government through the GAA of Agricultural Credit Policy Council (ACPC). This is an identified prime need to elevate the entire carabao sector by the commissioned VCA of Carabao and Carabao-based Products. This credit window was designed to compose three loan products namely Animal Acquisition Loan, Working Capital Loan and Machinery, and Equipment Acquisition Loan.
>
> The Animal Acquisition Loan is intended for those players especially the Smallholder dairy farmers to scale-up operations to increase chances of profitability. The Working Capital Loan is for those who need additional financing to support dairy farming's basic needs like development of pasture area or acquisition of feeds and other farm materials. The Machinery and Equipment Acquisition Loan is appropriate for semi-commercial and commercial farm holders who already need equipment intervention to efficiently run its operational scale. Common needed machinery and equipment are milk cans, milking machines, milk testing equipment, and forage choppers.

(2) ***Participation in the Asia-Pacific Rural Finance and Community Development Conference (23-25 March 2016 Bangkok, Thailand).*** As a prequel to the PhP100 million credit facility via ACPC, the PIMD took an active role in the Asia-Pacific Rural Finance and Community Development Conference convened by the Asia-Pacific Rural and Agricultural Credit Association (APRACA). The idea that rural finance is an integral prerequisite towards attaining rural economic growth to increase per capita income in the countryside was firmed up in the event. As the poor are very vulnerable, a capitalization support via financing must be put in place to aid these poor communities in alleviating their vulnerability.

(3) Approval and Inception of 5 Value Chain Projects in Luzon. Through the PIMD's lead facilitation, five projects, still as a result of the VCA of Carabao and Carabao-based Products in Luzon, were approved and implemented under the SEARCA funding. Two federations and 10 cooperatives/associations spread in Regions 1, 2, 3 and 4A were identified as beneficiaries of the projects. An Economic Impact Analysis model was also structured by PIMD to assess the increase in income of the cooperatives after the projects' duration.

(4) Value Chain Players Consultation Workshop. A VCA players' consultation workshop was also held to uncover the 'felt' needs of the sector stakeholders. The activity centered on understanding the business perspective, policy reform requirements and service expectations from PCC and its development partners. Some 53 supply and demand chain players participated with active PCC partners (i.e. DTI, LGUs, DAR, and TESDA) and private companies engaged in animal feeds, veterinary products and logistics. This was conducted in compliance to RA 10717 also known as the General Appropriations Act wherein consultation with the civil society is required to present, review and evaluate agency's plan, resource utilization and performance. Thus, this activity will be conducted periodically henceforth.

Integrated Management System

The PCC through its Management Systems Audit Office (MSAO) ensured that the established Integrated Management System (IMS) that has been certified to ISO 9001 (Quality Management System); ISO 14001 (Environmental Management System); and OHSAS 18001 (Occupational Health and Safety Management System) is maintained and effectively carried out. During the first quarter of 2016, first surveillance audit for the second cycle was conducted by TUV SUD. The activity culminated with the confirmation of the continuing validity of IMS Certification for PCC National Headquarters and Gene Pool.

To ensure sustained effective implementation of the IMS, two batches of Internal Audits covering all areas at the National Headquarters and gene pool were conducted. The audits were done purposely to check on the operating unit's compliance not only to the requirements of the three standards but to applicable legal, regulatory and other requirements (LOR) without compromising customer requirements.

To warrant efficient conduct of internal audits, continued coaching and sharing of learnings and experiences among the internal audit team was done to improve the Internal Auditors' skills.

Efforts towards migrating to the new edition of ISO 9001 and ISO 14001 were also started. In-house training on the requirements of ISO 9001:2015 and ISO 14001-2015 was conducted with 25 participants coming from the different units of the National Headquarters. Following these, five (5) employees coming from MSAO and Internal Audit Team participated in the Risk Management Training to strengthen capabilities in the conduct of risk and opportunities assessment which is a new requirement of both standards.

Apart from overseeing the maintenance of IMS at the National Headquarters, the MSAO also assisted the PCC regional centers in their maintenance of certification to ISO 9001. The following Centers have maintained there certification: PCC@Cagayan State University (CSU); and PCC@University of Southern Mindanao (USM); PCC@Mariano Marcos State University (MMSU); and PCC@Ubay Stock Farm (USF).

Human Resources Management

The Human Resource Management Section aims to help the agency achieve its mandate, while ensuring employees are engaged and motivated in the attainment of their targets. The HRMS identified issues and executed corrective measures to further improve the services for the employees. In the coming year, the HRMS will use its resources, systems, and processes of recruiting, developing, rewarding, motivating and retaining employees who are contributing to the attainment of agency's MARC through aligned target MFOs of its programs, projects, and development priorities.

The major accomplishments of the section were summed up in terms of continued implementation of the Strategic Performance Management System. Specific highlights of accomplishments are as follow:

- Started the Competency Development of the agency with its expected completion in the first quarter of 2017
- Completed and submitted to the Civil Service Commission the needed evidence requirements for the agency Level 2 PRIME HRM accreditation
- Conducted two sessions of Values Orientation Workshop in two regional centers (PCC@USF and PCC@UPLB) wherein outputs of the workshop will be used as basis in defining the PCC core values
- Identified five Job Family Classifications, namely: Administrative, Managerial, Research, Extension and Finance
- Submitted proposal for Job Order Salary Adjustment, which was finally approved by the Executive Director and implemented on October 2016.

As of December 31, 2016, the PCC has a workforce comprised of 191 permanent employees and 462 personnel under the Job Order Status (Tables 10a and 10b).

Table 10a. Distribution of PCC Plantilla (Regular) Personnel, CY 2016.

Particulars	Technical Staff	Nontechnical Support Staff	Admin Staff	Total
Office of the Executive Director	31	9	20	60
PCC@CLSU	16	5	3	24
PCC@UPLB	7	5	10	22
PCC@CSU	9			9
PCC@MMSU	6	2	1	9
PCC@DMMMSU	6	1		7
PCC@USF	8			8
PCC@VSU	5	1		6
PCC@WVSU	4	4	1	9
PCC@LCSF	3	2	1	6
PCC@CMU	5	6	4	15
PCC@USM	6			6
PCC@MSU	2			2
PCC@MLPC	8			8
Grand Total	**116**	**35**	**40**	**191**

Table 10b. Distribution of PCC Job Order Personnel, CY 2016.

Particulars	Technical Staff	Nontechnical Support Staff	Admin Staff	Total
Office of the Executive Director	34	8	133	175
PCC@CLSU	11	22	7	40
PCC@UPLB	5	17	4	26
PCC@CSU	17		7	24
PCC@MMSU	2	10		12
PCC@DMMMSU	1	5	2	8
PCC@USF	11	23	10	44
PCC@VSU	3	12	15	30
PCC@WVSU	3	6	3	12
PCC@LCSF		10	4	14
PCC@CMU	4	24	3	31
PCC@USM	6	17	4	27
PCC@MSU				0
PCC@MLPC	2	12	5	19
Grand Total	**99**	**166**	**197**	**462**

Budget and Finance Management

The Philippine Carabao Center (PCC) has continued its commitments to the public expenditures management reform objectives of the government. These commitments were translated in the operating budget of PCC for FY 2016, specifically addressing the following critical areas of the agency financial management system:

a. Fiscal discipline. As a matter of policy, all operating units of the agency are expected to exercise due care and prudence in spending government funds. Effective measures were instituted to ensure prevention of excessive and unconscionable expenditures. All programmed expenditures are aligned to the strategic priorities of the agency.

b. Fund management effectiveness. Consistent with the public financial management reform roadmap of the government, the PCC has continued to enhance the adoption of the Unified Accounts Code Structure (UACS) system across the regional centers. The UACS provides a harmonized budgetary and accounting code classification that will facilitate the efficient and accurate financial reporting of actual revenue collections and expenditures of the center. The institutionalization of the UACS system across the PCC networks has improved the internal controls and risk management through streamlined and simplified financial reporting that redounds to the improvement of transparency and accountability in expenditure management.

c. Operational effectiveness. Enhancement of the engagement of the agency's program implementers/the ground personnel/ frontline service provider in the budget preparation process was pursued in 2016. Consultative mechanism was introduced across partners and key stakeholders in the budget cycle as well during the implementation of the programs.

Budgetary requirements of the operating units of the center were provided on time and in accordance with the approved plans. Appropriate administrative policies, procedures and processes were also implemented to enhance transparency of operation and minimize lead time in the procurement of critical goods and services.

Highlights of FY 2016 Budgetary Expenditures

The FY 2016 PCC expenditures were focused on IREB strategy i.e., to carry out continuing and expanding initiatives in 'Intensified Research-Based Enterprise Build-up' in rural communities. The major focused is on organized and wide-scale genetic improvement program, systematic extension and technology delivery, and creation of favorable environment for enterprise development. This is anchored on strengthened human resource competencies and growing linkages and active partnership. The iREB's felt effect is seen at the community level where dairy production bases composed of smallholder farming families achieved expanded supply chain for milk from genetically improved Carabaos and increasing incomes from Carabao-based enterprises from organized groups through value-adding and wider market reach.

In general, a shift in terms of the CPD's major strategies was undertaken to effectively manage program output and outcome at the sectoral level. Thus, the PCC fully engaged in Research for Development (R4D) to focus efforts on solutions to industry issues and problems. Specifically, this included cohesive efforts to genetic improvement, technology development, and creation of competitive CBE models. The pragmatic conduct of R4D was toward the vision of producing the Philippine Dairy Breed through massive upgrading of the animal resource and genetic evaluation, and making available competitive buffalo-based products at practicable costs. Therefore, more effective knowledge sharing, technology transfer and improved confidence in enterprise build-up was equally given deliberate priority.

