



PHILIPPINE
CARABAO
INDUSTRY
ROADMAP 2022-2026





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**CARABAO
INDUSTRY**
ROADMAP 2022-2026



Department of Agriculture

PHILIPPINE CARABAO CENTER

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The Philippine Carabao Industry Roadmap (2022-2026)

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TABLE OF CONTENTS

TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF ANNEXES	xi
ACRONYMS AND ABBREVIATIONS	xii
MESSAGE	xv
FOREWORD	xvi
PREFACE	xvii
EXECUTIVE SUMMARY	1
INTRODUCTION	5
Background and Rationale	5
Objectives	6
CARABAO INDUSTRY ROADMAP 2022-2026	
GLOBAL PERSPECTIVE	8
World Buffalo Meat and Milk	9
Carabao Industry Situation and Outlook	11
Development Perspective	11
Farm Mechanization	12
Importation of Buffalo Meat	12
Institutionalization of the Carabao Development Program	13
Industry Performance	16
Meat Production	16
Milk Production	18
Industry Outlook	20
Increasing Population, Urbanization, and Increase in Income	20
Niche Market for Buffalo-Derived Milk Products	21
School-based Milk Feeding Program	21
Industry Analysis	23
Value Chain Analysis	23
Carabao's Milk and Milk Products	23

Carabao's Meat and Meat Products	26
Price Structure Along the Market Channels	28
Summary of Identified Constraints	30
Pre-Farm Gate	30
Limited Access to Credit	30
Development of Partnership Modalities with LGUs, NGAs, and NGOs	30
Improving Capabilities and Capacities for Policy Research, Product Development, Marketing, and in Business Process	31
Expanding Focus on Enhancing Technology Flow from Laboratories to Farmer Users	31
In-Farm	32
Feed-based Constraints	32
Animal-based Constraints	32
Post-Farm Gate	35
Milk Quality Assurance	35
Access to Market	36
SWOT Analysis	37
Strengths	37
Weaknesses	38
Opportunities	40
Threats	41
Farm Income/Cost and Return Analysis	43
Consumption Trend	44
Price Competitiveness	45
Nondairy Alternatives	47
Plant-based Meat Products	47
Vegan Leather	48
VISION, MISSION, OBJECTIVES	49
Vision	49
Mission	49
Objectives	49
STRATEGIES AND POLICIES	50
Sector-Wide (Towards Meat and Draft) Program	51

Massive Bull Entrustment	51
Support to the Establishment of “Livestock Hotel” and Fattening Facility	53
Specialized Buffalo Dairying Program	55
Germplasm Infusion (live stocks and embryos from elite donors)	55
Directed Backcrossing	55
Use of Sexed Semen	56
Privatization and Expansion of AI system	57
Buy Back Scheme	57
Rearing of Replacement Heifers	58
Dairy Herd Improvement	59
Dairy Buffalo Business Hub	59
Crosscutting Programs	60
Feed Base Development Program	60
Animal Health and Safety Assurance Program	61
Product Development Center	61
Business Center and Export Portal	62
Special Credit Window Facilitation	62
Research, Development, and Innovation	62
Human Resource Development	63
One DA Reform Agenda	64
PROGRAM TARGETS	65
BUDGETARY REQUIREMENTS, in million pesos	67
IMPLEMENTATION SCHEDULE	69
RESPONSIBILITY MATRIX	70
CONCLUSIONS	71
MONITORING AND EVALUATION	76
Policy	76
Industry Level	76
Program Level	77
REFERENCES	79
ANNEXES	81

LIST OF TABLES

Table 1.	Water Buffalo Population in the World, Asia and the Philippines, 2019	8
Table 2.	Changes in Water Buffalo Inventory, 2009 vs 2019	9
Table 3.	World and Regional Production of Buffalo Meat and Milk, 2019	10
Table 4.	World Per Capita Meat Consumption, 1961-2013	10
Table 5.	Recorded Introduction of Riverine Buffalo (Live Animals) to the Philippines, 1917-2013	14
Table 6.	Carabao Inventory and Meat Production, 2014-2020	16
Table 7.	Average Annual %Change in Carabao Inventory, Annual Production and Average Annual Carabeef Importation, 2000-2020	17
Table 8.	Classification of Carabaos According to Sex and Age Groups, 2018-2020	17
Table 9.	Milk Production by Animal Type, '000 liters, 2014-2019	18
Table 10.	Inventory of Dairy Animals, 2014-2019	19
Table 11.	Projected Human Population, Philippines, 2020-2035	20
Table 12.	Summarized Average Annual Growth Rates of Total Dairy Imports, RTD, Butter, and Cheese	21

Table 13.	Projected Number of Populations Aged 1-14 Years Old, Philippines, 2020-2035	22
Table 14.	Price Structure of Buffalo (in Liveweight and Carcass) in Selected Regions in Luzon, PHP/kg, 2014	28
Table 15.	Price Structure of Buffalo Milk (Raw and Pasteurized) in Regions 1-4A, PHP/kg	29
Table 16.	Price Increment Per Market Channel of Buffalo Milk in Regions 1-4A, 2014, PHP/kg	29
Table 17.	Summary Investment and Profitability Indicators for 5,10,15, and 20-Head Dairy Buffalo Modules	43
Table 18.	Global Per Capita Consumption Pattern of Meat, 1961-2013	44
Table 19.	Per Capita Meat Consumption Pattern in the Philippines, 2000 vs 2019	45
Table 20.	Price Comparison of Meat from Various Sources	46
Table 21.	Import of Indian Carabeef *	46
Table 22.	Estimated Number of Potential Purebred Bulls for Bull Entrustment Program, 2022-2026	52
Table 23.	Estimated Inventory of Female Dairy Buffalo Stocks as Potential Sources of Milk, 2022-2026	71
Table 24.	Summary Milk Production of Dairy Buffaloes, with Sexed Semen for AI, Directed Backcrossing, Buy Back, and Stock Infusion, '000 liters, 2022-2026	72

LIST OF FIGURES

Figure 1a. Value Chain Map of Carabao’s Milk and Milk Products in Luzon, (2014-2015) (Lantican et al., 2015)	24
Figure 1b. Value Chain Map of Carabao’s Milk and Milk Products in Visayas and Mindanao (2015) (Lantican et al., 2016)	25
Figure 2a. Value Chain Map of Carabao’s Meat and Meat Products in Luzon (2014-2015) (Lantican et Al., 2015)	26
Figure 2b. Value Chain Map of Carabao’s Meat and Meat Products in Visayas and Mindanao (2015) (Lantican et al., 2016)	27
Figure 3. The Roadmap Strategies Categorized According to the OneDA Pillars: Consolidation, Modernization, Industrialization, and Professionalization	64
Figure 4. Estimated Effect of Use of Sexed Semen on Water Buffaloes for the Production of Female Offspring, 2022-2026	72
Figure 5. Estimated Total Milk Production of Water Buffaloes with Buy Back, Stock Infusion, and Sexed Semen for AI, 2022-2026	73

LIST OF ANNEXES

Annex I	Water Buffalo Inventory in the World, Asia, Philippines and Selected Countries, 2000-2019	82
Annex II	Changes in Swamp Buffalo Inventories in Asian Countries, 2009 Vs. 2009	83
Annex III	Carabao Inventory, Extraction Rate and Self Sufficiency, Philippines, 2000-2020	83
Annex IV	Inventory and Meat Production, '000 Tons, 1982-2020, Philippines	84
Annex V	Philippines: Urbanization From 2010 - 2020	84
Annex VI	Priority Ranking of Issues/Constraints in the Carabao Industry VCA, Philippines, 2014/2017	85
Annex VII	Projected Income Statement (Zero Debt, 5-Cow Dairy Business Module)	86
Annex VIII	Projected Income Statement (Zero Debt, 10-Cow Dairy Business Module)	90
Annex IX	Projected Income Statement (Zero Debt, 15-Cow Dairy Business Module)	94
Annex X	Projected Income Statement (Zero Debt, 20-Cow Dairy Business Module)	98
Annex XI	Important Areas in Carabao Sector VC For RDE	102
Annex XII	Recommendations on Aligning RDE with the VCA Concerns	104
Annex XIII	Carabao Roadmap Milestone 2022-2026	108

ACRONYMS AND ABBREVIATIONS

ACPC	Agricultural Credit Policy Council
AI	Artificial Insemination
BAI	Bureau of Animal Industry
BAR	Bureau of Agricultural Research
BDCU	Business Development and Commercialization Unit
CDA	Cooperative Development Authority
CDP	Carabao Development Program
CLSU	Central Luzon State University
CME	Cow Milk Equivalent
CMU	Central Mindanao University
COA	Commission on Audit
CIR	Carabao Industry Roadmap
DA	Department of Agriculture
DA-RFU	Department of Agriculture-Regional Field Unit
DBP	Development Bank of the Philippines
DepEd	Department of Education
DHI	Dairy Herd Improvement
DOH	Department of Health
DOLE	Department of Labor and Employment
DOST	Department of Science and Technology
DRM	Dairy Roadmap
DTI	Department of Trade and Industry
DSWD	Department of Social Welfare and Development
DTRI	Dairy Training and Research Institute

FAO	Food and Agriculture Organization
F1	First Filial Generation
FMD	Foot and Mouth Disease
GAHP	Good Animal Husbandry Practice
GDP	Gross Domestic Product
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis Critical Control Point
IBM	Improve Breeding and Management
IFCN	International Farm Comparison Network
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
LBP	Land Bank of the Philippines
LGU	Local Government Unit
LME	Liquid Milk Equivalent
NMIS	National Meat and Inspection Service
MPP	Milk Processing Plant
MTDP	Medium Term Development Plan
NABC	National Artificial Breeding Center
NDA	National Dairy Authority
NDDP	National Dairy Development Plan
NGO	NonGovernment Organization
NIZ	National Impact Zone
OML	On Milk Line
PCAF	Philippine Council for Agriculture and Fisheries
PCARRD	Philippine Council for Agriculture Resources Research and Development
PCAARRD	Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development
PDO	Protected Designation of Origin
PO	Producers Organization

PLA	Pasture Lease Agreement
PCC	Philippine Carabao Center
PNS	Philippine National Standards
PO	People's Organization
PSA	Philippine Statistics Authority
PVO	Provincial Veterinary Office
RA	Republic Act
REDI	Research, Development, and Innovation
RFO	Regional Field Office
RIZ	Regional Impact Zone
RTD	Ready to Drink Milk
SEA	South East Asia
SMFP	School-based Milk Feeding Program
SMP	Skimmed Milk Powder
SSG	Special Safeguard Mechanism
SUCs	State Universities and Colleges
UHT	Ultra High Temperature
UNDP	United Nations Development Program
UNAIP	Unified Artificial Insemination Program
UPLB	University of the Philippines at Los Baños
US	United States
USDA	United States Department of Agriculture
USDA FAS	USDA Foreign Agricultural Service
VBAIT	Village-based Artificial Insemination Technician
VCA	Value Chain Analysis



MESSAGE

The Carabao Industry Roadmap CIR is a dynamic document reflective of the needs of the stakeholders to bolster the carabao industry. While the COVID-19 Pandemic ushered in new challenges, an extensive consultation to gather inputs from the carapreneurs, Local Government Units, partners, and selected members of the academe provided steering in the development of the CIR.

The CIR shall focus on the key results areas: herd buildup, improving productivity and profitability, consolidation of smallholders and development of buffalo business hub, and harnessing the niche market for buffalo-derived products in the local and international market, with cross-cutting measures to support the implementation.

With the Philippine Carabao Center as an implementor, the Department of Agriculture shall commit to serving the carapreneurs through sustained support in the policy framework and harnessing additional public and private investment and support services from Regional Field Office.