Specifically, the usage of funds is channelled to meet the requirements for the expansion of R&D implementation on three areas:

a. Genetic Improvement Program (GIP). This program focuses on the improvement of the genetic potential of carabaos for milk and meat through organized breeding and selection and conduct of R4D and related production support activities. In 2016, expenditures were focused to redesign the GIP to emphasize efforts towards the attainment of common medium and long-term goals of breed development. Animal facilities of the PCC regional centers were also upgraded e.g., construction of new communal pen, working corral, and milking barn across the 11 regional centers of the PCC.

b. Cryobanking of Animal Genetic Resources. Conservation of genetic materials of important livestock species/ breeds is the main thrust of this sub-program component. This includes characterization of indigenous and introduced breeds. In 2016, the PCC sustained and expanded the implementation of the in-vitro conservation of animal genetic materials needed for long term breeding requirements and in response to changing global environment.

c. Intensified Research and Development. A good portion of the budget supported the efforts towards the development of DNA-based technologies applicable across species. R&D efforts supported the conduct of the development of DNA-based biotechnologies, market assisted selection, genetic defect screening, parentage and breed Identification, product development, improved application of reproductive biotechniques for water buffaloes, and improving semen quality and AI efficiency.

d. Modelling Carabao-Based Enterprises (CBE). Overall, the support to smallholder rural farming communities was implemented by way of development of industry-business models to support expansion of supply and value chain for carabao milk and meat. This involved the conduct of extension and enterprise researches that facilitates the technology transfer and harness skills of program clients and improves business confidence amongst carabao-based micro-small-medium entrepreneurs (MSMEs).

Sources and Usage of Funds

The agency's main sources of funds to support its operation are provided by the national government through the General Appropriation Act (GAA). Details of allotment and utilization are as follows:

Table 11. PCC Sources and Utilization of Funds as of December 31, 2016 (PHP Million)

Fund Source	Authorized Allotment	Usage	% Utilization
GAA-Current & Continuing	**508.77**	**500.09**	**98**
Personnel Services	102.90	102.80	100
Maintenance & Other Operating Expenses	315.99	310.00	98
Capital Outlay	89.88	87.30	97
Revolving Fund- Dairy Business Module	**84.49**	**80.85**	**96**
Locally funded special projects/research funds	**97.67**	**66.68**	**68**
Foreign Assisted Projects	**-**	**-**	**-**
TOTAL	**690.93**	**647.62**	**94**

Special projects fund are the receipt of research funds from various government agencies and institutions. Project funds utilization is mainly on the maintenance and operating requirements of the project.

Financial Condition

Table 12 presents the PCC's Statement of Financial Position at the end of FY 2016.

The PCC's total assets as of December 31, 2016 are Php 2,451.46 million comprising mainly of the agency Property, Plant & Equipment (PPE) and Biological assets. The new standard for accounting for biological assets as per Philippine Public Sector Accounting Standards affected the significant decrease in agency's biological assets. The decrease by 31% or PHP359 million is due to the recognition of biological assets at fair market value less cost to sell and the dropping of dead animals from the books of accounts. The number of death of the said animals is within the acceptable rate of mortality.

Total liabilities posted PHP207.03 million and total accumulated surplus reached PHP2,244.43 million. The increase in liabilities represents payables from various suppliers and contractors at year end.

Table 12. Statement of Financial Position as of December 31 (PHP Million)

Particulars	FY 2016	FY 2015	% Change
Assets			
Current Assets	538.25	452.68	19%
Property, Plant & Equipment	1,093.28	1,021.03	7%
Biological assets	813.13	1,172.15	-31%
Other assets	6.80	7.25	-6%
Total Assets	**2,451.46**	**2,653.11**	**-8%**
Liabilities	207.03	130.74	58%
Accumulated Surplus	2,244.43	2,522.37	-11%
Total Liabilities & Government Equity	**2,451.46**	**2,653.11**	**-8%**

Table 13 presents the PCC's Statement of Financial Performance for FY 2016.

The PCC's total revenue for the year reached PHP111.29 million comprising mainly of the business income from the sales of milk, meat, live animals, and other by-products as a consequence of the operation of the institutional dairy business module of the regional centers and Milka Krem.

Personnel services expenses posted PHP102.51 million, while total maintenance and other operating expenses including other expenses is PHP360.76 million giving a deficit from current operation of PHP515.68 million. The increase in personnel services is due to the 1st tranche implementation of the Salary Standardization Law of 2016. The significant increase by 33% of the maintenance and operating expenses is due to the implementation of various research projects in support to the iREB strategy of FY 2016. The posted deficit for the period is attributed to the decrease in subsidy from the national government due to the decrease in the budget for non-recurring expenditures such as infrastructure projects.

Table 13. Statement of Financial Performance for the period ending December 31, 2016 (PHP M)

Particulars	FY 2016	FY 2015	% Change
Revenue			
Business Income	90.46	92.40	-2
Other Income	20.83	0.85	
Total Revenue	**111.29**	**93.25**	**19**
Current Operating Expenses			
Personnel Services	102.51	87.28	17
Maintenance & Other Operating Expenses	442.61	332.75	33
Other expenses	81.85	80.64	2
Total Current Operating Expenses	**626.97**	**487.06**	**29**
Surplus (Deficit) from Current Operation	**(515.68)**	**(393.81)**	**31**
Assistance and Subsidy	**556.95**	**433.14**	**29**
Loss of Assets	**(202.15)**	**(14.45)**	**1299**
Surplus (Deficit) for the period	**(160.88)**	**24.87**	**-747**

Appendices

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
1	Urea Molasses Mineral Block Making Demonstration	9	January	CSU
2	Dairy Buffalo Production & Management	41	January	LCSF
3	Training on Milk & Milk Handling	41	January	LCSF
4	Training on Quality Control & Milk Processing	41	January	LCSF
5	Hands - on On Cheese Preparation	28	January	MMSU
6	Hands - on Training in Milk Handling, Quality Testing and Processing of Milk Products	1	January	MMSU
7	Training on Processing of Lacto Juice	4	January	UPLB
8	Financial Literacy Training	45	January	USF
9	Manage Your Business Money Training	19	January	USF
10	Silage Making	17	February	DMMMSU
11	Hands-on Training on Lactojuice Preparation	1	February	MMSU
12	Seminar on Processing of Milk and Milk Products	67	February	MMSU
13	Training on GMP and Food Safety for New Pastillas Maker	1	February	UPLB
14	Training on Processing of Lacto Juice	4	February	UPLB
15	Training on Processing of Mozzarella Cheese	2	February	UPLB
16	Milk Handling and Milk Processing	15	March	CMU
17	Training Course on Animal Health Program & Management with Emphasis on Dairy Buffaloes	18	March	CSU
18	Hands-on Training on Lactojuice Preparation	1	March	MMSU

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
19	Hands-on Training on Milk Collection and Handling	1	March	MMSU
20	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	16	March	USF
21	SMILE Training	45	March	USF
22	Technical Training of Buffalo Dairying	15	April	CMU
23	Dairy Buffalo Production & Management	51	April	LCSF
24	Training on Dairy Enterprise Development (Conceptualization)	25	April	MLPC
25	Hands-on Training on Dairy Carabao Management	6	April	MMSU
26	Hands-on Training on Processing of Milk Products	1	April	MMSU
27	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	12	April	UPLB
28	Training on Dairy Processing	47	April	UPLB
29	Farmers Training (Milk Handling & Processing, Feeding Mngt, Bull Mngt. Etc.)	21	May	CLSU
30	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	13	May	CMU
31	Training Course on Forage Production and Commercialization	20	May	CSU
32	Carabao Dairy Raising	13	May	DMMMSU
33	Evaluation of Value Chain Analysis Beneficiary	17	May	DMMMSU
34	Forage/Silage Production	11	May	DMMMSU
35	Training of Proposed Recipient of BUB Carabao	31	May	DMMMSU
36	VCA Project Corn/Silage Production	25	May	DMMMSU

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
37	Hands-on Training on Quality Testing and Pasteurization of Milk	4	May	MMSU
38	Coaching on Hands-On Milking of Canahay Dairy Farmers Association	10	May	USM
39	Importance of AI & Bull loan, Pasture & Forage Development	48	May	VSU
40	Dairy Production and Management	30	June	CMU
41	Milk Processing	31	June	CMU
42	Good Manufacturing Practices	26	June	DMMMSU
43	Dairy Buffalo Enterprise Development	61	June	LCSF
44	Dairy Buffalo Production and Management	62	June	LCSF
45	Training on Dairy Products Processing	25	June	MLPC
46	Lecture on Programs at Negosyo ng Gatasang Kalabaw	13	June	UPLB
47	"SMILE" Implementation Workshop	23	June	USF
48	SMILE Training/Workshop	23	June	USF
49	Training on Milking	4	June	USF
50	Training on Milk Collection & Handling	15	June	VSU
51	Dairy Production and Management	22	July	CMU
52	Advances in Animal Health	28	July	LCSF
53	Social Preparation Training	20	July	MLPC
54	Basic Training of Animal Health and Production Management Training	23	July	USF

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
55	Hands-on Training on Milk and Milk Handling	10	July	USF
56	Organizational Development Training	36	July	USF
57	Special Training on the Utilization on Carabao Milk on Pastries	11	July	USF
58	Training on Caramilk Soap, Pizza and Cookies Processing	11	July	USF
59	Value Chain Analysis of Carabao and Carabao-Based Products in the Visayas	32	July	USF
60	Quarterly Evaluation, Workshop & Training for AI Technician, Livestock, Meat Quarantine Inspector	14	July	USM
61	Training on Milk Collection & Handling	14	July	VSU
62	Training on processing of milk to other products for promotion and massive production	14	July	WVSU
63	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	16	August	CMU
64	Orientation on Carabao Upgrading Program	23	August	LCSF
65	Training on Dairy Buffalo Production and Management	138	August	LCSF
66	Training on Milk and Milk Handling	69	August	LCSF
67	Dairy Processing	25	August	MLPC
68	Training on Dairy Processing	23	August	UPLB
69	Training on Mozzarella Cheeze	5	August	UPLB
70	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	15	August	USF
71	Internal Quality Audit Refreshing Course	18	August	USF
72	Organizational Management Training	144	August	USF

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
73	Milking, Milk Handling and Milk Processing of Beffalo Milk of Canahay Dairy Farmers	34	August	USM
74	Social Preparation Training of Bitoka Dairy Farmers Association Members	31	August	USM
75	ANIMAL HEALTH TRAINING	30	August	VSU
76	Financial Literacy Training	24	August	WVSU
77	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	16	September	CLSU
78	Hands-on Training on Milk Processing (under CBED)	59	September	CLSU
79	Short Training on Pregnancy Diagnosis in Water Buffaloes forparticipants of National Meat Inspection Service Training NCR	15	September	CLSU
80	Milk Handling	36	September	CMU
81	Orientation on Carabao Upgrading Program	64	September	LCSF
82	Training on Dairy Buffalo Production and Management	196	September	LCSF
83	Feed Resources for Buffaloes & Establishing Improved grasses and Legumes for Buffalo Farming	26	September	MMSU
84	Feeding the Different Physiological Stages of Buffaloes	23	September	MMSU
85	Forage Conservation and Enrichment of Quality Farm By-Products	23	September	MMSU
86	Health Management for Various Stages of Growth	18	September	MMSU
87	Training on Dairy Buffalo Production and Management	26	September	UPLB
88	Organizational Management Training	52	September	USF
89	Social Preparation Training	49	September	USF
90	Hygienic Milk Collection, Handling and Processing	29	September	VSU

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
91	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	9	September	WVSU
92	Buffalo Milking and Milk Handling	5	September	WVSU
93	Hands-on Training on Milk Processing	3	October	CLSU
94	Bull Handlers Training	9	October	CMU
95	Silage Making	26	October	CMU
96	Social Preparation Training on Dairy Buffalo	26	October	CMU
97	Training on Buffalo Milk Soap Making	22	October	CMU
98	Training on Quality control and Milk Processing	25	October	LCSF
99	Animal Record Keeping/Eartagging	60	October	MLPC
100	Disease Prevention and Control	23	October	MMSU
101	Maximizing the use of Proper Genetics to Increase Milk Production	10	October	MMSU
102	Proper Housing for Calves and Adults	23	October	MMSU
103	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	12	October	UPLB
104	Database Management and Utilization for Reproductive Performance	18	October	USF
105	Financial Literacy Training	32	October	USF
106	Manage Your Business Money Training	92	October	USF
107	Organizational Management Training	46	October	USF
108	SPT and Hands-on Milking Training	29	October	USF

Appendix 1. CY 2016 Trainings Conducted by PCC and Number of Participants.

No.	Title of Training Conducted	No. of Participants	Month	Center
109	Bull Management Training	15	October	USM
110	Herd Health, Feeds and Feeding Management	18	October	WVSU
111	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	14	November	CMU
112	Demo on Making Urea Molases Mineral Block	8	November	CSU
113	Training on Cheese Making	21	November	LCSF
114	Techical Training on Proper Feeding, Breeding and Introduction of Dairy Buffaloes	4	November	UPLB
115	Training on Soap Making using Carabao's Milk	40	November	UPLB
116	Basic Training Course on Artificial Insemination and Pregnancy Diagnosis on Large Ruminants	15	November	USF
117	Financial Literacy Training	28	November	USF
118	Health Management Training for Farmer-Beneficiaries of Dairy Buffaloes	35	November	VSU
119	Milk Handling and Quality Control	21	November	WVSU
120	Training on Buffalo Milk Processing	8	December	CSU
121	Hands-on trainig for walk in	24	December	LCSF
122	Milk and Milk Handling	30	December	LCSF
123	Re-training of bull recipients w/ inactive animals	43	December	LCSF
124	Dairy Buffalo Management	20	December	MLPC
	TOTAL	**3,376**		

Appendix 2. CY 2016 Trainings Conducted for the National Impact Zone (Nueva Ecija).

No.	Trainings/Seminar/Fora Conducted	Date (2016)	No. of Participants	Center
1	Social Preparation Training	March 1-2	11	USM
2	Basic Buffalo Management Training	March 17-18	28	USM
3	Animal Health Care Management Training	April 21-22	20	VSU
4	Social Preparation Training	May 5-6	23	WVSU
5	Basic Buffalo Management Training	May 12-13	25	CLSU
6	Basic Record and Book Keeping	June 13	24	CLSU
7	Basic Buffalo Management Training	June 16-17	37	CLSU
8	Animal Health Care Management Training	August 3-5	14	CMU
9	Financial Management	August 17	24	LCSF
10	Basic Buffalo Management Training	September 14-15	65	LCSF
11	Basic course on Financial Management	October 19	20	MMSU
12	Twice a day milking	December 27	60	MMSU
13	Biogas Digester Operation and Management	August 22-24	55	MMSU
14	Milk Handling and quality control	October 18	25	MMSU
15	Milk Handling and quality control	November 4	25	UPLB
	TOTAL		456	USF

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Genetic Improvement	Optimizing Artificial Reproductive Technologies (Art) in Water Buffaloes Through the Regulation of Ovarian Function	EP Atabay
	a. Enhancing AI Efficiency in Buffalo through Synchronized Ovulation and Fixed Time Insemination in Water Buffaloes	
	b. In Vitro Embryo Production from OPU-derived Oocytes for Vitrification and Embryo Transfer in Water Buffaloes	
	c. Integration of Transrectal Ultrasonography and Hormone Analysis in Fixed Timed Artificial Insemination to Enhance Pregnancy Diagnosis and Rebreeding in Water Buffaloes (Bubalus bubalis)	
	d. Validation of Ovulation Synchronization Protocols and Optimization of its Efficiency in Water Buffaloes	
	e. Factors Affecting Efficiency of FTAI in Water Buffaloes	
	The Kinetics of Sperm Penetration and Embryo development as Predictors of Fertility of Frozen Buffalo Semen	ERS Maylem
	Improving Artificial Insemination Efficiencies Using Fertility Indexed Bulls Selected by Fourier Harmonic Analysis and Screened from Environmental Instabilities	PG Duran
	Screening of Sperm-Factor (Phospholipase C-Zeta) by Molecular Technique as a Novel Biomarker of Bull Fertility for Genetic Improvement in Water Buffaloes	EP Atabay
	Gene Expression Analysis and Detection of Heat Shock Protein (HSP70) and its Correlation with Buffalo Semen Quality and Seasonal Variation	ERS Maylem
	Epididymal Sperm Cryopreservation as a Tool for the Conservation in Vitro of Indigenous Livestock and/or Endangered Wildlife in the Country: Prospects for Animal Genetic Resources (AnGr) Cryobanking	LC Ocampo
	a. Epididymal Sperm Freezing from Post Mortem Testes of Native Carabaos for AnGR Cryobanking	

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Genetic Improvement	Enhancing Milk Production of Water Buffaloes through S&T Interventions Project 2: Development of Reproductive Management Program for Increased Efficiency of AI in Dairy Buffaloes, with the following studies:	EP Atabay
	a. Follicular dynamics and hormone profile during estrus cycle of Swamp and Dairy buffaloes	
	b. Follicular dynamics and hormone profile during ovulation synchronization treatments for FTAI in buffaloes	
	c. The Use of Pregnancy Associated Glycoprotein in Early Pregnancy Detection following FTAI in Dairy Buffaloes	
	d. Improving Efficiency of Prostaglandin-based Estrus Synchronization for Pre-determined AI in Water buffaloes (Enhanced AI)	
	Establishment of Dairy Cattle Foundation Breeder Herd Thru ET Using Imported Pedigreed Frozen Embryos	J Lopez; EP Atabay
	Genetic Propagation of Girolando Dairy Cattle by Reproductive Techniques	EP Atabay
	Production of Genetically Superior Goat/Sheep and Germplasm Cryopreservation Through Assisted Reproductive Techniques	MB Ocampo
	Cryopreservation of Chicken Sperm for Cryobanking	FP Aquino
	Genotyping the Philippine Water Buffaloes Using Medium Density 90K Buffalo SNP Panel	EB Flores; JR Herrera
	Screening for additional microsatellite markers for second stage validation protocol of parentage testing in buffaloes (Bubalus bubalis)	LM Labonite; MN Reyes; EBFlores
	Association of single nucleotide markers with estimated breeding values (EBVs) for milk yield and milk component traits of Philippine dairy buffaloes	LM Labonite; JRVHerrera; EBFlores
	Evaluation of milk production performance of dairy buffaloes in selected cooperatives in Nueva Ecija	GG Gantioque; EB Flores
	Utilization of DNA Marker Selection in Breeder and Commercial Swine Farm Units	EB Flores
	Genetic Divesity of Philippine Carabaos using mtDNA (COI) and microsatellite (FAO STR)	LP Villamor

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Production Management System	Enhancing Milk Production of Water Buffaloes through S&T Interventions Project 1: Development of Feeding Protocols and Practices to Support the Nutritional Requirement of Dairy Buffaloes	DL Aquino
	a. Assessment of the feed resources, feeding practices and production performance of dairy buffaloes at the NIZ and San Agustin, Isabela	
	b. Establishment of grasses and legume plantation for commercial seed production and for sustainable (year-round) supply of fodders for feeding dairy buffaloes	
	S&T Community Based Farm (STCBF) On Cassava Foliage Feeding For Dairy Buffaloes In Bohol	CB Salces
	Establishment of Tropical Feed Library Utilizing Locally Available Feed Resources for Ruminant Production in the Philippines	DL Aquino
	Assessment of Microbiota Dynamics of Water Buffalo Calf Digestive Tract on Different Weaning Diet	KV Serrano; DL Aquino
Biosafety	Gene Marker Identification Targeting Toll-like Receptor 4 (TLR4), Breast Cancer 1 (BRCA1), and Adenosine Triphosphatase 1 Alpha 1 (ATP1A1) Genes: Assessing Their Association with Subclinical Mastitis Cases in Dairy Water Buffaloes, Bubalusbubalis	C Biendima, MR Uy and CN Mingala
	Development of Schistosoma japonicum Paramyosin vaccine	MSL Jiz and CN Mingala
	Investigation on the Extent of Leptospira Infection Among Different Water Buffaloes in the Philippines	MA Villanueva, CN Mingala, C Nakajima, Y Suzuki and N Koizumi
	Genetic assessment of Trypanosoma spp. towards vaccine development (collaboration with NIMBB, UP Diliman)	CN Mingala, NS Abes, M Miguel and M Uy
	Sero-surveillance and Isolation of Bovine Viral Diarrhea Virus, Parainfluenza Virus, and Herpes Virus in the Philippines affecting Large Ruminants (Collaboration with CJVM)	NS Abes and CN Mingala
	Isolation and Purification of Cathepsin L Proteinase and Paramyosin from Mature Fasciola spp.	CN Mingala