The DA envisions a food-secured and resilient Philippines with empowered and prosperous farmers and fishers.

PCC shall develop relevant research and innovations and help collectively empower stakeholders to increase agricultural productivity and profitability, taking sustainable, competitive, and resilient technologies and practices into account.

Thus, the roadmap shall ensure a sustainable “Masaganang Ani at Mataas na Kita” for our CARAPRENEURS.

A handwritten signature in black ink, appearing to read 'Ces G. Dar', with a long, sweeping flourish extending to the right.

WILLIAM D. DAR, Ph.D.

Secretary
Department of Agriculture



FOREWORD

The Karabaw or Carabao (in Visayan) or Kalabaw (in Tagalog) is the official national animal of the Philippines albeit not enacted through law. It was introduced to the country around 300 BC by Malay and Chinese settlers and since then has become a valuable asset for the agriculture sector. It is a symbol of strength, persistence, determination, efficiency, and most especially hardwork, which also fittingly describes remarkable qualities of our Filipino farmers. In some rural areas of the country, the Carabao remains a reliable companion of the Filipino farmers. It bears a myriad of benefits for the farmers in terms of carrying out hard labor such as plowing and harrowing of rice fields.

The country's carabao inventory, as of recent statistics, is 2.9 million with carcass yield of 60,200 metric tons valued at PHP12.6 billion, and milk yield of 8.6 million liters with estimated value of PHP645 million. The carabao industry remains to contribute to the overall production value of livestock and poultry in the country while maintaining a stabilized population since 1976. From 2020 to 2021, the carabao posted an increase in the value of by 19.38%.

The Philippine Carabao Center through its Carabao Development Program (CDP) aims to transform the carabao from being used mainly as a source of draft power into efficient producers of milk, meat and meat products in order to improve life, income, nutrition, safeguard job security, and overall well-being of our farmers. I commend the Philippine Carabao Center for leading the Carabao Industry Roadmap initiative which will serve to address challenges faced by the industry. This strategic master plan shall constitute courses of action to be followed by the industry in order to move forward to the best path towards the future. I hope that this document may serve its purpose, that it may contribute to the advancement, growth, and development of the carabao industry.

Mabuhay ang industriya ng kalabawan! Mabuhay ang agrikultura!

A handwritten signature in black ink, appearing to read 'W. Medrano'.

WILLIAM C. MEDRANO, Ph.D.
Undersecretary for Livestock
Department of Agriculture



PREFACE

Although the carabao (water buffalo) population in the Philippines has not grown drastically from the 2.8 million level 20 years ago, significant positive changes have been observed in the utilization, breeding, nutrition, and marketing of this rice farmers' friend. The last four years have been notably favorable to the dairy buffalo farmers especially with the implementation of the School-Based Feeding Program under the Department of Education, the supplementary feeding program of children in the day care centers of the Department of Social Welfare and Development, the collaborative Coconut-Carabao Development Project of the Philippine Coconut Authority and the Philippine Carabao Center, and the Enhanced Partnership Against Hunger and Poverty Convergence Program (EPAHP) spearheaded by President Duterte's Cabinet Secretary.

While the COVID-19 pandemic brought severe damages to various industries, the Philippine dairy cooperatives flourished under the same environment because of the unrestricted implementation of the various feeding programs requiring milk from local sources. The increasing demand for buffalo products, also driven by population growth, urbanization, and increasing incomes, places a corresponding pressure on the carabao farmers to produce more. This scenario underscores the need for a good plan. Even King Solomon emphasized in Proverbs 21:5 that "the plans of the diligent lead surely to abundance and advantage, but everyone who acts in haste comes surely to poverty."

We endorse the competence and commitment of our public servants and private partners in crafting this carabao industry roadmap. The writers masterfully integrated the developments in breeding and genetics, molecular biology, nutrition, product development, animal health, and marketing under the whole carabao industry value chain in order to come up with an applaudable roadmap. The various goals and programs were also aligned with the key pillars of the ONE DA Reform agenda: Consolidation, Modernization, Industrialization and Professionalization. In the midst of increasing challenges and changing socio-political climate, we are optimistic that this roadmap will serve as a stabilizer for the growing carabao industry.

Sama-sama po tayo para sa "Masaganang Ani at Mataas na Kita".

A handwritten signature in black ink, appearing to read "Ronnie D. Domingo". The signature is fluid and cursive.

RONNIE D. DOMINGO, Ph.D.

**OIC Executive Director
Philippine Carabao Center
Department of Agriculture**





EXECUTIVE SUMMARY

The water buffalo, locally known as carabao, is an important source of meat, milk, hide, draft power, and social security in many regions and countries of the world. Today, the world population of water buffalo is 204.3 million, of which, 97.0% are in Asia. The two types of water buffalo, namely, the riverine (dairy, representing 80.1%) and the swamp (draft-meat, representing 19.9%) diverged in growth patterns during the last few decades. While the dairy type increased in inventory by 9.5%, the swamp type declined in inventory by 9.36% owing to the massive substitution with farm tractors as source of farm power, a pattern noted to be associated with economic development in most of the SEA countries.

Dramatic decline in carabao population in the Philippines also followed the same pattern in a short span of time, from 4.4 million head in 1970 to 2.7 head in 1976. From there onward, there were periods of slight decline followed by periods of slight increase, giving a semblance of stabilized population when seen in a longer time frame. Measures to protect carabaos by imposition of ‘slaughter ban’ as early as 1946 until it was lifted in 1998 pointed out the perceived recognition of the importance of carabaos as source of draft power in Philippine agriculture. To date, the carabao inventory is 2.9 million, with carcass yield of 60.2 million kg valued at PHP12.6 billion, and milk yield of 8.6 million liters with estimated value of PHP645.0 million.

The government recognized the important role of carabaos in the livelihood of the smallholder farming families who raise 99.9% of the carabao population through institutionalization of the Carabao Development Program (CDP) with the creation of the Philippine Carabao Center (PCC) under R.A. 7307 in 1992. The CDP’s

main focus is the transformation of the carabao from being mainly for draft into efficient producers of milk and meat in order to improve income, nutrition, and general wellbeing of the rural farming families. Following the 10-year research funded by UNDP/FAO and coordinated by PCARRD (now PCAARRD), the CDP's strategy has been the introduction of the riverine genetics to produce crossbreds and backcrosses with high genetic potentials for milk and for meat production.

An industry value chain analysis (VCA) was carried out in 2014-2017 and covered both the meat and dairy aspects. Seen as the major constraints for faster development of the industry are centered on feed base inadequacy that is translated in poor production and reproduction performance, punctuated by the slow absorptive capacity for appropriate feeding and management technologies for dairy and meat production by the resource-deficit smallholder producers. Market for carabeef remains depressed due to the impression by majority of the consumers that carabeef is tough, an impression imprinted due to decades of imposition of slaughter ban allowing only the old and retired work animal (which provides inferior meat quality) to reach the slaughterhouse. The processing sector also has substituted locally produced carabeef with low cost Indian carabeef, and of late, with mechanically deboned meat (MDM).

On the other hand, while the niche market for carabao milk products such as pastillas and kesong puti remain steady and growing, the fresh milk market is flooded with low-cost imported UHT milk labelled as 'fresh milk'. The palates for fresh milk of the Filipino consumers have not been developed due to limitation in supply of locally produced milk, representing only about 1/3 of the RTD market. The main issue on improving volume of production is the absence of indigenous dairy breed, and limited number currently available stocks. Demand for locally produced milk has increased significantly with the approval of R.A. 11037, which mandated the inclusion of milk as a component of school feeding program. Moreover, prospects for wider market for processed dairy products is shown by the fast-growing demand for cheese and butter and other related items, a trend noted in domestic and international markets. However, there is also a growing market for "plant-based meat" products and non-dairy alternatives that cater to consumers conscious about health and environmental concerns.

The Carabao Industry Roadmap 2022-2026 (CIR) supports the OneDA reform agenda which channels investments in the more transformative interventions that will help consolidate, modernize, industrialize and professionalize Philippine agriculture. CIR envisions a vibrant carabao industry through harnessing the niche market for buffalo-derived products fueled by the growing human population, urbanization and increasing income, amid the implementation of the Mandanas-Garcia Supreme Court Ruling (which includes full devolution of extension activities). This can be achieved by improving productivity and efficiencies of the carabao sub-sector, and focus on the development of internationally competitive buffalo-derived products and business processes.

The CIR focuses on four key results areas, namely, (a) herd build-up, (b) improving productivity and profitability, (c) consolidation of smallholders and development of buffalo business hub (BBH), and (d) harnessing the niche market for buffalo-derived products, local and international. Strategies and activities include massive upgrading through expansion of artificial insemination and wide-scale bull entrustment program for natural mating for improved meat production and production of potential dairy animals. For specialized buffalo dairying, herd build-up shall include infusion of 2,500 purebred high genetics dairy buffaloes, improving breeding management of the current stocks of purebred buffaloes, and an aggressive program for rearing of replacement heifers. Serious efforts shall also be focused on directed backcrossing of the existing crossbreds to attain a blood composition of at least 75% riverine. Use of sexed semen on these initiatives will enhance the production of higher percentage of females as potential dairy animals. Furthermore, the existing DHI shall be expanded with the assistance from KOICA, allowing better selection of superior animals and improvement in productivity among dairy buffaloes.

High on the strategy list is the improvement of feed base through implementation of smallholder forage development, promotion of establishment of corn silage production and supply system, and harnessing the wide coconut areas.

Corresponding efforts shall be directed towards consolidation of smallholders by way of strengthening their cooperatives and associations, and the establishment of Buffalo Business Hubs. These initiatives are paralleled by the establishment of Buffalo Product Development Center aimed at developing internationally competitive buffalo-derived products and the operationalization of Business Center and Export Portal. Research, development and innovation (RDI) initiatives shall support the envisaged attainment of improving profitability, competitiveness and sustainability, covering the concerns in the entire carabao value chain.

Human resource capacitation shall be heavy on addressing the need of the LGUs in preparation for the full implementation of the Mandanas-Garcia Supreme Court Ruling. Technicians of the LGUs that signified participation in the program shall be trained in all areas of carabao production, including artificial insemination, animal health, herd management, product handling as well as organizational aspects, as they shall directly oversee the program at the field level. There shall also be initiative for offering of degree courses in Dairy Science in at least two universities, the UPLB and CLSU. Establishment of Rural Management Institute (RMI) designed to offer degree course on Cooperative Management that entails theoretical as well as actual cooperative management tailored for future co-op managers is for consideration.

There are areas where farmers, entrepreneurs, and cooperatives need capability strengthening such as those pertaining to the business aspect of the CDP in concert with the LGUs, which shall be seriously addressed.

Finally, the human complement of the PCC shall be capacitated in the areas of product development, policy research, social sciences, among others.

To ensure that CIR 2022-2026 shall be on track, there shall be quarterly meetings of the Program Management Team headed by the Undersecretary for Livestock, submission of annual reports to the DA, the House of Representatives, and the Senate, and bi-annual monitoring and evaluation to be carried by the PCAF.

INTRODUCTION

Background and Rationale

The Department of Agriculture (DA) is complying with the guidance and has initiated active Roadmapping initiatives among its agencies. Roadmap development is one of the eight paradigms of DA Secretary William D. Dar to achieve its vision of “A food secure and resilient Philippines with empowered and prosperous farmers and fisherfolk”, as well as the vision of National Livestock Program “A meat, egg, and milk secured and resilient Philippines anchored on a vibrant, robust and globally competitive livestock and poultry industry, and prosperous farmers”. There is an existing ruminant roadmap for 2010-2034. However, it is not focused on the carabao industry. Thus, this roadmap was done.