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Biosafety	Molecular Characterization of Lactic Acid Bacteria Isolated from Water Buffalo's Milk Functioning as Reservoirs of Mobile Antibiotic Resistance Genes	J Gautane, E Ermitanio, M Balbin and CN Mingala
	In-Vitro Evaluation of the Effect of Betel Nut (Areca catechu) and Neem (Azadirachtaindica) extract on the Motility and Morphology of Liver Fluke (Fasciola spp.)	MA Miguel and CN Mingala
	Molecular Characterization of Coccidia spp. in water buffaloes towards vaccine development	LP Belotindos, NS Abes and CN Mingala
	Enhancing Milk Production of Water Buffaloes through S&T Interventions Project 3: Development of Health Care Technologies and Practical Farm Practices in Support of Increasing Buffalo Milk Production	CN Mingala
	a. Establishment of epidemiology data (temporal and spatial data) for risk factor analysis including identification of predisposing causes affecting decreased milk production	
	b. Development and identification of technologies and effective farm management practices to reduce the incidence and economic impact of these diseases in water buffaloes	
	c. Disseminate information and involve farmers in the adaptation of the developed/identified management practices	
	d. Develop diagnostic protocols for the early detection of infectious pathogens affecting milk production in water buffaloes	
	Epidemiological Surveillance and Development of Diagnostic Protocols for Neglected Disease of Large Ruminants (Water Buffalo and Cattle) in the Philippines	Biosafety and Environment Section
	Development of Loop-Mediated Isothermal Amplification (LAMP) Assay Based Test Kit for the Detection/Screening of Caprine Arthritis Encephalitis Virus (CAEV)	D delaCruz, J Gautane, M Balbin and CN Mingala
	Correlates of Immunity to hemorrhagic septicemia in water buffaloes	SH Gamul; CN Mingala
	Mycoflora in Bubaline Milk and Detection of Aflatoxin M1	W Pagaduan

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Enterprise Development	Enhancing Milk Production of Water Buffaloes through S&T Interventions Project 5: Strengthening San Agustin Crossbred Carabao-Based Enterprise Development (CBED) Model	AS Sarabia
	a. Stakeholders' Analysis of the San Agustin Crossbred Carabao Production	
	b. Capacity Building of Stakeholders and its Effect on Dairy Carabao Production	
	c. Upscaling of Production, Collection, Processing and Marketing to Hasten Dairy Carabao Enterprise	
	d. Strengthen the Monitoring and Evaluation through the Creation of Project Monitoring and Evaluation Teams	
	e. Institutionalization of Support Program as a Strategy to Sustain the Carabao Dairy Development in San Agustin	
Product Development	Enhancing Milk Production of Water Buffaloes through S&T Interventions Project 4: Milk Quality and Safety Assurance from Farm to Milk Processing Plant	MP Abella
	a. Assessment of existing milk handling practices and quality of milk produced by smallholder dairy farmers	
	b. Provision and adoption of interventions for improved milk quality	
	Quality Improvement of Acidified Buffalo Milk Products Through Utilization of PHILMECH-Developed Mango Pectin	MP Abella
	Standardization of Product Formulation, Packaging and Label Designs of PCC Products across Regional Centers, Phase 1	MP Abella

Appendix 3a. List of On-going Researches, CY 2016

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Technology Transfer	Adoption of Carabao-Based Technologies in the National and Regional Impact Zones in Luzon: Implications to PCC's Technology Transfer Program	EP Palacpac
	Extension Methods for the Adoption of Dairy Buffalo Technology in Selected Barangays in Nueva Ecija and Ilocos Norte	EP Palacpac
Socio-Economic Dimensions of CDP Implementation	Enhancing the Buffalo Milk Production thru Philippine Carabao Center's NIZ Strategy	ZG Sanches
	GAD in Carabao-Based Dairy Enterprises (SCBEs) in the Philippines	LG Battad
	Social Imageability and Socio-Cultural, Economic and Biophysical Contexts of Selected Philippine Carabao Festivals	LG Battad
	Value Chain Analysis of Carabao and Carabao-based Products in the Philippines	FA Lantican; LG Battad
	Pilot Test on Milk Supplementation for Supplementary Feeding Program Children Beneficiaries	MTR Sawit; DSWD
Institutional Development	Operationalization of Livestock Biotechnology Center	CN Mingala
	Strengthening Institutional R&D Capability to Improve Reproductive Efficiency	EC Atabay; MP Abella

Appendix 3b. List of Completed Researches, CY 2016.

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Genetic Improvement	Molecular Characterization and Comparison of Phospholipase C Zeta (PLCzeta) Between Swamp type (Bubalus carabanensis) and Riverine type (Bubalus bubalis) Buffaloes	EP Atabay
	Private-Public Partnership in the Application of Animal Genomics to Increase Productivity and Improve Efficiency of the Philippine Swine Industry Project 1. Development and application of genetic markers in selecting genes for prolificacy and other positive traits of swine	EB Flores
Production Management System	Community Based STBF on Improving the Carabao-based Dairy Farms in Magdalena, Laguna	AN del Barrio
	Community Based STBF on the Preparation and Utilization of Urea-Treated Rice Straw (UTRS) as Fodder for Dairy Buffaloes in Llanera, N.E.	DL Aquino
	Commercialization of Grass/Forage Corn Silage for Dairy Buffaloes in Lupao, Nueva Ecija Through Technomart	EP Palacpac
	Effects of By-Passed Fat and Feed Microbial on Milk Production and Post-Partum Reproduction of Riverine Buffaloes	J Santos; DL Aquino
	Effects of Feeding Corn Silage on Milk Production, Milk Quality and Farmer Profitability	EP Palacpac
	Agronomic Characterization and Nutrient Composition of Super Napier (Pakchong1) at Different Cutting Intervals and Fertilization Rate	IC DelaRosa; DN Aquino
Biosafety	Epidemiological Surveillance and Development of Diagnostic Protocols for Neglected Disease of Large Ruminants (Water Buffalo and Cattle) in the Philippines	Biosafety and Environment Section Staff
	Sub-study (protozoa): Molecular epidemiology of Babesia spp (B. bovis and B bigemina) in ruminants in the Philippines	PC Hererra, MM Balbin, LP Belotindos, V Venturina, NS Abes and CN Mingala
	Sub-Study (virus): Detection and Characterization of Bovine Ephemeral Fever in the Philippines through Reverse Transcription Polymerase Chain Reaction	J Lapira, MM Balbin, LP Belotindos, J Lazaro, NS Abes and CN MIngala
	Anthelmintic Potential of Pochonia chlamydosporia against Fasciola sp. In Water Buffaloes (Bubalusbubalis)	V Salting; S Ramos
	Swine Genomics Project II: Private-Public Partnership in the Application of Animal Genomics to Increase Productivity and Improved Efficiency of the Philippine Swine	CN Mingala

Appendix 3b. List of Completed Researches, CY 2016.

Thematic Areas	Program/Project Title	Project Leader/ Proponents
Product Development	Utilization of Whey as Substrate for Vinegar Production	CJ Callaga; RD Perez; MP Veneracion; J Rustia; MPAbella
	Production of Sports Drink from Delactosed Whey	
Enterprise Development	Enhancing the Carabao-Based Dairy Enterprise in Rosario, Batangas through TechnoMart	R Lapitan ; JC Canaria
	Enhancing the Carabao-Based Dairy Enterprise in Magdalena, Laguna through TechnoMart	ARJ Montes
Socio-Economic Dimensions of CDP Implementation	A review on the Effects of the Lifting of the Carabao Slaughter Ban	FCI Sebastion; LG Battad
	Social and Philosophical Underpinnings of Animal Entrustment in Carabao-based Enterprise Development in the Philippines	MG Duran; LG Battad
	Competitive Market Analysis of Buffalo-Based Products	I Calica; LG Battad
	Feasibility Study: One Stop-Dairy Shop of the philippine Carabao Center	FCI Sebastion; LG Battad
	Profiling the Modalities of Carabao-based Enterprise Led by the PCC and its Partner Institution	EP Palacpac; R Jacang; E Valiente

Appendix 3c. List of Externally Funded and Collaborative R&D, CY 2016

Project Title	Project Leader	Funding/ Collaborating Agency
Community Based STBF on Improving the Carabao-based Dairy Farms in Magdalena, Laguna	AN del Barrio	PCAARRD
Private-Public partnership in the application of animal genomics to increase productivity and improve efficiency of the Philippine swine industry (Project 2:Development and application of microsatellite markers in selecting disease resistance genes and screening of genetic defects of swine)	CN Mingala	PCAARRD
Private-Public partnership in the application of animal genomics to increase productivity and improve efficiency of the Philippine swine industry (Project 1: Development and application of microsatellite markers in selecting genes for prolificacy and other positive traits of swine)	JRV Herrera	PCAARRD
Community Based STBF on the Preparation and Utilization of Urea-Treated Rice Straw (UTRS) as Fodder for Dairy Buffaloes in Llanera, N.E.	DL Aquino	PCAARRD

Project Title	Project Leader	Funding/ Collaborating Agency
Commercialization of Grass/Forage Corn Silage for Dairy Buffaloes in Lupao, N.E. through TechnoMart	EP Palacpac	PCAARRD
Screening for Sperm-Factor (Phospholipase C-zeta) by Molecular Technique as a Novel Biomarker of Bull Fertility for Genetic Improvement in Water Buffaloes	EP Atabay	DA-Biotech
Application of Genomic Information in Dairy Buffalo Breeding Program: Genotyping the Philippine Water Buffalo using Medium Density 90k Buffalo SNP Panel	EB Flores	PCAARRD
Improving Artificial Insemination Efficiencies using Fertility Indexed Bulls Selected by Fourier Harmonic Analysis and Screened from Environmental Instabilities	PG Duran	DA-Biotech
Genetic Diversity of the Philippine Carabao mtDNA (COI) and microsatellite markers (FAO STRs)	LP Villamor	DA-Biotech
Epididymal Sperm Cryopreservation as a Tool for the Conservation In Vitro of Indigenous Livestock and/or Endangered Wildlife in the Country: Prospects for Animal Genetic Resource Cryobanking	LC Ocampo	DA-BAR
Development of Loop Mediated Isothermal Amplification (LAMP) Assay based test kit for the detection/screening of caprine arthritis encephalitis virus (CAEV)	MM Balbin	DA-Biotech
Gene Expression Analysis and Detection of Heat Shock Protein (HSP70) and its Correlation with Buffalo Semen Quality and Seasonal Variation	ERS Maylem	DA-Biotech
Evaluation of the Ovicidal Action of Nematode Predacious Fungus Pochonia chlamydosporia against Fasciola sp. In Water Buffaloes (Bubalus bubalis)	SC Ramos; VB Salting	DA-Biotech
Program Title: Enhancing Milk Production of Water Buffaloes through S&T Interventions	AN del Barrio	PCAARRD
Project 1: Development of Feeding Protocols and Practices to Support the Nutritional Requirement of Dairy Buffaloes	DL Aquino	
Project 2: Development of Reproductive Management Program for Increased Efficiency of AI in Dairy Buffaloes	EC Atabay	
Project 3: Development of Health Care Technologies and Practical Farm Practices in Support of Increasing Buffalo Milk Production	CN Mingala	

Project Title	Project Leader	Funding/Collaborating Agency
Project 4: Milk Quality and Safety Assurance from Farm to Milk Processing Plant	MP Abella	PCAARRD
Project 5: Strengthening San Agustin Crossbred Carabao-Based Enterprise Development (CBED) Model	AS Sarabia	
Operationalization of Livestock Biotechnology Center	CN Mingala	DA-Biotech
Strengthening Institutional R&D Capability to Improve Reproductive Efficiency	EC Atabay and MP Abella	PCAARRD
Enhancing the Buffalo Milk Production thru Philippine Carabao Center's NIZ Strategy	ZG Sanchez	
Utilization of DNA Marker Selection in Breeder and Commercial Swine Farm Units	EB Flores	
Establishment of Dairy Cattle Foundation Breeder Herd Thru ET Using Imported Pedigreed Frozen Embryos	J Lopez; EP Atabay	
Sero-surveillance and Isolation of Bovine Viral Diarrhea Virus, Parainfluenza Virus, and Herpes Virus in the Philippines affecting Large Ruminants	T Ito; CN Mingala	Japan Veterinary Products Association
Genetic assessment of Trypanosoma spp. towards vaccine development	C Saloma; CN Mingala	National Institute for Molecular Biology and Biotechnology, University of the Philippines, Diliman
Bovine Vaccine Trial of Schistosoma japonicum Paramyosin	M Jiz; CN Mingala	Research Institute for Tropical Medicine
Animal and Veterinary Sciences (Disease surveillance and vaccine development)	Y Aida; CN Mingala	Viral Infectious Diseases Unit, RIKEN, Japan
Evaluation of the efficiency of therapeutic antibody for persistent diseases in large ruminants (water buffalo and cattle)	S Konnai; CN Mingala	Department of Disease Control, Graduate School of Veterinary Medicine, Hokkaido University
Leptospira spp. research	Y Suzuki; CN Mingala; MA Villanueva	Division of Bioresources, Hokkaido University Research Center for Zoonosis Control

Title	Researchers	Summary/Abstract
Molecular Detection of Tetracycline Resistance Genes in Respiratory Bacterial Isolates of Small and Large Ruminants	AJ Francia, GG Garcia, MM Balbin, CN Mingala	The resistance of previously identified respiratory bacterial isolates (Acinetobater schindleri, Bacillus pumilus, Enterococcus faecalis, Pseudomonas aeruginosa, Staphylococcus sciuri and Staphylococcus sporosarcina) from small and large ruminants to tetracycline was evaluated. The conventional agar cup well method was applied in evaluating the sensitivity of the 6 isolates to different concentrations of tetracycline. Tetracycline resistance data generated from the antibiotic sensitivity test was further validated by amplification of genes that mediate tetracycline resistance through PCR. The aforementioned procedure required utilization of primers for efflux pumps (tet B), for ribosomal protective proteins (tet M) and enzyme inactivation (tet X). Results of the antibiotic sensitivity test demonstrated that the six (6) isolates were resistant to different concentrations of tetracycline as evidenced by the absence of zones of inhibition. DNA sequences of amplified products revealed tetracycline resistance in one isolate (E. faecalis) out of the 6 isolates tested. The DNA amplicon carrying the putative tetracycline resistance was recognized by the tet M and registered a molecular weight of 171 bp, close to the sequences of other genes in the gene bank that encode for tetracycline resistance. Results point out the involvement of ribosomal protective proteins encrypted in the tet M gene as a key mediator of tetracycline resistance in E. faecalis.
Optimization of Different Polymerase Chain Reaction Techniques for Sensitive Detection of Bovine Herpes Virus	RR Manuela, MM Balbin, LP Belotindos, JV Lazaro, and CN Mingala	Infectious bovine rhinotraheitis (BoHV-1) is recognized as one of the economically important diseases in ruminants. The detection of the infectious agent is usually conducted through serological techniques, virus isolation and recently, polymerase chain reaction. This study is conducted to optimize different PCR techniques for the detection of BoHV-1, which could be used in different diagnostic laboratories. Primers amplifying the gB viral surface was used to detect the BoHV-1. A synthetic plasmid or BoHV-1 gene was used as a positive control. Different PCR protocols such as single-step PCR, nested-PCR and real time PCR was optimized. The optimized protocol was also used in the detection of BoHV-1 in dairy cattle collected from farms in South Luzon. Each DNA sample was subjected to PCR. The PCR products are visualized under UV light and the presence of a compact band in the 385 bp size was noted.

Title	Researchers	Summary/Abstract
Production Performance of Dairy Buffaloes Fed With Distillers Dried Grain with Solubles	CA Alvaran	A total of 15 (Brazilian and Bulgarian) buffalo on their last month of pregnancy with an average weight of 624kg were used in the study to determine the effect of Distillers Dried Grain with Soluble in milk production, milk nutrient components, nutrient digestibility and economic viability. The treatments were randomly assigned to the buffaloes with uneven replication of 5, 5 and 4 following randomized complete block design (RCBD). The diets were: without DDGS (control), 25% DDGS AND 50% DDGS. Results showed numerical increase in milk production and milk nutrient components, however, statistical analysis disclosed no significant differences between the treatments. Buffaloes fed diet with 50% DDGS tended to increase intake of CP, while 25% in the diet increased the NDF intake. In terms of digestibility, however, NDF was shown to be higher in 25% than in 50% DDGS. While CPD revealed a comparable values in 25% and 50% DDGS. Incremental benefit from the sale value of milk in buffalo cows fed with 25 and 50% DDGS was realized compared to the buffalo cows without DDGS which is the highest IOFC from buffalo cows fed with 25% DDGS.
Comparative Gene Expression of SLA-1 and SLA-2 involved in Porcine Pre-Weaning and Post-Weaning Diarrhea	GG Garcia, MR Uy, JN Aquino, JC Sampang, R Abuyuan, and CN Mingala	The immune responses of piglets to diarrhea at pre-weaning and post-weaning were evaluated in terms of the relative quantification of MHC glycoproteins represented by the swine leukocyte antigen (SLA) class I. Expression of SLA-1 and SLA-2 genes of diarrheic and non-diarrheic Native and Large White piglets were measured using real time polymerase chain reaction (qPCR). A total of 20 pre-weaned and 20 post-weaned piglets were used in the study. cDNA samples were amplified with primers that recognized SLA-1 and SLA-2 alleles with amplicon size of 217 bp and 126 bp, respectively. Data analysis was computed using comparative threshold cycle (CT) method. Significantly higher levels of SLA-1 were noted in diarrheic pigs compared to those of non-diarrheic piglets ($P<0.0399$) of the Native and Large White breeds at pre-weaning period which is contrary to the comparable levels of SLA-1 in diarrheic and non-diarrheic piglets of the same breeds at post-weaning. This observation was not analogous with the non-significant differences in the concentration of SLA-2 expression deduced as SLA-linked immune responses of piglets from the Native and Large White breeds with and without diarrhea observed at pre-weaning and post-weaning stages. The upregulation of SLA-1 in piglets with diarrhea at pre-weaning in the two breeds of swine examined the participation of SLA-1 in the host's response to diarrhea. These data associate the significance of the SLA-1 gene as a marker for diarrhea in pre-weaning piglets.

Title	Researchers	Summary/Abstract
Development of Lactase-Treated Isotonic Drink from Whey	RF Amurao, LC Castillo, CM Lazo	Whey is oftentimes considered as an ignored by-product which is obtained during cheese production. To make it more useful, the innovation of whey like in the production of energy drinks became the study's main concern. This study aimed to produce a whey drink with reduced lactose using lactose using lactase enzyme and improve the sensory characteristics of the beverage. Whey was obtained from mozzarella cheese and was filtered and fermented with 1.67% of lactase for 1 hour at 23°C. The fermented whey was added with pectin and sugar and was homogenized for 3 minutes and was allowed to swell for 10 minutes. The sodium chloride, potassium chloride, sodium citrate, sodium monophosphate, and flavoring (mango, orange, and lemon) were added. The solution was pasteurized for 2 minutes at 90°C. The produced flavored whey drinks were subjected to lactose hydrolysis and the microbiological and physicochemical properties were monitored for 5 weeks. Consumer testing was also conducted. The results of the study showed that 92% of the lactose was hydrolyzed after fermentation. The total aerobic bacterial count, coliform, salmonella, E.coli, and yeast and mold count of the flavored whey drinks were below the standard value. On the other hand, in the consumer testing, it was found out that among the different flavors, mango flavor was the most liked in terms of overall acceptability, liking attributes, JAR, and purchase intention. However, lemon flavor was not significantly different as compared to the results obtained than that of the mango's. The penalty test suggested that the sourness of the mango flavor needs improvement. After this, the researchers concluded that lactase enzyme can reduce lactose content by 92% at 23°C for 1 hour and was recommended to improve the sourness of the mango.