The Philippines is one of the countries that were recognized as Foot and Mouth Disease (FMD)-free without vaccination by the OIE in May 2015 and Peste de Petits Ruminants (PPR). However, despite these advantages, the country still cannot compete in the international market. Some of the reasons are lack of beef cattle supply, limited utilization of pasture land, limited number of nucleus herd, and lack of good quality carabao for beef and milk.

These are some of the challenges in the carabao industry that will be addressed by this roadmap. The roadmap will present the current situation of the carabao industry in the country. Key result areas, strategies, and policies will also be shown to move the industry forward.

Objectives

The general objective of this Carabao Industry Roadmap is to come up with a master plan that is inclusive, stakeholder-crafted and market-driven, that would help in improving the farmers' income, create jobs, and increase the number of carabaos in the Philippines to become self-sufficient.

The specific objectives are to:

1. provide a situational assessment of the carabao industry in the Philippines;
2. set goals and strategies as well as plan targets towards a competitive and sustainable carabao industry; and
3. recommend strategic directions and action programs in short to medium terms to enhance the Philippine carabao industry.

The roadmap will cover the following:

- Profile, Prospects, and Trends of the Carabao Industry
- Shared Vision and Mission
- Goals and Objectives
- Strategies and Policies
- Program Targets
- Budgetary Requirements
- Implementation Schedule



CARABAO INDUSTRY ROADMAP 2022-2026

GLOBAL PERSPECTIVE

Water buffalo plays many different roles in various regions and countries of the world. Principally, they provide milk, meat, draft power, fertilizer, fuel, and social security in various proportions and combinations. To date, the world population of water buffalo is 204,342,419 head (FAO, 2020), of which, 97.0% are found in Asia. Water buffalo inventory in the Philippines represents 1.42 % of the world total (Table 1). Details of buffalo inventories during the last 20 years are shown in ANNEX 1.

TABLE 1. WATER BUFFALO POPULATION IN THE WORLD, ASIA AND THE PHILIPPINES, 2019

Area/ Coverage	Inventory, hd	Percent of Total
WORLD	204,342,419	100.00
ASIA	198,414,255	97.00
PHILIPPINES	2,922,000	1.42

There are two types of water buffalo, namely, (a) the riverine type, generally the dairy type, estimated to be 80.11% of the world total, and, (b) the swamp type, mostly found in Southeast Asian countries, which represents 19.8% of the total population. More common breeds of riverine buffalo are the Murrah from India, Nili Ravi from Pakistan, and Mediterranean buffalo of Italy. The water buffaloes in the Philippines are of the swamp type and are mainly used for draft power and as source of meat.

Interestingly, the growth pattern in inventory of the two types of water buffaloes diverged significantly. While the riverine type had positive growth of 9.85% from 2009 to 2019,

the swamp type buffalo inventory had negative growth of 9.36% (Table 2). Growth in inventory of dairy breed is steady in major buffalo-producing countries such as India and Pakistan. Brazil has very fast-growing stocks of riverine breed substituted for beef cattle as sources of meat, while countries such as Germany, UK, and Canada introduced recently the riverine breed in their dairy system.

TABLE 2. CHANGES IN WATER BUFFALO INVENTORY, 2009 VS 2019

Buffalo Type	2009	2019	2009 vs 2019, % Change
Swamp ¹	44,846,249	40,646,119	-9.36
Riverine ²	137,711,191	163,696,300	9.85
World ³	194,135,166	204,342,419	5.25

Source: FAOSTAT 2020

1 SEA and China; 2 India, Pakistan and Brazil; 3 Both types total

The decline in swamp buffalo inventories is directly linked with the advent of farm mechanization, replacing water buffaloes as source of power for agricultural activities. This development is tightly linked with industrialization and economic growth, i.e., it is characterized by declining contributions of agriculture in the total economy. This was the case in Taiwan and Malaysia, and of late, in Thailand and Indonesia.

In SEA, there are only two countries wherein swamp-type water buffaloes have increased in number from 2009 to 2019, namely, Myanmar with significant 42.02%, and to some extent, Laos with 2.67% growth (ANNEX 2).

World Buffalo Meat and Milk

The world milk production in 2019 was 887.88 million MT from all kinds of dairy animals. Some 15.06% of this figure came from buffalo milk. In terms of the global meat production, buffalo meat is only about 1.20% of the 335 million tons produced in 2019.

And since the water buffaloes are predominantly Asian animals, 98.21% of buffalo milk and 90.82% of buffalo meat in the world are produced in Asia, with South Asia, essentially India and Pakistan, as the main contributors (Table 3).

Water buffalo as a source of meat ranked behind cattle, swine, and poultry. Cattle meat is about 16 folds more, while meat from pigs and chicken are 25 folds and 27 folds more, respectively, compared to buffalo meat.

TABLE 3. WORLD AND REGIONAL PRODUCTION OF BUFFALO MEAT AND MILK, 2019

Region	Buffalo Meat	% of World	133,752,296	% of World
World	4290212	100	0	100.00
South America	6720	0.15	2,109,253	0
Africa	365588	8.52	131,363,080	1.57
Asia	3896627	90.82	127,981,522	98.21
South	2904206	67.69	325,309	95.68
SEA	326282	7.6	279,963	0.24
Europe	21277	0.49		0.20

Source: FAOSTAT 2021

The pattern in the levels of meat production is also reflected in meat consumption during the last five decades. From 1961 to 2013, the per capita consumption of chicken meat increased by 5 folds while that of pork increased by 2 folds, whereas consumption of beef and buffalo meat decreased by 0.63% (Table 4).

YEAR	Chicken Meat	Pork	Cattle & Buffalo Meat	Mutton	Other Meat	TOTAL
1961	2.88	8.02	9.38	1.92	0.89	23.09
1970	4.06	9.54	10.8	1.78	0.83	27.01
1980	5.76	11.86	10.61	1.59	0.78	30.6
1990	7.65	13.04	10.34	1.74	0.62	33.39
2000	10.99	14.19	9.57	1.81	0.77	37.33
2013	14.99	16.02	9.32	1.91	0.98	43.22

Source: Our World in Data, 2021

Carabao Industry Situation and Outlook

Development Perspective

The Philippines has around 2.9 million carabaos, of which, 99.99% are found in the backyard and are tightly connected with smallholder farming, mainly rice-based production system. There were few commercial carabaos farms in the 1970s but they slowly diminished in number over the years.

The average farm size in the country is 1.29 hectares (PSA, 2021) and the carabao has been the main source of draft power in a crop-dominant mixed farming system for several decades. In fact, in earlier years, one of the major initiatives of the government was to import carabaos from China to increase the available work animals. These early animals were used in opening new farm lands and in regular farm activities such as plowing, harrowing, and in hauling of farm produce. Only after their productive use, many animals reaching up to 20 years old, were work animals sent to slaughterhouse for meat. Because of this practice, the general consuming public had the impression that buffalo meat is tough and is only second in quality after beef.

In later years, younger carabaos were sold for meat, a practice normally expected as part of the larger economic system. This would satisfy the economic needs of the carabao raiser, and, at the same time, supply the meat requirements of the growing human population. In the larger context, however, policy advocates perceived that the slaughter of younger carabaos had negative implications to the government efforts of increasing agricultural production. Thus, as early as 1946, slaughter of carabaos was prohibited upon the implementation of R.A. 11, an “Act to Prohibit the Slaughtering of Male and Female Carabaos, Horses, Mares and Cows”. It took two decades before the slaughter of carabaos 20 years and older (E.O. 100, 1967) was allowed. Interestingly, three years later, the total slaughter ban was reimposed (E.O. 234, 1970).

In 1980, Executive Order 626, otherwise known as the 7/11 policy, amended E.O. 234 and permitted the slaughter of male carabaos 7 years and older, and females 11 years and older. The slaughter ban was finally lifted upon the passage of R.A. 8485, “Animal

Welfare Act of 1998”, allowing the slaughter of carabaos irrespective of age and sex provided that the manner is humane.

Farm Mechanization

Government mechanization program started slowly in 1960s, and from then on, substitution of draft carabaos with small hand tractors became common. In subsequent years, there was a significant decline in carabao population, i.e., from 4,442,000 in 1970 to 2,725,000 in 1976. The population started to rebound very slowly in the years that followed and reached a peak of 3,384,000 head in 2007. Thereafter, the carabao population stabilized to an average of 2.8 million head despite the aggressive farm mechanization program of the government.

The growth in farm tractor usage in the country had an average of 11.57% from 1983 to 2002. In 2011, the four-wheel farm tractor for all crops was 394,190, and this is translated as 0.34 available power per unit area (hp/ha). In 2011, the available farm power for rice and corn was 2.31 hp/ha, of which 0.15 hp/ha was from human labor (6.49%), 0.39 hp/ha from draft animals (16.88%) and 1.77 hp/ha by mechanical power (76.62%) (dela Cruz and Bobier, 2011). Contributions of draft animals’ power were mainly from 1,804,000 carabaos.

Earlier reports indicated that the problem encountered in maintaining carabaos was one of the major motivating factors for mechanizing rice farms in the Philippines. The farmers experienced that the use of hand tractors resulted in better cultivation compared with the work using carabaos, and that the use of hand tractors was cheaper in the long run (Orcino, 1974; Alviar, 1983).

Importation of Buffalo Meat

In the early 1990s, a concern was raised on the possibility of the decimation of the carabao population if the rate of slaughter cannot be tamed due to continuing increase in demand for carabao meat. In view of such concern, the clamor of the meat processing sector to import large volume of cheap materials for the meat processing, and the inability of the local ruminant sub-sector to meet the increasing demand for carabeef,

prompted the approval to import buffalo meat from India in 1993. Meat processors and meat traders were allowed to import frozen boneless, and deglanded buffalo meat products from accredited facilities in India, purely for processing and never to reach the wet market. In 2020, the volume of importation reached 34.5 million kg, estimated to be equivalent to 230,000 head of carabaos. Total importation from 1997 to 2020 are shown in ANNEX 3.

An analysis of the impact of buffalo meat importation, which started in 1993 and onward concluded that such policy provided some buffer on the mounting pressures on the domestic carabao sub-sector (STRIVE, 2009)

Institutionalization of the Carabao Development Program

Introduction of riverine buffalo genetic materials into distinctly swamp buffalo-populated Philippines started as early as 1917 in the form of both live animals and frozen semen (Tables 5). The breeds infused were Murrah breed from India and Nili-Ravi breed from Pakistan. Imported stocks were distributed to several government breeding stations and agriculture colleges and universities. Many of the bulls were able to reach the few commercials' herds and resulted in the production of crosses of riverine and indigenous carabaos.

The renewed interest in dairy buffalo emanated from the completion of the 10-year UNDP/FAO-funded research project coordinated by PCARRD (now PCAARRD) on crossing swamp x riverine types buffaloes, and the institutionalization of the National Carabao Development program following the enactment of R.A. 7307 that created the Philippine Carabao Center (PCC) in 1992. The program's main goal is increasing income of smallholder farming community by way of improving the genetic potentials of the carabaos primarily for milk, and secondarily for meat production.

TABLE 5. RECORDED INTRODUCTION OF RIVERINE BUFFALO (LIVE ANIMALS) TO THE PHILIPPINES, 1917-2013

Year	Country Source	Breed of Buffalo	No. (Hd) of Buffalo		
			Male	Female	Total
1917-1956	India	Murrah	115	597	769
1918	India	Nili-Ravi			85
1994	USA	American Murrah	70	154	224
1995-1999	Bulgaria	Bulgarian Murrah	286	3,080	3,366
2010	Brazil	Murrah	11	2,027	2,038
2011-2013	Italy	Italian- Mediterranean	29	2,334	2,363

Source: Balaine(1988); Cruz (2015)

Sourcing of animals from India was not allowed during this period in view of the Philippine’s program to achieve an FMD-free without vaccination status. Instead, importation of elite Murrah-based buffaloes was made from Bulgaria, an FMD-free country and with an organized system for selection and genetic improvement for milk. Subsequent germplasm importations were sourced from Brazil, and lately, from Italy.

The program installed a continuing genetic improvement program (GIP) featured by a Gene Pool of elite dairy buffaloes and considered as the Nucleus Herd, from where sires/ semen donors are derived. There is also a corresponding pool of native carabaos aimed at conserving genetic materials of indigenous breed. These initiatives are also punctuated by the establishment of the National Cryobank for animal genetic resources.

The crossbreeding of carabaos with riverine breed was expanded with the use of artificial insemination (AI) following the establishment of semen processing laboratory and training of hundreds of AI technicians in 1984 onward. Artificial insemination was complemented with the nationwide bull entrustment program. To date, the system covers an average of 5.8% of the breedable female carabaos, and the services by private AI technicians, commonly known as “village-based AI technician” (VBAIT) has profound contributions in the past several years.

As a strategy, the CDP considered the establishment of a National Impact Zone (NIZ), i.e., the Province of Nueva Ecija, and 12 Regional Impact Zones (RIZs) throughout the country featured by smallholder buffalo-based enterprises. In these impact zones, primary dairy cooperatives were set up as a mode of consolidation, enabling the smallholder dairy producers' access to commercial market. Altogether, the milk production from dairy buffaloes contributes 35.39% of the national milk production (PSA, 2020) or about 52.28% converted in cow's milk equivalent.

The CDP is supported by organized and focused research and knowledge management system. Over the years, partnership with local and international institutions permitted the access to specialized expertise, cutting edge technologies, and enhanced human resource development.

Twenty-five years of CDP have provided important learnings as summarized below.

SUMMARY LEARNINGS, PAST 25 YEARS

- a. Harnessing the already existing livestock resources at the smallholders is a rational approach.
- b. Transforming the huge population of indigenous carabaos into efficient producers of milk is an effective way of increasing farmers' income.
- c. There is a need to 'businessize' the smallholders for effective access to inputs, services, and more importantly, to market.
- d. Strong partnership with local and international entities (e.g., DAR, DTI, CDA, LGUs, etc./UNDP, FAO, USAID, JICA, KOICA, AusAID) with similar objectives of promoting improvement among smallholders is essential.
- e. Privatizing AI is a better option to bring genetics to the smallholders.
- f. Herd build-up of potential dairy carabaos needs much attention. Related to this is the need to focus on directed backcrossing to attain blood composition of at least 75% dairy to attain reasonable level of milk production; there is a need to focus on rearing of replacement heifers; work hard to reduce pre- and post-weaning mortalities.
- g. Nutrition and nutritional management among smallholders are major limiting factors for productive and profitable operation; improving the feed base can bring substantial benefits.
- h. Backcrossing should be focused on dairy impact areas where farmers are able to appreciate the importance of having the correct animals for dairying; otherwise, farmers with crossbreds are proved to selling their crossbreds for meat or draft purposes.
- i. It is important for smallholders to transform from subsistence to entrepreneur mode; there is a minimum herd size (e.g., 5 hd) required by a smallholder farmer. They need to focus or concentrate on good rearing management practices for dairy carabaos, as they generate sufficient income for the family.
- j. Good leadership and organizational capabilities are critical for a sustainable smallholder dairy producers organization/cooperative.
- k. Focus on improving cold chain among smallholders is very important to reduce wastage and losses among producers.

Industry Performance

Meat Production

The country's carabao inventory as of 2020 is 2.921 million head, with slaughter of 400,270 head, translated into volume of 120.4 metric tons of carabeef (live weight), which is valued at PHP12.668 billion (Table 6).

TABLE 6. CARABAO INVENTORY AND MEAT PRODUCTION, 2014-2020

Particular	2014	2015	2016	2017	2018	2019	2020
Inventory, '000 hd	2,847	2,855	2,877	2,882	2,873	2,865	2,921
Slaughtered, '000 hd	461.49	453.70	464.69	464.00	467.55	462.72	400.27
Production, '000 ton live weight	143.00	142.00	144.70	144.40	143.10	140.60	120.40
Production, '000 ton carcass weight	71.50	71.00	72.35	72.2	71.55	70.3	60.2
Value, million pesos, current prices	10,740	11,100	11,333	12,566	13,648	13,993	12,668

Source: PSA 2020

A perusal of the record of inventory of carabaos from 1982-2020 would show that there has been no dramatic change in carabao population during the span of 38 years. This is so because there was an average annual growth of 0.24% from 1980 to 2000, however, the preceding period from 2000-2020 was characterized by average annual growth rate of -0.24% (ANNEX 4).

An in-depth revisit of the population growth behavior during the last 20 years (2000-2020) indicated that there was a period of positive growth that reached an average annual growth of 1.61% in 2000-2007, followed by a significant decline in population with an average annual growth rate of -2.41%. Starting 2015, the population has stabilized somehow with an average annual growth rate of 0.43% (Table 7).

It appears that the high volume of carabeef importation from India in 2000-2007 softened the number of slaughtered animals and, thus, resulted in slight positive growth in carabao population. Reduction in importation of Indian carabeef in 2008-2014 apparently resulted in higher domestic carabao slaughter that affected the population growth.

TABLE 7. AVERAGE ANNUAL %CHANGE IN CARABAO INVENTORY, ANNUAL PRODUCTION AND AVERAGE ANNUAL CARABEEF IMPORTATION, 2000-2020

PERIOD	Ave. Annual change in Inventory, %	Ave Annual Production, metric tons	Ave. Annual Import of Carabeef, metric tons	Total Ave. Annual Supply of Carabeef
2000-2007	1.61	131.605	40.68	172.285
2008-2014	-2.41	143.44	30.93	174.37
2015-2020	0.43	139.27	34.67	173.94

The available data published by PSA on the number of slaughtered carabaos seen as a percentage of the inventory is interesting. Given the inventories of 1,173,819 head of breedable females in 2019 (Table 8), representing some 40.55% of the herd, and number of carabaos slaughtered of 400,270 in 2020 (Table 6), it is estimated that it would require a calf crop of about 53.0% to be able to yield the number of carabaos slaughtered in 2020, with pre- and post-weaning mortalities of 10.0% and 5.0%, respectively, a 16-month calving interval, and a herd life of 10 years for cows. This estimate of 53% calf crop can be considered high given that in the villages, in wide scale pregnancy diagnosis carried out for several years prior to the conduct of AI, pregnancy rate among carabaos was found to be 20% on the average. Common also are the noted calving intervals that reached as long as 24 months.

TABLE 8. CLASSIFICATION OF CARABAOS ACCORDING TO SEX AND AGE GROUPS, 2018-2020

Sex/Age Group	2018	2019	2020	%
Carabull (>3 years old)	796,238	778,676	779,423	27.5
Caracow (>3 years old)	1,176,135	1,173,819	1,161,697	40.55
Caraheifer (2-3 years old)	303,216	306,607	309,703	10.57
Yearlings (both sexes, <2 years old)	476,196	476,006	479,702	16.66
Others	130,870	138,453	134,920	4.59

Milk Production

The PSA also publishes separate performance reports for the dairy industry, utilizing the field data provided by the National Dairy Authority (NDA) and the PCC of the Department of Agriculture. Such reports clearly demonstrate contribution of carabaos in terms of milk production.

From 2014 to 2019, the local stocks of “dairy buffalo” have produced a total volume of 46.416 million liters of milk, which represent 35% of the total volume of all locally produced milk during the same period (Table 9). Likewise, the average growth rate in the volume of milk produced by dairy carabaos during this period is 4.66% per annum.

TABLE 9. MILK PRODUCTION BY ANIMAL TYPE, '000 LITERS, 2014-2019

Animal	2014	2015	2016	2017	2018	2019	Total	% Share
Cattle	12,562.18	12,928.49	13,333.83	14,292.75	14,602.98	14,852.75	82,572.99	62.54
Carabao	6,859.02	7,121.80	7,435.08	8,014.71	8,378.96	8,606.69	46,416.26	35.15
Goat	306.32	335.84	387.09	447.97	709.35	857.93	3,044.50	2.31
Total	19,727.52	20,386.13	21,156	22,755.43	23,691.29	24,317.37	132,033.75	

Source: PSA 2020

Average farm gate of carabao’s milk in 2019 was PHP60.00 per liter. Thus, the 8.607 million liters of carabao’s milk produced in the same year translate to approximately PHP516 million. If this volume of liquid milk was transformed into value-adding products, the actual value would have increased by several folds. It goes without saying that buffalo dairying contributes enormously to the local dairy industry and to the whole economy.

A “dairy carabao”, for the purpose of gathering production statistics, includes the native carabaos, crossbreds, and the purebred dairy buffaloes that are used for full-time or incidental dairying. Full-time dairying is the practice of dairying almost throughout the year while incidental dairying is only done occasionally, i.e., incidental to the calving of the dams and the milk produced is either sold or consumed at home (PSA,2016).

Table 10 shows that the total dairy carabao inventory in 2019 was estimated at 18,886 head, of which, 9,328 head or almost 50%, are dams or milking animals (NDA website). The upward trend in the dairy carabao inventory is seen here as indicative of improved breeding efficiencies, growing interest of farmers in buffalo dairying, and high market demand for buffalo milk products.

TABLE 10. INVENTORY OF DAIRY ANIMALS, 2014-2019

Particular	2014	2015	2016	2017	2018	2019*
Dairy Cattle	21,605	22,498	24,512	25,700	25,187	25,377
Dairy Buffalo	16,829	17,299	17,802	18,800	18,946	18,886
Dairy Goat	1,888	1,984	2,118	2,400	14,685	17,149
Total	40,322	41,781	44,432	46,900	58,818	61,412

Source: PSA 2020

Industry Outlook

Increasing Population, Urbanization, and Increase in Income

The demands for animal derived products such as meat and milk are growing, most particularly in the Asian region driven by population growth, increasing urbanization, and increasing income. In the Philippines, human population is projected to be 125.3 million by 2030 (Table 11), up by 14% from the 2020 level. And while the average annual rate of urbanization during the past 10 years was only 0.55% (Annex 4), it is estimated that by 2030, 49.82% of the population will be in urban areas. Meeting the growing demand for animal-derived products of these urban dwellers offers huge opportunities for livestock producers. Moreover, the increase in income will drive further the demands for meat and milk due to changes in food preferences.

TABLE 11. PROJECTED HUMAN POPULATION, PHILIPPINES, 2020-2035

Item	2020	2025	2030	2035
Male	55,460,900	59,494,400	63,202,900	66,503,000
Female	54,487,000	58,465,000	62,134,600	65,400,900
Total	109,947,900	117,959,400	125,337,500	131,903,900

Source: PSA 2021

The increase in demand for dairy products is shown by the growing total dairy imports with average annual growth of 5.83% during the past 10 years (Table 12). And while the skim milk powder and whole milk powder, representing 55.57% of the total imports registered only an annual growth rate of 1.08% during the past five years, average annual imports growth rate of ready-to-drink milk (RTD) was considerably big at 10.85%. Also, cheese and butter imports registered average annual growth rates of 9.13% and 6.36%, respectively. The RTD represents only 3.33% of the total imports while cheese is 4.27% and butter is 8.52%. These are the products wherein locally produced milk can get a bigger share of the domestic market.