Title	Researchers	Summary/Abstract
Agronomic Characteristics and Nutrient Composition of Pakchong 1 using Vermicast	DL Aquino, PL Llantada, and IC Dela Rosa	The study was conducted to determine the agronomic characteristics and nutrient composition of Pakchong 1 using vermicast grown under Philippine conditions. The study was laid out as 3x3 factorial design with 3 treatments (IF – inorganic fertilizer, VC – vermicast, and IF + VC – inorganic fertilizer + vermicast) and 3 cutting intervals (45, 52, and 60 days). Results showed, that the application of VC did not improve the agronomic characteristics of Pakchong 1 with regards to the herbage yield, dry matter yield (DMY), height, tiller count per hectare, and leaf to stem ratio. IF application attained a yield of 510 tons per hectare per year and a DMY of 109 tons per hectare per year with a cutting interval of 45 days compared to the application of VC. However, during the 2nd cycle, the application of VC gave the highest yield compared to IF and IF + VC despite the leaf spot fungus that appeared on Pakchong 1. Meanwhile, the nutrient composition gave significant results ($P<0.01$) which gave interaction effects. The data gathered on the highest %Ash is 12.68% at 45 days of age treated with IF. The highest %CP is 11.32% treated with IF + VC harvested at 45 days of age. The highest %NDF is 60.55% at 45 days of age. The mean %DM in cycle 1 and cycle 2 is 20.58% and 18.17% respectively. The dry matter content and %NDF also increases as the cutting interval increases. However, %ash and %CP decreases as the cutting interval increases or as the plant matures.
Molecular Characterization and Comparison of Phospholipase C Zeta between swamp type and riverine type buffalos	EP Atabay, R Tadeo, EC Atabay, EV Venturina, R Fissore, and CN Mingala	Phospholipase C zeta (PLCZ1), a novel sperm-specific protein which is widely known to induce oocyte activation following fertilization, had already been characterized in various mammalian species, but not in water buffaloes thus far. While it has been found to be highly conserved among mammalian species studied to date, species-specific differences in terms of sequences, activities and expressions have been reported. Thus, the present study was conducted to initially characterize and compare the sequences of PLCZ1 gene of Swamp and Riverine Buffaloes. Semen samples were collected, total RNA was extracted and reverse-transcribed. PLCZ1 cDNA was then amplified, subjected to gel electrophoresis, and submitted for sequencing. Molecular characterization of buffalo PLCZ1 yielded a sequence of 1905 basepair nucleotides translated into 634 bp amino acids. Sequence analysis of Buffalo PLCZ1 gene revealed a structural EF hand, X and Y catalytic, and C2 domains, which are comparable with those of other species studied. Generally, the buffalo PLCZ1 was found to have high sequence identity with cattle and other domestic species. Similarly, significant residues and motifs in PLCZ1 sequence are found conserved in water buffaloes. However, there are variations in sequences identified between the two breeds of buffaloes that may play a role in the breed or species-specific differences in terms of gene and protein expression, physiological mechanisms, and biological functions. The molecular information on buffalo PLCZ1 is highly valuable in subsequent works such as the development of biomarkers for bull fertility and correlation studies on the identified gene variations with semen quality and fertility.

Appendix 5a. Research articles published in refereed journals, CY 2016

Authors	Title of Paper	Title of Journal
EC Atabay and EP Atabay	Production of Water Buffalo Clone Embryos Using Ear Skin Fibroblasts as Donor Cell in Nuclear Transfer	Philipp. J. Vet. Med., 53(2): 126-134, 2016
ERS Maylem,EP Atabay, EC Atabay , and EV Venturina	Identification of sperm subpopulations in water buffalo ejaculates: Changes in cryopreservation stages and bull variation (Abstract only)	Medicina Veterinaria Y Zootecnia, Septiembre-Diciembre 2016, p. 100
PG Duran, DH Duran, FV Mamuad, MD Peralta, EV Venturina, FA Venturina and HV Venturina	Fourier harmonic analysis in comparison with hypoosmotic swelling test and computer assisted sperm analysis in examining the quality of water buffalo bull semen (Abstract only)	Medicina Veterinaria Y Zootecnia, Septiembre-Diciembre 2016, p. 102
LC Ocampo, LM Rigos, and MB Ocampo	Factors influencing the maturation, fertilization and development of swamp buffalo oocyte in vitro	Research Opinions in Animal and Veterinary Science, 6(1): 24-31
MB Ocampo, JQ Silvestre, VD Viernes, and LC Ocampo	Live birth after transfer of vitrified embryos from superovulated goats	Research Opinions in Animal and Veterinary Science 6(2):47-52
JJ Gautane, EJY Balagan, FV Manaois II, MB Ocampo, and LC Ocampo	Characteristics of epididymal sperm recovered from slaughterhouse derived testes of non descript goats in the Philippines	International Journal of Agricultural Technology, 12 (2) pp. 215-218
EJP Valete, LC Ocampo, FP Aquino, KJ Cruz and MB Ocampo	Sperm concentration influences the post-thaw livability of frozen goat semen	Research Opinions in Animal and Veterinary Science 6(5): 158-164
LC Ocampo, EF Celestino Jr, FP Aquino and MB Ocampo	Developmental competence of water buffalo oocytes in a synthetic oviductal fluid base medium	Research Opinions in Animal and Veterinary Science 2016, 6(6): 173-177
JRV Herrera, EB Flores, C Gondro and J van der Werf	Performance of the Axiom 90k Buffalo Genotyping Array in Four Philippine Water Buffalo Populations (Abstract only)	Medicina Veterinaria Y Zootecnia, Septiembre-Diciembre 2016, p. 101
MA Villanueva, CN Mingala, N Gloriani, Y Yanagihara, N Isoda, C Nakajima, Y Suzuki and N Koizumi	Serological Investigation of Leptospira infection and its circulation in one intensive-type water buffalo farm in the Philippines	The Japanese Journal of Veterinary Research DOI: 10.14943/ jjvr.64.1.15
A Nipal, V Viloria, C Baltazar, NS Abes and CN Mingala	Retrospective assessment of mortality causes of water buffalo (Bubalus bubalis) in Nueva Ecija, Philippines from 2010-2013	Advances in Environmental Biology, 9(24) Nov. 2015, 339-346
V Venturina, MA Alejandro, CP Baltazar, NS Abes and CN Mingala	Evidence of Fasciola spp. resistance to Albendazole, Triclabendazole nd Bromofenofos in water buffaloes (Bubalus bubalis)	Annals of Parasitology DOI: 10.17420/ ap6104.20
NP Medina and CN Mingala	Transporter protein and drug resistance of Trypanosoma	Annals of Parasitology DOI: 10.17420/ ap6201.26

Appendix 5a. Research articles published in refereed journals, CY 2016

Authors	Title of Paper	Title of Journal
RBC Padiernos and CN Mingala	Molecular comparison of Slclla1 and Slclla2 genes of swamp- and riverine-type water buffaloes	International Journal of Immunogenetics DOI: 10.1292/jvms.16-0280
T Collantes,T Barroga and CN Mingala	Larvicidal activity of nematophagous fungi (Duddingtonia flagrans) against common strongyle worms of Buffaloes (Bubalus bubalis)	Philippine Journal of Veterinary and Animal Science, PhilippJVet AnimSci 2016, 42(1):49-58
MA Villanueva, CN Mingala, MM Balbin, C Nakajma, N Isoda, Y Suzuki and N Koizumi	Molecular epidemiology of pathogenic Leptospira spp. among large ruminants in the Philippines	Journal of Veterinary Medical Science DOI: 10.1292/jvms.16-0289
S Ramos, CN Mingala, EJY Balagan, L Domingo and F Dimalanta	Molecular Evaluation of Pork, Beef, and Poultry Meat sold in Nueva Ecija, Philippines for the presence of Horse (Equus caballus) and Rat (Rattus rattus)	Philippine Journal of Veterinary Medicine **PJVM** 53(1):34-41, January 2016
MM Balbin, B Lertanantawong, W Suraruengchai and CN Mingala	Colorimetric detection of caprine arthritis encephalitis virus (CAEV) through loop-mediated isothermal amplification (LAMP) with gold nanoprobes	Small Ruminant Research DOI:10.1016/j. smallrumres.2016.11.021
J Manalaysay, N Antonio, RL Apilado, J Bambino and CN Mingala	Screening of Bax gene polymorphism associated with scrotal hernia in domesticated swine using polymerase chain reaction-restriction fragment length polymorphism	Asian Australian Journal of Animal Science 30 (2): 262-266
GG Garcia, JP Aquino, JC Sampang, RA Abuyuan, MR Uy, and CN Mingala	Investigation of Sla-1 and Sla-2 gene expression involved in porcine pre-weaning and post-weaning diarrhea	Thai Journal of Veterinary Medicine (accepted)
EP Palacpac, E Valiente, R Jacang	Measuring the adoption of Improved Feeding Practices by Small-hold Dairy Buffalo Farmers in Nueva Ecija, Philippines (Abstract only)	Medicina Veterinaria Y Zootecnia, Septiembre-Diciembre 2016, p. 45

Appendix 5b. Research articles published in scientific proceedings

Authors	Title of Paper	Title of Proceedings
LC Ocampo, JJ Gautane, A Verdadero, FP Aquino, and MB Ocampo	Freezability and Fertilizing capability of epididymal sperm extracted from post mortem goat testicles	Abstracts of Proceedings of the International Conference on Nature Studies and Innovations for the Environment, Silliman University , Dumaguete City Philippines , May 24-28, 2016 pp 93-94
AC Bumanlag, MEC Leoveras, FP Aquino and LCOcampo	Survivability of frozen epididymal sperm from non –descript goats after liquid nitrogen vapor cooling	Abstracts of Proceedings of the International Conference on Nature Studies and Innovations for the Environment, Silliman University , Dumaguete City Philippines, May 24-28, 2016 pp85-86