TABLE 12. SUMMARIZED AVERAGE ANNUAL GROWTH RATES OF TOTAL DAIRY IMPORTS, RTD, BUTTER, AND CHEESE

Year	Total Imports	Ave. Annual % Change	RTD	Ave. Annual % Change	Butter	Ave. Annual % Change	Cheese	Ave. Annual % Change
2005	1,604	-23.9	45.7	5.27	85.5	-8.4	24.3	-12.2
2010	2,015	12.6	48.48	24.30	169.3	16.1	52.6	-12.0
2015	1,793	3.0	42.66	-2.29	148.5	14.5	95.0	38.0
2020	2,336	-1.11	97.81	12.16	250.4	-4.5	125.4	3.38
Ave annual % change 2010-2020	---	5.83	---	10.85	---	6.36	---	9.13
% of Total	100.0	---	3.33	---	8.52	---	4.27	---

Niche Market for Buffalo-Derived Milk Products

One thing good about buffalo’s milk is its unique properties not found in the traded milk coming from dairy cattle, and for that reason, it has a niche market. For example, the Italian buffalo entrepreneurs, although they have only small inventory of dairy buffaloes, are able to create a huge international market for “mozzarella di bufala”. In 2017, the value of PDO (Protected Designation of Origin) Italian mozzarella is reported to be 330 million euros and has registered an annual growth of 6.9% (Statista, 2017). Its main traditional markets are Europe and North America, and has penetrated the major Asian markets as well such as Japan, South Korea, Hong Kong, and Singapore. The proximity of the Philippines to these major Asian markets and the comparatively lower cost of production in the country provide distinct advantages.

School-based Milk Feeding Program

The other great prospect for the milk market is the approval RA 11037 or the “Masustansyang Pagkain para sa Batang Pilipino Act”, which includes the school-based milk feeding program of DepEd, and RA 11148 or the “Kalusugan at Nutrisyon ng Magnanay Act” under DSWD. The DSWD milk is to be given to preschoolers at the day care centers while DepEd shall cover those undernourished children in the elementary grades. There is a move that the program shall expand from the current coverage of 1.8 million undernourished schoolchildren to cover all students in Grades 1 to 3, numbering

to not less than 3.0 million in 2022, which is expected to grow to about 5.0 million by 2030. Table 13 shows the magnitude of potential elementary students to be covered.

TABLE 13. PROJECTED NUMBER OF POPULATIONS AGED 1-14 YEARS OLD, PHILIPPINES, 2020-2035

Age Group (Both Sexes; yrs)	2020	2025	2030	2035
5-9	11,233,600	11,385,600	11,273,500	10,957,600
10-14	10,601,800	11,162,300	11,312,500	11,197,900
Total	33,311,200	33,908,600	33,629,800	32,199,300

The outlook in terms of buffalo meat is not as robust as seen in terms of dairy although the increase in population is a single major factor to consider. This is because increases in meat consumption per capita in the country have shifted more to the rise in consumption of pork and chicken. In fact, the per capita consumption of beef and carabeef during the last 20 years indicated very small increment, albeit negative growth in some periods. There are data, however, that would indicate that low-income consumers opt to buy chicken, then shift to buying pork and then to beef, as the income increases.

Increasing demand for carabeef for processed meat production is met by importation of “industrial grade meat” such as deboned and frozen Indian buffalo meat as well as mechanically deboned meat (MDM), which are relatively cheaper than the locally produced carabao meat. Processors pointed out that there is a mismatch between what is a locally available carabao meat, classified as “table grade meat” sold in the wet market, as against the “industrial grade meat” required by the meat processing sector.

On the other hand, draft carabaos will still remain a mainstay in most of the irrigated rice-producing areas, mainly for hauling the harvest. Because of the two croppings in irrigated rice areas, the paddies remain wet and soft, and hauling of harvest is always aided by draft carabaos, particularly in areas where soil is of the clay type. The ongoing crossbreeding program complements the need for crossbreds with bigger body size and, thus, have higher draft capacity.

Industry Analysis

Value Chain Analysis

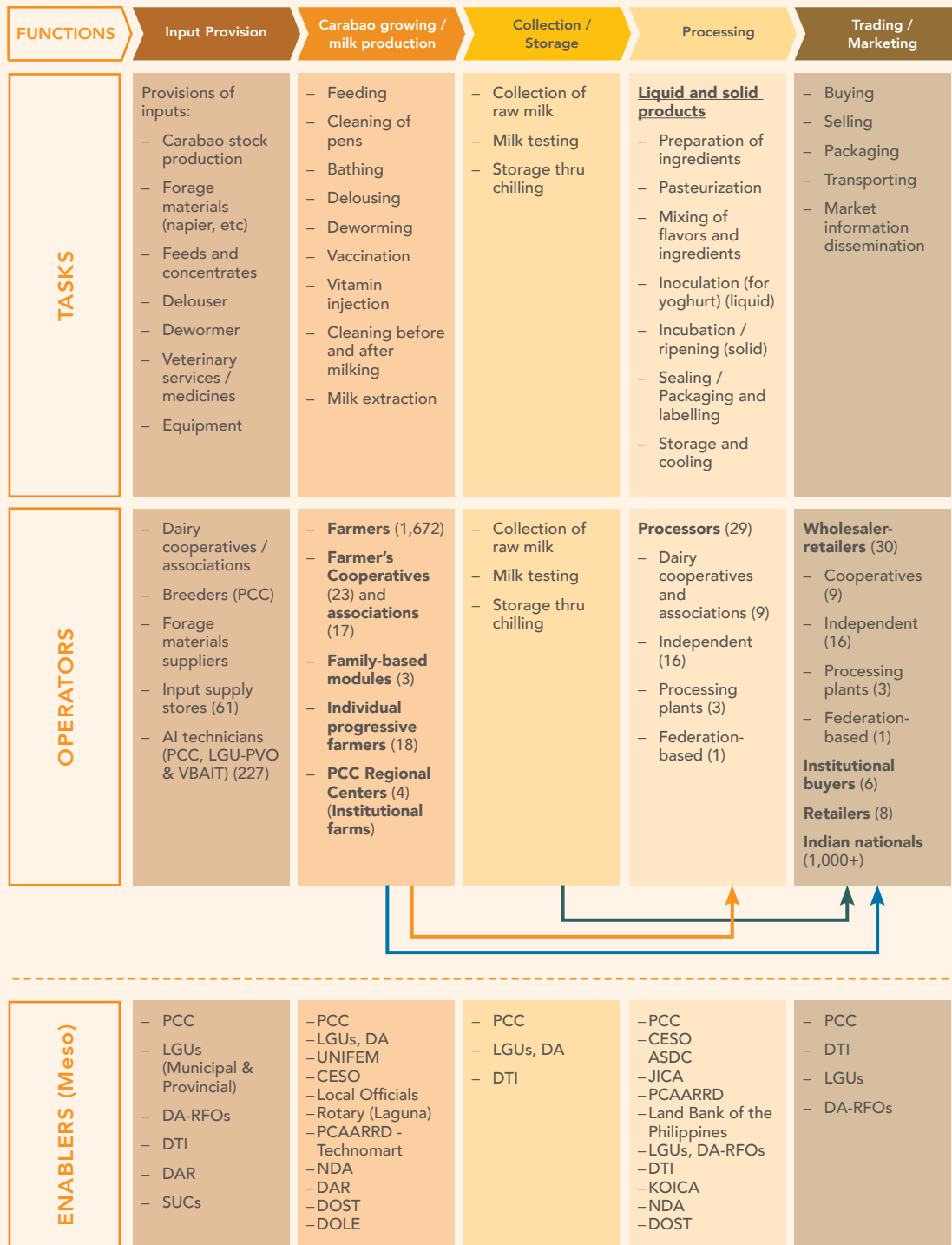
Carabao's Milk and Milk Products

Simply defined, a value chain describes the full range of activities, which are required to bring a product (in this case, buffalo's milk and dairy products) or service from conception, through the various phases of production, processing, and delivery to the final consumers (Kaplinski and Morris, 2000).

Common and popular buffalo dairy products being produced, processed, traded and/or marketed in specific areas across the country along the value chain include raw milk, fresh (pasteurized) milk, flavored milk (e.g., choco-milk, lactojuice), pastillas de leche, yoghurt, white cheese, mozzarella, ice cream, milk candy, dulce gatas, choco-bar, milk bread, milk-o-gel, and milk soap.

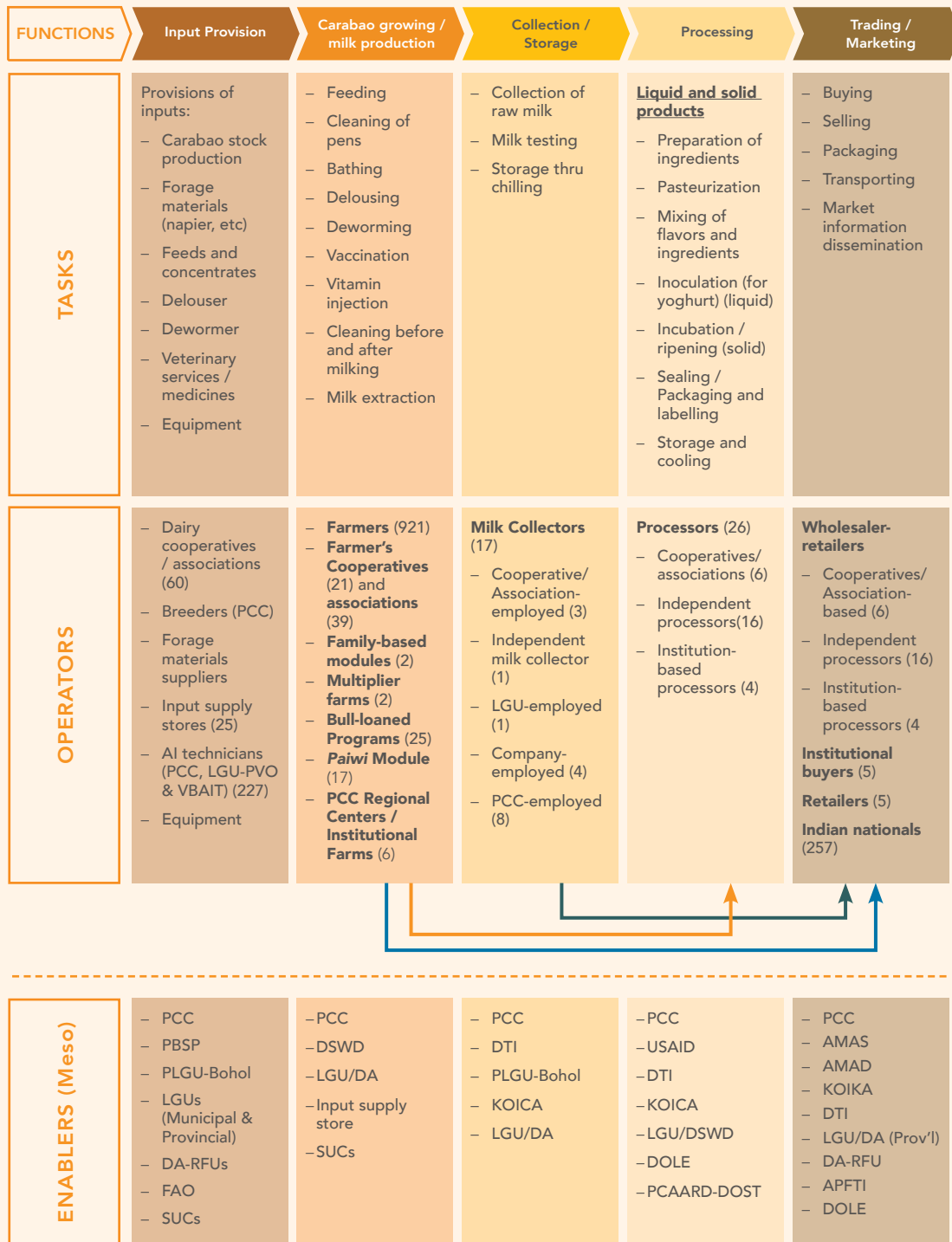
Lantican et al., (2015; 2016) identified seven key stakeholders in the dairy carabao value chain in the Philippines, namely, (1) input providers; (2) farmers; (3) milk collectors; (4) dairy processors; (5) wholesaler-retailers; (6) retailers; and (7) consumers (Figures 1a and 1b). Input providers include dairy farmer's cooperatives or associations, DA-PCC (as breeder and source of forage materials and semen), AI technicians, and agricultural supply stores. Aside from input provision, they also cover production, milk collection, processing, and marketing functions. Other enabling organizations aside from DA-PCC include various national government agencies, international organizations, local government units, non-government organizations, and state universities and colleges.

FIGURE 1A. VALUE CHAIN MAP OF CARABAO'S MILK AND MILK PRODUCTS IN LUZON, (2014-2015) (LANTICAN ET AL., 2015)



Note: Arrows mean that the players are also involved in functions where the arrows are pointed.

FIGURE 1B. VALUE CHAIN MAP OF CARABAO'S MILK AND MILK PRODUCTS IN VISAYAS AND MINDANAO (2015) (LANTICAN ET AL., 2016)

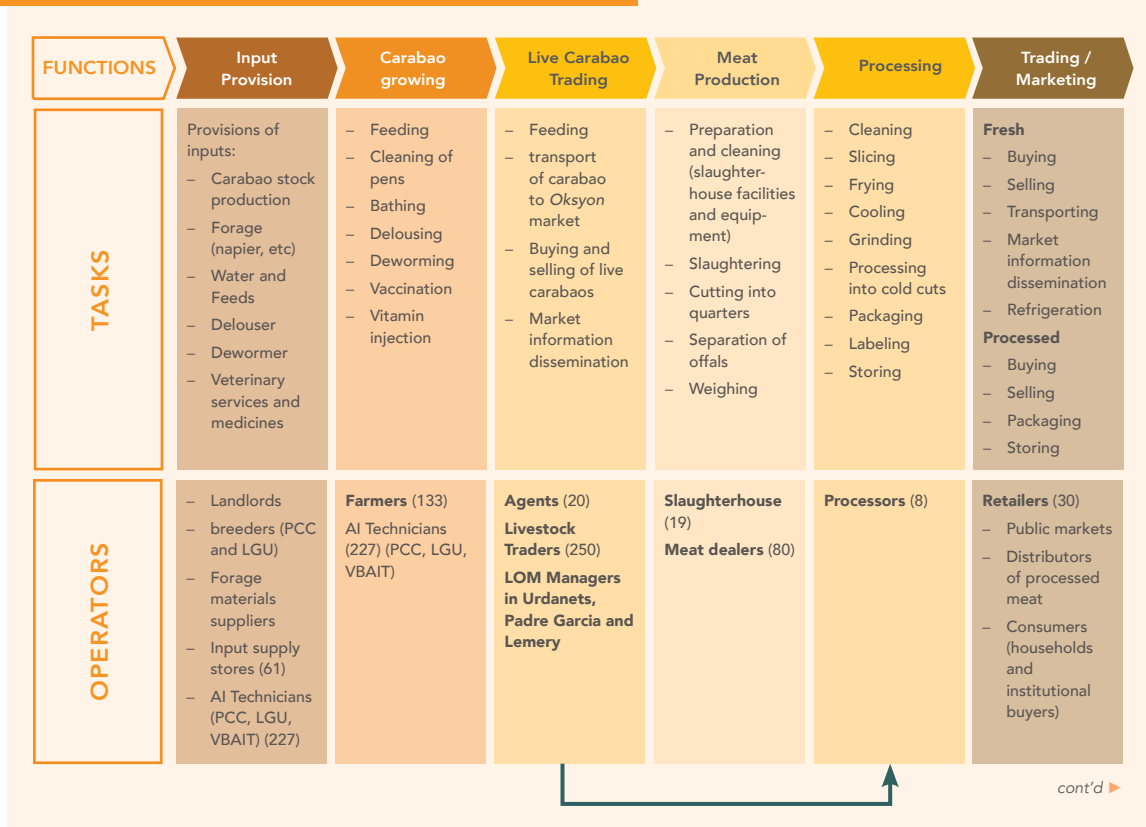


Note: Arrows mean that the players are also involved in functions where the arrows are pointed.

Carabao's Meat and Meat Products

Lantican et al., (2015; 2016) identified eight types of players comprising the value chain of carabao's meat and meat products in the country (Figures 2a and 2b). These include the input providers, farmers, agents, livestock traders, meat dealers, processors cum wholesaler- retailers, retailers, and consumers (household and institutional buyers). In Luzon, there are two categories of business establishments involved, i.e., livestock auction market for trading live animals and slaughterhouse for butchering carabaos. In Visayas and Mindanao, aside from auction market and slaughterhouse businesses, there is also a seaport business intended for transporting the animals to the buyers outside the region. Key functions performed by value chain players include input provision, carabao growing, live carabao assembly and distribution or trading, meat production, meat processing, and meat marketing. The enablers are almost the same as those found in the value chain for carabao's milk and milk products.

FIGURE 2A. VALUE CHAIN MAP OF CARABAO'S MEAT AND MEAT PRODUCTS IN LUZON (2014-2015) (LANTICAN ET AL., 2015)



CONT. FIGURE 2A. VALUE CHAIN MAP OF CARABAO'S MEAT AND MEAT PRODUCTS IN LUZON (2014-2015)

ENABLERS (Meso)	<ul style="list-style-type: none"> - PCC - LGUs (Municipal & Provincial) - DA-RFOs - DTI - DAR - SUCs 	<ul style="list-style-type: none"> - PCC - LGUs - DAR - PCARRD - DA-RFOs - Rotary (Laguna) - BAI - UNIFEM 	<ul style="list-style-type: none"> - LGUs - DTI 	<ul style="list-style-type: none"> - NMIS - LGUs - DOST - CESO - DOLE 	<ul style="list-style-type: none"> - DTI - DENR - CESO - APDC-BAI - Land Bank of the Philippines - DOH - LGUs - DOST 	<ul style="list-style-type: none"> - DTI - DA-RFOs - LGUs - JICA
	<p>RA 10611 - Food safety registration to protect consumer's health and facilitate market access</p> <p>Provincial Ordinance No. 170-2013 regulating the slaughter of female carabaos (riverine buffaloes & crossbreds) within the province of Pangasinan thereby establishing scheme for female breedable carabao and providing funds thereof.</p>					

FIGURE 2B. VALUE CHAIN MAP OF CARABAO'S MEAT AND MEAT PRODUCTS IN VISAYAS AND MINDANAO (2015) (LANTICAN ET AL., 2016)

FUNCTIONS	Input Provision	Carabao growing	Live Carabao Trading	Meat Production	Processing	Trading / Marketing
TASKS	Provisions of inputs: <ul style="list-style-type: none"> - Forage materials (napier, etc) - Water and Feeds - Delouser - Dewormer - Vitamins (A,D,E) - Vaccines against carabao diseases 	<ul style="list-style-type: none"> - Feeding - Cleaning of pens - Bathing - Delousing - Deworming - Vaccination - Vitamin injection 	<ul style="list-style-type: none"> - Feeding - transport of carabao to Oksyon market - Buying and selling of live carabaos - Market information dissemination 	<ul style="list-style-type: none"> - Preparation and cleaning (slaughter-house facilities and equipment) - Slaughtering - Cutting into quarters - Separation of offals - Weighing 	<ul style="list-style-type: none"> - Cleaning - Slicing - Grinding - Marinating - Frying - Packaging - Labeling - Storing 	Fresh <ul style="list-style-type: none"> - Buying - Selling - Transporting - Market information dissemination - Refrigeration Processed <ul style="list-style-type: none"> - Buying - Selling - Storing
OPERATORS	<ul style="list-style-type: none"> - Dairy cooperatives/ association (60) - Breeders (PCC) - Forage materials suppliers - Input supply stores (25) - Dewormer - AI Technicians (PCC, LGU, PVO, and VBAIT) (212) - Equipment 	Farmers (921) AI Technicians (212) (PCC, LGU, VBAIT)	Agents (19) Livestock Traders (84) LOM Managers (8) Ports (31)	Slaughterhouse (17) Meat dealers (73)	Processors cum Wholesaler-Retailer (7)	Carabao's Meat Retailers (17) <ul style="list-style-type: none"> - Distributors - Public Market - Consumers (households and institutional buyers)
ENABLERS (Meso)	<ul style="list-style-type: none"> - PCC - DSWD - PCARRD-DOST - LGU - FAO - DOLE - BAI - JICA - PBSP 	<ul style="list-style-type: none"> - PCC - PCARRD-DOST - DSWD - LGU/DA - DA-RFU - Input supply store 	<ul style="list-style-type: none"> - PCC - LGU - JICA - Quarantine/ Ports (Municipal and Provincial) - Philippine Ports Authority 	<ul style="list-style-type: none"> - DTI - NMIS - LGU (Municipal and Provincial) 	<ul style="list-style-type: none"> - PLGU-Bohol - DTI - KOICA - LGU-Surigao City - Women's Association 	<ul style="list-style-type: none"> - PCC - DTI - LGU - DA-RFUs - Women's Association - LGU-Surigao City

RA 10611 - Food safety registration to protect consumer's health and facilitate market access

Note: Arrows mean that the players are also involved in functions where the arrows are pointed.

Price Structure Along the Market Channels

The price structure of buffalo meat along the market channels are summarized below (Table 14). As described in the foregoing pages, the common marketing channel for carabaos in a smallholder system starts through an agent who moves around and looks for carabaos for sale. The agent is actually the arm of “viajeros” who consolidate the animals from farm gates and transport the same to the auction market or to the slaughterhouse. Based on the simplified data on price structure of buffalo liveweight market channels, on the average, the agent gets only 1.07% increment above the farm gate price, and the “viajero” gets the bigger share of about 19.3%.

TABLE 14. PRICE STRUCTURE OF BUFFALO (IN LIVWEIGHT AND CARCASS) IN SELECTED REGIONS IN LUZON, PHP/KG, 2014

REGION	Farmer, (Liveweight)	Agent (Liveweight)	Viajero (Liveweight)	Meat Dealer (Carcass)	Retailer (Meat Cuts)	Processor (Tapa)
1	96.71	98.18	102.12	190.00	203.33 - 220.00	300.00
2	106.21	107.55	123.76	176.15	188.00- 200.00	300.00
3	102.05	103.72	144.93	190.00	238.35- 232.50	300.00
4a	103.52	105.04	123.69	165.45	194.44- 196.25	---
Ave	102.1225	103.6225	123.625	180.4	---	---
% Increment	---	1.07%	19.3%	---	---	---

Source: Lantican et al., 2015

The price structure of buffalo's milk along the market channels varies between Regions, with highest farm gate in Region 4A. The same is true for the wholesale and retail prices of milk sold after pasteurization (Table 15).