Appendix 5b. Research articles published in scientific proceedings

Authors	Title of Paper	Title of Proceedings
EJP Valete , EDC Leoveras, FP Aquino and LC Ocampo	Characteristics of epididymal sperm from Philippine native goats (Capra hircus)	Abstracts of Proceedings of the International Conference on Nature Studies and Innovations for the Environment, Silliman University , Dumaguete City Philippines, May 24-28, 2016 p. 72
LC Ocampo, EJP Valete, EA Abella, and MB Ocampo	Effect of Post-Mortem Storage of Testicles on the Quality and Fertilizing Ability of Water Buffalo Epididymal Sperm	17th Animal Science Congress of AAAP, Fukuoka, Japan August 22-25, 2016
LA San Diego, AC Bumanlag, MB Ocampo and LC Ocampo	Carabao epididymal sperm from post mortem testes remain alive for up to 24 hours in semen extender at refrigerated temperature	Abstracts of the Proceedings of the International Congress and General Meeting of the International Southeast Asian Agricultural Sciences (ISSAAS), Vietnam National University of Agriculture, Hanoi, Vietnam, November 5-7, 2016, pp285-286
HLM Harada, AC Bumanlag, MB Ocampo and LC Ocampo	Post thaw survivability after cryopreservation of epididymal sperm from goat testicles held at 4-6°c during transport	Abstracts of the Proceedings of the International Congress and General Meeting of the International Southeast Asian Agricultural Sciences (ISSAAS), Vietnam National University of Agriculture, Hanoi, Vietnam, November 5-7, 2016, pp284-285
RA Garcia, V Viernes, MB Ocampo and LC Ocampo	Recovery of epididymal sperm from post mortem goat testicles using 0.9% NaCl isotonic solution	Abstracts of the Proceedings of the International Congress and General Meeting of the International Southeast Asian Agricultural Sciences (ISSAAS), Vietnam National University of Agriculture, Hanoi, Vietnam, November 5-7, 2016, p. 287
AC Bumanlag, HLM Harada, MB Ocampo, LC Ocampo	Sperm motility assessment of epididymal sperm from post mortem goat testicles held at refrigerated condition	Abstracts of the Proceedings of the International Congress and General Meeting of the International Southeast Asian Agricultural Sciences (ISSAAS), Vietnam National University of Agriculture, Hanoi, Vietnam, November 5-7, 2016, pp284-285
MB Gajeton, JV Tomas, MB Ocampo and LC Ocampo.	Morphological assessment of post mortem epididymal spermatozoa from bucklings using differential staining technique	Abstracts of the Proceedings of the International Congress and General Meeting of the International Southeast Asian Agricultural Sciences (ISSAAS), Vietnam National University of Agriculture, Hanoi, Vietnam, November 5-7, 2016, p. 286

Appendix 5b. Research articles published in scientific proceedings

Authors	Title of Paper	Title of Proceedings
PG Duran, DH Duran, FV Mamuad, MD Peralta, EV Venturina, FA Venturina and HV Venturina	Classification of water buffalo bulls according to fertility using Fourier Harmonic Analysis	ISSAAS Philippines 2016 National Congress and General Meeting, PCC-NHGP, October 17-19, 2016, p. 102
MA Villanueva	Epidemiological investigation of Leptospira and its circulation in one intensive-type water buffalo farm in the Philippines	53rd PSAS Scientific Seminar and Annual Convention Proceedings, Pasay City, Manila, October 20-21, 2016, p. 9
MA Miguel, MR Uy and CN Mingala	Detection of Mycobacterium avium subsp. paratuberculosis (MAP) in water buffaloes using enzyme-linked immunosorbent assay (ELISA) and real-time polymerase chain reaction (rtPCR)	53rd PSAS Scientific Seminar and Annual Convention Proceedings, Pasay City, Manila, October 20-21, 2016, p. 38
S Ramos and CN Mingala	Genotyping and molecular detection of polymorphism in fucosyltransferase 1 gene of swine for resistance or susceptibility to enterotoxigenic Escherichia coli F18	53rd PSAS Scientific Seminar and Annual Convention Proceedings, Pasay City, Manila, October 20-21, 2016, p. 37 25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 174
MA Miguel and CN Mingala	Screening of swine (Sus scrofa) bactericidal permeability-increasing protein (BPI) gene as marker for disease resistance	53rd PSAS Scientific Seminar and Annual Convention Proceedings, October 20-21, 2016, p. 40 25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 142
KJB Prades, CR Castañeda, and EB Flores	Foreign body detection in the reticulum in a 7-year old Barzilian Murrah buffalo (Bubalus bubalis) using ultrasonography	53rd PSAS Scientific Seminar and Annual Convention Proceedings, Pasay City, Manila, October 20-21, 2016, p. 27
LM Labonite; HM Cruz; SD Matias; MN Reyes; JRV Herrera; EB Flores	Genetic Polymorphism of Heart Fatty Acid-binding protein and insulin-like Growth Factor 2 Associated with Lean Content and intramuscular Fat in Local Pigs (Sus scrofa)	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 158
AJDS Escuadro; LP Villamor	Genetic Variation of Bubalus bubalis Swamp Type Buffaloes in Luzon Populations using Microsatellite Markers-are They Polymorphic?	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 161
LM Labonite; JRV Herrera; HM Cruz; SD Matias; MN Reyes; RM Dela Cruz; EB Flores	Estrogen Receptor, Prolactin Receptor and Leukemia Inhibitory Factor Gene Polymorphisms and its Impact on Reproductive Traits of Local Commercial Pigs (Sus scrofa)	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 167

Appendix 5b. Research articles published in scientific proceedings

Authors	Title of Paper	Title of Proceedings
AM Paraguas; TP Cailipan; LP Villamor	Mitochondrial DNA Cytochrome C Oxidase Subunit I (COI) Haplo-Types of Bubalus bubalis Swamp Type Buffalo in Luzon Population-Any Significance?	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 172
D Atalan III; AM Paraguas; AJDS Escuadro; EB Flores; LP Villamor	Philippine Carabao in Luzon with Combined Phenotypic and Genotypic Characterization-Homogeneous or Not?	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 229
HM Espiritu; LP Villamor	Molecular Phylogeny of the Bubalus bubalis Based on the Mitochondrial Cytochrome-B Gene-An In-Silico Analysis	25th FAOBMB International Conference & 43rd PSBMB Annual Convention, PICC, Manila, December 5-7, 2016, p. 137

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
INTERNATIONAL				
1	Post-Doctoral Research (Fullbright)	USA	January 12-June 12	1
2	Armidale Genetics Summer Course 2016: Investigating the Genetic Architecture of Complex Traits & Prediction of Phenotype from Genome-wide SNPs	Australia	February 1-5	2
3	Asia Pacific Rural Finance & Community Development Conference	Thailand	March 23	3
4	Plant and Animal Genome (PAG) Asia	Singapore	June 7-9	1
5	Summer School of Computational Biology for Infectious Diseases	Vietnam	September 18-25	1
6	DairyAsia – First meeting of the Dairy Asia Technical Working Group on Dairy Genetics	Thailand	November 7-9	1
7	11th World Buffalo Congress	Colombia	November 23-25	3
8	Japan Veterinary Products Association Annual Convention	Japan	December 21-22	1

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
LOCAL				
1	Flow Cytometer Operation Training	PCC, SCM, Nueva Ecija	January 4-8	2
2	Knowledge Management Practitioner Certification	Online	January 25-June 5	6
3	Effective Business Writing,Inform,Impress & Influence : Upgrade Year Communication Skill and Series	Greenhills, Manila	February 10	4
4	Orientation Course in Competency Modelling And Profiling	DAP, Pasig City	February 16	1
5	83rd PVMA Scientific Conference And Annual Convention	Davao City	February 17-19	2
6	Statistical Data Management And Analysis Using Ms Excel	UP, Diliman, Quezon City	February 18	4
7	Windows Server 2008. Server Administrator	España, Manila	March 5	1
8	8th Annual National Convention of Electronic Financial Users Circle (EUC) Inc	Iloilo City	March 8	2
9	Basic Occupational & Health & Safety	Baguio City	March 11-14	4
10	Prepress Survival Guide Step by Step	Mandaluyong City	March 21	3
11	Content Management Training for PCC Cross-Regional Learning and Thematic Communities of Practice	Online	March 28-October 13	22
12	Basic Training Course On AI & PD	-	April 4	1
13	Project Monitoring and Evaluation using Statistics	-	April 4	1
14	ICT for disaster risk reduction, climate change, green growth and sustainable development seminar	Diliman, Quezon City	April 5	1
15	Waters HPLC/UPLC Overview And Empower Software Training	Makati City	April 6	13

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
	LOCAL			
16	Impact Evaluation of Projects	-	April 11	1
17	19th Dairy Congress & Expo. (DairyCon Ex)	Dumaguete City	April 13	2
18	Training of Trainers on Writing Effective Knowledge Products	Basco, Batanes	April 18-21	26
19	Principle & Applications of Chromatography	-	April 20	1
20	Training on R.A 9184 & Its IRR And Preparation of Phil Bidding Documents	Manila	April 21	3
21	Adobe Illustrations CC & CS6 (Advanced Graphix Design)	Makati City	April 26	3
22	PCC's R4D Preinhouse Review	PCC, SCM, Nueva Ecija	April 26-27	85
23	Photo Editing and Management with Adobe Photoshop Light room	Makati City	May 11	2
24	Innovation Platforms, Rural Advisory Services, and Knowledge Management towards Inclusive and Sustainable Agricultural and Rural Development	SEARCA, Los Baños, Laguna	May 17-19	1
25	Introduction to the Next Generation Sequencing Data Analysis	CLSU, SCM, Nueva Ecija	May 20	11
26	Seminar on the Implementation of GAM for NGAS	Baguio City	May 23	6
27	2016 International Conference in Nature Studies and Innovation in the Environment	Dumaguete City	May 24	3
28	2016 Public Sector Symposium	-	May 23-25	1
29	Social Media Marketing For Business	Greenhills, San Juan	May 26	1
30	ISO 9001:2015 Transition Course	Los Baños, Laguna	May 30	5

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
	LOCAL			
31	Property and Supply Management System	COA	June 7	1
32	Production Management	Makati City	June 8	1
33	PSAS Mindanao Chapter Annual Convention	Davao City	June 9-10	4
34	PSAS Ilocos Chapter Lecture Series	Batac, Ilocos Norte	June 16-17	2
35	Prepress Essentials: Understanding the Digital Production Workflow (seminar)	Makati City	June 16	2
36	PCC's R4D Annual Inhouse Review	PCC, SCM, Nueva Ecija	June 27-28	120
37	NAST Annual Scientific Meeting	Manila	July 13-14	1
38	4th Farm Tourism Conference	Tagaytay City	July 14	3
39	National Symposium on Agriculture, Aquatic, and Natural Resources Research and Development	PCAARRD, Los Baños, Laguna	July 27	6
40	JAAP Annual Conference and General Assembly	Pasay City	July 29	1
41	Business Workshop and Project Viability Analysis	PCC, SCM, Nueva Ecija	August 3-5	55
42	Network Administration using Windows Server	Baguio City	August 4-19	1
43	ISO 31000:2009 Risk Management Course	Subic, Zambales	August 16	6
44	Essentials and Supervision	ADMU, Manila	August 22,23, 30	1
45	1st International Symposium on Livestock Biotechnology	Manila	August 26	41

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
LOCAL				
46	Fulbright Phil Agriculture National Conference	General Santos	September 4-7	3
47	AI Technical Discussion for PCC Luzon Cluster	Batac, Ilocos Norte	September 5-7	1
48	Molecular Phylogenetics Workshop	PCC, SCM, Nueva Ecija	September 12, 19, 26	7
49	AI Summit for PCC Mindanao Cluster	Maramag, Bukidnon	September 19-20	3
50	4th Annual Swine Commodity Program R&D Review	Los Baños, Laguna	September 22	1
51	PSAS Cagayan Valley Chapter Convention	Tuguegarao City	September 23	2
52	PSAS Bicol Chapter Lecture Series	Pili, Albay	September 29	1
53	KM4CBE Environmental Scanning: Workshop on Opportunities for and Threats to Carabao-Based Enterprises	Clark, Pampanga	September 29-30	21
54	Updates on Regulatory requirements for procurement, importation and usage of chemicals	Alabang, Muntinlupa	October 7	6
55	League of Agricultural Biotechnology Students Career Orientation Seminar	Los Baños, Laguna	October 17	2
56	ISSAAS Philippines National Congress and General Meeting	PCC, SCM, Nueva Ecija	October 17-18	3
57	Management skills for new leaders	-	October 18-19	1
58	53rd PSAS Scientific Seminar and Annual Convention	Heritage Hotel, Pasay City	October 19-21	34
59	12th National Research Symposium	DA-BAR, Quezon City	October 25-27	3
60	AI Technical Discussion DA-CAR	Baguio City	October 26-27	1

Appendix 6. Conferences, Seminars, Symposia, Workshops, and Trainings Participated in by PCC Personnel, CY 2016.

No.	Title	Venue	Date (2016)	No. of Participants
LOCAL				
61	Gov't Procurement: comprehensive updates	Tagaytay City	October 26-29	8
62	Innovators in Governance	Tagaytay City	November 9-10	5
63	National Biotechnology Week	Manila	November 21-25	20
64	AI Technical Discussion for PCC Visayas Cluster	Mandawe City	November 23-25	1
65	PICPA National Convention	Davao City	November 23-26	2
66	2016 Luzon Convention of HRMS	PICC, Manila	November 28-30	2
67	Hands on training & encoding for AFMechRDEN	Clark, Pampanga	November 28	4
68	Validation Workshop for AFMechRDEN	Clark, Pampanga	November 28	1
69	PACS Annual Meeting	Alabang, Muntinlupa CIty	November 29	5
70	25th FAOBMB International Conference & 43rd PSBMB Annual Convention	PICC, Manila	December 4-8	19
71	Forecasting & ordering, delivery, inspection,acceptance, custodianship, issuance & utilization disposal & appraisal of gov't properties	COA, Regional Office, Pampanga	December 6-9	2
72	Seminar/workshop: Genomic Prediction in the Age of Next generation sequencing (NGS)	PCC, SCM, Nueva Ecija	December 12-16	25

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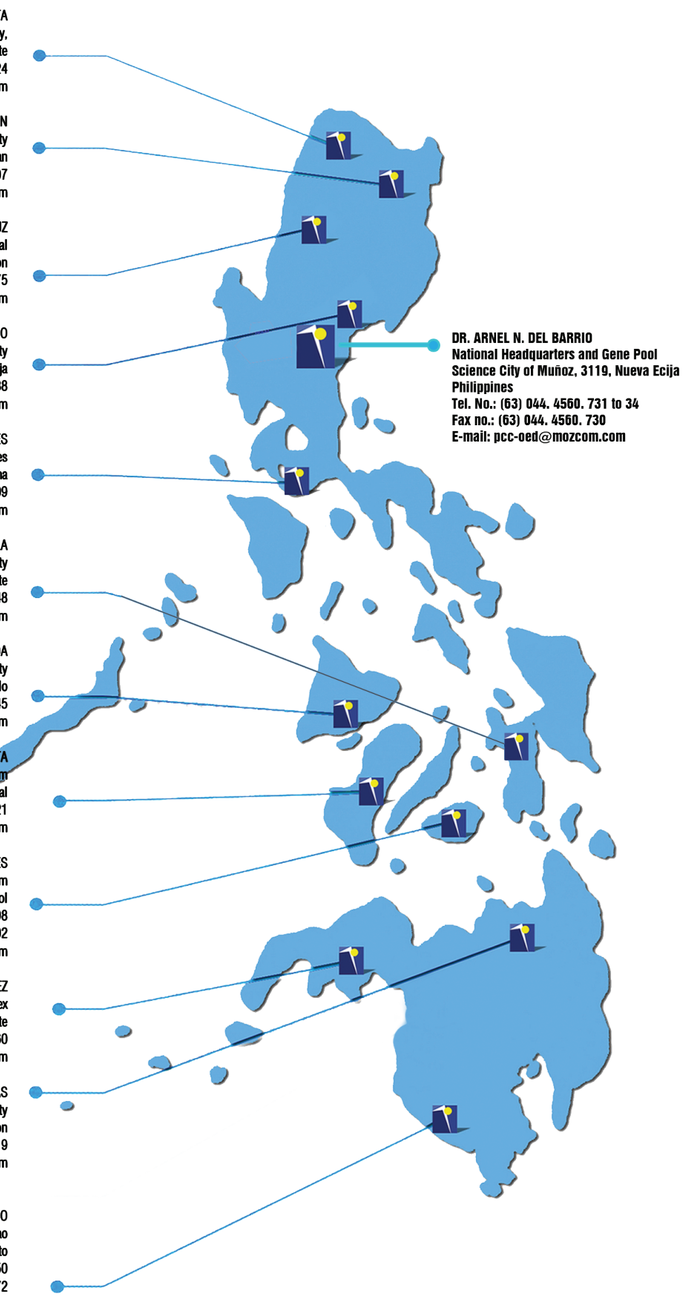
President, Central Luzon State University, Science City of Muñoz, Nueva Ecija

DR. LIZA G. BATTAD
Board Secretary

PCC DIRECTORY



DIR. GRACE MARJORIE R. RECTA
PCC at Mariano Marcos State University,
Batac City, Ilocos Norte
Tel. No.: (63) (077) 792.3187 | CP No.: 0927.956.5724
E-mail: pccmmsu@gmail.com

DIR. FRANKLIN T. RELLIN
PCC at Cagayan State University
Tuguegarao City, Cagayan
CP No.: 0916.752.8507
E-mail: pccpiat07@yahoo.com

DIR. GLORIA M. DELA CRUZ
PCC at Don Mariano Marcos Memorial
State University, Rosario, La Union
CP No.: 0930.782.6038 / 0908.864.9975
E-mail: pccdmmmsu95@yahoo.com

DR.DANIEL L. AQUINO
PCC at Central Luzon State University
Science City of Muñoz, Nueva Ecija
Tel. No.: (63) (044) 456.5238
E-mail: pcc.clsu@yahoo.com

DR. THELMA A. SALUDES
PCC at University of the Philippines
at Los Baños, Laguna
Tel. No.: (63) (049) 536.2729 | (63) (049) 534.2009
E-mail: pccuplb@gmail.com

DR. JULIUS V. ABELA
PCC at Visayas State University
Baybay City, Leyte
Tel. No.: (63) (053) 335.5648
E-mail: pccvsu@gmail.com

DIR. ARN D. GRANADA
PCC at West Visayas State University
Calinog, Iloilo
Tel. No.: (63) (033) 320.2445
E-mail: pccwvsu@yahoo.com

DIR. ARIEL L. ABAQUITA
PCC at La Carlota Stock Farm
La Granja, La Carlota City, Negros Occidental
Tel. No.: (63) (034) 735.0121
E-mail: pcclcsf@yahoo.com

DR. CARO B. SALCES
PCC at Ubay Stock Farm
Ubay, Bohol
Tel. No.: (63) (038) 518.5598
CP No.: 0919.809.6791 | 0916.834.1202
E-mail: pccusf.ubay@yahoo.com

DR. CECELIO G. VELEZ
PCC at Mindanao Livestock Production Complex
Kalawit, Zamboanga del Norte
CP No.: 0949.404.4559 | 0906.956.9060
E-mail: pcc-mlpc09@yahoo.com

DR. LOWELL C. PARAGUAS
PCC at Central Mindanao University
Maramag, Bukidnon
CP No.: 0939.133.9815 | 0939.916.9719
E-mail: pccmusuan@yahoo.com

DIR. BENJAMIN JOHN C. BASILIO
PCC at University of Southern Mindanao
Kabacan, North Cotabato
Tel. No.: (63) 064.248.2250
CP No.: 0919.397.0872
E-mail: usm_pcc@yahoo.com

DR. ARNEL N. DEL BARRIO
National Headquarters and Gene Pool
Science City of Muñoz, 3119, Nueva Ecija
Philippines
Tel. No.: (63) 044. 4560. 731 to 34
Fax no.: (63) 044. 4560. 730
E-mail: pcc-oed@mozcom.com

www.pcc.gov.ph

PHILIPPINE CARABAO CENTER

National Headquarters and Gene Pool
Science City of Muñoz, 3120 Nueva Ecija
Philippines
Tel. Nos: (+63)44 456-0731 to 34
Fax No: (+63)44 456-0730
Email: oed@pcc.gov.ph

Manila Liaison Office
5F DCIEC Bldg., NIA Complex EDSA
Diliman, Quezon City
Philippines
Tel. No.: (63) 02 921.3863
Fax No.: (63) 02 926.7077
E-mail: pcc-mlo@mozcom.com