TABLE 15. PRICE STRUCTURE OF BUFFALO MILK (RAW AND PASTEURIZED) IN REGIONS 1-4A, PHP/KG

Region	Farm Gate	Milk Collector/ Co-op	Wholesaler- Processor	Retailer	Dairy Outlet
1	45.83	---	55.00-60.00	---	65.00
2	41.85	52.85	---	90.00	100.00
3	47.57	57.57	112.00	121.00	---
4A	68.68	80.00	120.00	135.00	---
4A1	68.68	---	105.00	150.00	---

Source: Lantican et al., (2015)

The practice among milk farmers is they sell raw milk to a milk collector who in turn brings the collected milk direct to processor. Some farmers bring their milk directly to their respective cooperative for processing. In this case, the collector/co-op has a margin of PHP10.00/kg to PHP11.32/kg. The larger margin in the market channel goes to wholesaler/processor who sells the milk in pasteurized form, with margin that ranged from PHP36.32/kg to PHP54.43/kg (Table 16).

TABLE 16. PRICE INCREMENT PER MARKET CHANNEL OF BUFFALO MILK IN REGIONS 1-4A, 2014, PHP/KG

Region	Milk Collector/ Co-op	Wholesaler- Processor	Retailer	Dairy Outlet
1	---	9.17-14.17	---	5.00-10.00
2	11.00	---	37.15	10.00
3	10.00	54.43	9.00	---
4a	11.32	40.00	15.00	---
4a1	---	36.32	45.00	---

Summary of Identified Constraints

The value chain analysis on carabao industry carried out by Lantican et al., (2015-2016) has identified several constraints to industry development. A summary of the observed constraints was categorized into under pre-farm gate, in-farm, and post-farm gate, as presented below.

Pre-Farm Gate

Limited Access to Credit

Credit availability is a single major element needed to spur enterprise development when resource-deficit smallholders are the participants. In large animal production, acquisition of stock constitutes the bulk of the investment. And while it can be said that feeding ruminants is less costly owing to its ability to utilize forages and other low-quality farm by-products, there is also a need to supplement the animals in order to meet the requirements for their specific purpose, a good example is in milk production. One physiological attribute of large ruminants is their long growing and long gestation period. This would then suggest that the raiser has to have a cash flow for considerable period before revenues from the operation starts to be achieved.

The credit facilities for livestock production are available, however, the ease of access is a major consideration. Smallholders have no adequate assets to be used as collateral to avail of the credit fund. Secondly, the available credit program has interest rates higher than the ROI expected in large animal production system.

There is a need to review the existing credit facilities for livestock production, and based on the analysis on the profitability of a given large animal enterprise, craft a “special credit window”, defining the scheme and the most suitable interest rate.

Development of Partnership Modalities with LGUs, NGAs, and NGOs

With LGUs as frontline partners, as defined in the LGU code and in view of the Mandanas-Garcia Supreme Court Ruling, it becomes imperative that interested LGUs be able to

internalize the CDP and adopt the program as their own, allocating adequate resources for effective extension works as well as in monitoring. The priority for LGUs is assignment and hiring of full-time livestock technicians, and to be trained completely on livestock production, particularly in dairying.

Partnership with leading agricultural universities has a myriad of advantages. These institutions have the human resource and facilities that can be harnessed to carry out needed training of participating partners, as well as training of young technical personnel who in due time shall be part of the production system. Universities can also share their experts in the conduct of research in various disciplines, particularly in areas where PCC has inherent deficiency.

Improving Capabilities and Capacities for Policy Research, Product Development, Marketing, and in Business Process

Most of the available competencies in PCC and in other partner institutions is skewed towards technical areas, leading mostly to the concerns of production. There is a perceived need to develop competencies in other critical areas related to improving business process to include policy research, product development, and marketing.

One approach to filling up the competency gap is linking with institutions, both domestic and international, where the needed high-level expertise is available. This avenue can achieve the direct needed output, and at the same time can result in training and improvement in competencies of the host institution.

Expanding Focus on Enhancing Technology Flow from Laboratories to Farmer Users

There are technological developments elsewhere in livestock production, including a long list of completed research and identified technologies at PCC. The challenge is now shifted on how to enhance the technological flow from the laboratories to the field usage. Extension modalities vary between technologies, as they depend on the socio-economic environment.

In-Farm

The constraints in production can be grouped into animal-based, feed-based, and human-based. But by and large, the overbearing issue is on the issue of profitability, be it in production of carabaos for meat or for milk. Given that all needed inputs are available and accessible to the producers, there is a need to review the profitability of semi-commercial and commercial operations, systems that are supposed to be a resultant of graduating from the small and subsistence production system.

Feed-based Constraints

Nutritional deficiencies in animals lead to complex physiological abnormalities to include poor reproduction, poor growth, and high mortality, which are contributory to inefficiency and poor profitability. Inefficiencies noted in the animals, particularly those raised by smallholders, are not actually inherent in the animal, but rather a reflection of the rearing and management system employed by the raisers. Modalities to hasten adoption of proven technologies in forage production and conservation are major research areas.

One area often missed in development of production base is the feed audit. There is always the assumption that feed is available in the farming community. This assumption is true if the number of animals in a proposed production base is very limited at the start of the program. However, if assessment of the carrying capacity of a given area or community is not taken into serious account, forage deficiency will surely manifest, as the animal population grows. This may result in sourcing feed materials from far places, adding the cost of feeding.

Animal-based Constraints

The issues are expressed broadly in slow population growth rate and in reduced profitability. As covered in the foregoing discussion, most of the observed abnormal performance are not inherent in the animals, rather are results of poor feeding and herd management. It is indeed an issue of technology flow and adoption of proven technologies.

Difficulty of Rebreeding. Many farmer participants in the dairy program complain about difficulty of rebreeding of dairy animals. This is true particularly among high yielder cows even the animals have been under correct feeding management regime. Available technical schemes to address this anomaly entail cost.

Difficulty of rebreeding often results from nutritional deficiencies. Dairy cows are milked daily, with the milk containing much calcium and phosphorus, in addition to protein and energy. Energy and protein deficits are common among dairy animals in the villages receiving no concentrate and mineral supplements.

Low success rate in artificial insemination. Artificial insemination (AI) is a single technology that has impacted on animal production worldwide. Applied in the carabaos in the villages, the success rate obtained is relatively low owing to various factors. First and foremost is the proficiency of AI technician. Program for continuing proficiency improvement of AI technician should be in order.

Between the semen donor and the pregnant heifer/cow lies multitudes of factors. Elucidating these factors under actual field conditions and instituting corrective measures would have significant contributions to success of AI in carabaos in the villages.

Gender of calves produced from AI is skewed towards male. Issues raised by farmers, particularly those in dairying, has been on the higher number of male calves out of AI. It would be interesting to review the gender of offsprings of all the semen donors in the PCC bull farms and identify bulls with offspring skewed towards female if there is such a trend. There is also an unanswered question as to the effect of semen processing on the integrity of x- or y-bearing sperm cells.

On the other hand, it would be of great industry impact if semen sexing facilities can be installed and sexed semen can be used successfully to produce more female offsprings to address the need for dairy animals in the country. This becomes an interesting issue in view of the reported decline in success rate using the sexed semen as applied commercially in multiparous cattle.

High percentage of private AI technicians go inactive. Many LGUs adopt AI services as part of their local program and were active in providing support in many respects. Due to devolution of function of extension to LGUs, most of the livestock technicians become generalists and have lost focus on livestock services.

In view of such development, interest on privatizing AI services was initiated through training of village-based AI technicians (VBAIT). The concept is to develop private AI technicians and in the course of service, farmers will have to pay. However, after several months from training period, a large percentage of trained VBAIT were found inactive. In view of this trend against the background of the need to increased diffusion rate of AI, an understanding of the dynamics of privatized AI for large animals has to be fully understood, and models for sustainable AI system be developed.

Absence of directed production of crossbreeds and backcrosses. Backcrossing to the riverine sires to attain backcrosses after three or four generations can be considered a practical way of increasing dairy animal population from the indigenous population. However, after more than twenty years of AI and bull entrustment services, the desired number of backcrosses of the 3rd and 4th generation is still very limited. The reason has been that number of AI services has been the focus, with quality of animals produced only a second consideration. Installation of accurate recording system and deliberate backcrossing tied up with the on-going genetic improvement program will have great impact on the growth of the young carabao dairy industry in the country.

Low efficiency of bulls loaned for breeding. Under the current program, bulls are loaned out for natural mating to communities hardly covered by AI services. Records of services and offspring produced out of loaned-out bulls is only 3.8 calves per bull per year on the average, far less than the expected number. Studies on development of more efficient way of bull utilization in the villages need to be undertaken in order to maximize the use of loaned-out bulls.

Attention on rearing replacement heifers is minimal. Very common in the village is the desire of the dairy farmer to obtain as much cash as possible from the milk sales and, thus, deprives the young animal of needed milk for normal growth. Under this condition, the calf exhibits stunted growth and very delayed age to reach mature weight.

Nutritionally deprived calves during growth period will exhibit poor milk production performance even when the animal is able to reach mature weight at a later age. At worst, the stunted heifer is not eligible as a replacement heifer. Appropriate extension strategies to improve adoption of correct calf rearing practices will have great impact on the ability of the dairy herd population to grow and become sustainable.

Crossbreeds are not fully utilized for dairy purposes. There are already considerable number of crossbreeds out of more than twenty years of crossbreeding activities. The male crossbreeds are highly acceptable for draft and meat purposes in view of their bigger body size and faster growth rate. On the other hand, the female crossbreeds are not fully utilized as potential dairy animals. Possible schemes acceptable and applicable for the full utilization of the huge number of crossbreeds on the ground would be a big boost to the national dairy development program.

Aging dairy farmers. Some farmers who surrendered their dairy buffaloes are proven good caretakers, taking cues from the good animal body score, and records of calving and milk production. Their reason for animal return is old age. Their sons who were supported to complete schooling by the dairying project have different interests, a clear case of absence of continuity of the dairying in the family. This is not an isolated case in the village area. If carabao dairying is to continue and to grow, there should be measures to make dairying attractive to the younger generation. The most logical reason maybe is related to income level and issue of comfort. Determining the appropriate farm size and income level that would give reason for the younger generation to continue dairy farming can be interesting research.

Post-Farm Gate

Milk Quality Assurance

One major concern in smallholder dairying is the milk quality due to low level of sanitary and hygienic practices, which start from the cleanliness of the animals being milked, the cleanliness of milk containers being used, and the cleanliness of the milkers. Often, the absence of clean water magnifies the problem of milk quality. Another common reason for the deterioration of milk quality is the absence of attention to cooling the milk as

soon as possible after milking. Due to distance from the milk collection center, it takes considerable time between milking time to cooling the milk, giving the chance for the microorganism to build up and, thus, damage milk quality.

Access to Market

Many dairy farmers who are not members of the dairy cooperative find it difficult to market their milk in time of lactation peaks. Most of them are selling their milk to middlemen who pay their milk at considerably low price. And because they are not members of a cooperative, often, they are not well informed about the market price of milk, and would just rely on the pricing scheme offered by the middlemen.

Among farmers that sell their live animals, long distance from livestock auction market prohibits them to transport their animal for sale. In some areas, there are simply no established livestock auction markets. The cost of transport from their farm to some suitable market places becomes very expensive. Even the “viajeros” are complaining of the bad road system in the far-flung areas from where the animals are being sourced.

In most cases, farmers rely on the presence of middleman who can buy animals right at the farm. However, in the absence of up-to-date information on market price, the farmers are always at the disadvantaged end.

SWOT Analysis

Based on a series of consultations with the stakeholders, the carabao industry's strengths, weaknesses, opportunities, and threats (SWOT) have been adequately enumerated and discussed in length. Below is a summary of the SWOT analysis for the carabao industry.

Strengths

Institutionalization of the Carabao Development Program

There is a dedicated government agency with facilities, highly trained human resource compliments, and with sustained funding support to pursue on the growth and development of the carabao industry.

Presence of Adequate Breeding Base to Propel the Program

There are about 2.8 million indigenous stocks of carabaos, which can be used as a stage for massive upgrading. For the past 10 years, there is a semblance of stability of the carabao population despite the changes such as government's massive farm mechanization program, and industrialization of raising swine and poultry, which effectively offer ready meat at competitive prices.

FMD-free without Vaccination Status

This status is basically the passport for export of livestock products, assuming that the system can produce marketable and competitive products for the international market. Buffalo-derived products such as "mozzarella di bufala" with quality, price, and supply reliability have the potentials to be competitive in major markets in Asia such as Japan, Singapore, South Korea, and Hong Kong.

Established Partnership with Domestic and International Institutions and Entities

Over the years, strong partnership has been established with local research and funding agencies such as DOST-PCAARRD, DA-BAR, BAI, NDA, NMIS, PCAF and international bodies such as JICA, KOICA, FAO/UNDP and many other research institutes and

universities around the globe. Such partnerships/linkages are valuable modes to access expertise, technologies, as well as funding support for the program.

Strong Legislative Support

Cognizant of the contributions of the program to improving income, employment, and food security, there is a growing support from the legislative branch, particularly the Senate Committee on Food, Agriculture, and Agrarian Reform by way of policies and fund allocation for the program expansion.

Weaknesses

Limited Stocks of Dairy Genetics

The country has no indigenous dairy breed, and therefore, has not developed the culture of dairying, and has failed the development of the palate of the consuming public for fresh milk. We need to import stocks from suitable country sources, but at a relatively high price. In the case of dairy buffaloes, the best genetics are available in great numbers in India and Pakistan, however, the current phytosanitary conditions in these countries prohibit imports. Because of limited number of dairy animals, it becomes difficult to quickly respond to the growing demand.

Less Developed Feed Base

Efficiently raising ruminants such as dairy buffaloes would need availability of good quality forage, normally by way of developing pasture for grazing. And since there is no sufficient land to establish a grazing system, the most common way is "cut and carry system". Many smallholder farmers rely on grasses harvested elsewhere rather than from established forage plot, and because of short supply of grasses during dry season, animals are fed with farm wastes such as rice straw with very low nutritional value, far deficient for meeting the nutritional requirements of growing and lactating animals. Limitations in quality feeds affects reproduction, milk production, as well as growth among young animals.

Program Based on Smallholders Mixed Crop-Livestock System

In most of the cases in a mixed farming system, the crop is the dominant commodity and attention to properly raising the animals becomes secondary. This is also true in terms of resource allocation, as well as in technology adoption. The result is the inability to harness the full potentials the animals. Under this setup, even the quality of milk becomes an issue due to deficiency in adoption of hygienic and sanitary practices.

The other aspect of a smallholder system is that the numbers of animals are so limited per farm/farmer and are spread too thinly over a wide geographical area. Provision of technical services such as artificial insemination, milk test and quality monitoring, among others are greatly affected.

Physiological Attributes Inherent in Large Animals

In a period when fast growth is required, the physiological attributes of the water buffaloes becomes a limitation such as the long gestation and long calving interval, and single offspring per birth. Added to this is the longer time to reach reproductive age. Because of these inherent attributes, it will require a longer time to see substantial development. This is particularly true in the case of crossing the native stocks with the dairy breed to attain a blood of at least 75% dairy, requiring at least 2-3 generations, equivalent to 10-15 years. This is unlike in swine, wherein a good sow can produce 30 offsprings/year, or in the case of poultry, which can lay eggs for hatching at the rate of 296 per year.

Low Efficiency of Existing AI and Bull Entrustment Programs

Since artificial insemination and bull entrustment are the tools to impart the genetics for milk production potentials to the indigenous carabaos, it becomes premium to look into how to upgrade the current efficiencies.

Opportunities

School-based milk feeding program

The approval of RA 11037 and RA 11148 opened a huge market for the locally produced milk. Moves to expand the current coverage of the school-based milk feeding program, from the selective mode of feeding only those undernourished children in elementary grades to non-selective mode would create a much bigger and sustainable market for local dairy farmers. The beauty of feeding the young is creating their palate for fresh milk, thereby developing also the future consumers of fresh milk.

Increasing population, rising urbanization, and increasing consumers' income

Demand for meat and milk products are expected to grow due to increasing number of consumers as well as rise in their purchasing ability. It has been shown elsewhere that rise in income is directly associated with the change in food preference, demanding more protein of animal origin in the form of meat and milk. In fact, it is established that the rate of development of the dairy industry in any country is a function of rate of economic growth.

Asian niche market for buffalo-derived products

Buffalo-derived products such as “mozzarella di bufala” has a niche market growing in major Asian countries such as Japan, Hong Kong, South Korea, and Singapore. There exist good opportunities to get a share of the growing market in view of the inherent loss from the cost of production as well as proximity of the Philippines to these potential export markets.

Wider LGU program participation

The newly issued Mandanas-Garcia Supreme Court Ruling is seen as a good opportunity to expand the program implementation given that appropriate working partnership are established with LGUs with interest to participate in the program. Not only that the new Supreme Court ruling allocates additional fund for agricultural development of LGUs, but also it gives the LGUs the ownership and responsibility to implement programs of

their choice. In simple terms, there are more hands to fast track and ensure sustainable development of the carabao sector.

Integration of Dairying in Coconut Farming

There are 3.56 million hectares of land planted to coconut, representing 26% of total agricultural land and are in 68 of the 81 provinces in the country, involving 3.4 million farmers. Harnessing the suitable land out this huge area, and engaging the interested farmers to participate in the program offers a great opportunity for program expansion.

New Technical Developments

There are available technologies developed and commercialized elsewhere that can be accessed in order to enhance the program components development. Example is the technology of semen sexing, technology long used in dairy cattle to produce more female offsprings to fast track dairy herd buildup.

Threats

Competition from Cheap Imports of Milk and Meat Products

In a pro-consumer policy environment wherein low-cost products produced in other countries can readily enter our market and compete with the local products, the growth and development of the domestic industry is guaranteed to get stunted. The case of entry of low-cost powdered milk from Australia and New Zealand, and that of the Indian carabeef, and lately, of MDM, are concrete examples.

Growth in Market Share of Non-Dairy Alternatives and Plant-Based Meat Products

There is growing concern about the health issues on consumption of animal-derived food items such as milk and meat. Associated with this issue is the alarm caused by increasing greenhouse gasses fueling the impending climate change. Because of these concerns, there are mounting efforts to develop non-dairy alternatives, and plant-based “meat” products. The share of these various new products in meat and milk markets is growing at an unexpected rates.

Growth in Market Share of Meat from Chicken and Pork

Data elsewhere have clearly shown that the increases in meat requirements of the growing consumers are being filled up by meats coming from monogastric animals such as swine and poultry. Issue of price setting as well as cost to environment are two major points in this shift in meat consumption preference.

Emerging New Diseases and Climate Change

It is easily understandable that emerging new diseases, both of livestock and human, are direct threats to the program. There is growing body of evidence that these issues are indeed results of human activities that precipitated after a long period. At the rate human population is increasing also goes the rate by which environmental degradation is progressing, and so will remain to be one of the greatest threats in the future.

Political Climate

In a program largely dependent on government intervention such as those involving smallholders, the change in government leadership, from the lowest to the highest level, is also expected to have implications on the program in various configurations. This is because the system has become highly politicized of late. The threats of non-continuity of funding support and changes in policy and priorities are real.

Farm Income/Cost and Return Analysis

The PCC's Business Development and Commercialization Unit (BDCU) developed portfolios for setting up a 5, 10, 15, and 20 head dairy buffalo modules. The financial analyses involved 10 years operation under zero debt condition. Details of each of the investment portfolio are presented in ANNEXES 5-8 and the summary investment and profitability indicators are shown in Table 17.

TABLE 17. SUMMARY INVESTMENT AND PROFITABILITY INDICATORS FOR 5, 10, 15, AND 20-HEAD DAIRY BUFFALO MODULES

Item	5 hd	10 hd	15 hd	20 hd
Total Investment, PHP	514,993	909,623	1,489,933	1,943,346
NPV, PHP	242,981	645,083	1,168,093	1,115,254
IRR, %	23.56	26.33	27.71	24.99
Payback period, years	5.97	5.47	5.06	5.18
Present value of cash flow, PHP	796,851	1,657,919	2,844,922	3,237,042
Profitability Index	1.55	1.82	1.91	1.67

Source: BDCU-PCC (2021)

There are adequate indicators showing that the dairy buffalo modules are viable based on the above-listed parameters. The IRR that ranged from 23.56 to 27.71 can be considered highly acceptable for investment. Moreover, the profitability index of the dairy buffalo modules presented in the BDCU investment portfolio of 1.55 to 1.91 is indeed a go signal for investment.

In view of the high investment cost of dairy stocks and the inherent physiological attributes of the dairy buffaloes, it may take 5.6- 5.97 years to achieve a payback.

Competitive Analysis

Consumption Trend

As source of meat, globally there is a continuing shift from ruminant-derived meat products to monogastric animal's meat. This is associated with a long production cycle among ruminants, apart from the issue of lower feed conversion efficiency, and coupled with consumer preference and price setting. During the period 1961 to 2013, there was a two-fold increase in pork and four-fold increase in chicken meat per capita consumption globally as shown below (Table 18).

TABLE 18. GLOBAL PER CAPITA CONSUMPTION PATTERN OF MEAT, 1961-2013

Meat Source	Average per capita meat consumption, kg/year		Percent Change
	1961	2013	
Other Meat	0.89	0.98	10.1
Mutton and Goat	1.92	1.91	-0.52
Beef and Buffalo	9.32	9.32	0
Swine	8.00	16.02	99.75
Poultry	2.88	14.99	420.48

The trend in the Philippines during the last 19 years follow the same pattern (Table 19). Perhaps, it can be argued that the declining per capita consumption of carabeef in the country, other than the issue of price, is because of the slow rate of production compared to fast reproductive cycle in poultry and swine. The supply gap can be seen in the low average self-sufficiency rate of 69.25% during the past 10 years. Growth in demand by the processing sector is being filled up through importation of Indian carabeef, and of late with MDM.

TABLE 19. PER CAPITA MEAT CONSUMPTION PATTERN IN THE PHILIPPINES, 2000 VS 2019

Meat Source	2000	2019	%Change, 2000 vs 2019
Chicken	999,316	1,927,413	92.87
Pork	1,571,943	2,296,652	51.30
Beef	271,556	260,624	-4.0
Carabeef	123,972	140,661	13.46
Chevon	75,185	76,357	15.57

The dramatic shift in global meat consumption has impact on improvement of feed conversion efficiency, as it would require 7.5 kg of feed to produce a kilo of beef whereas only 3.3 kg to produce a kilo of chicken meat. This has also significant impact on environmental footprint since CO₂ emission to produce a kilo of beef is equivalent to 27.0 kg and only 6.9 kg for chicken meat.

The major factors for the fast growth of the chicken industry include the establishment of commercial farms coupled with expansion in their stocking capacities and adequate supply of day-old chicks. This has been fueled by the expanding fast-food sector, which are chicken-meat based.

Price Competitiveness

There are products in the market today that directly compete with buffalo meat in terms of price, and there are also newly emerging plant-based products designed for consumers that are concerned about the environmental impacts of animal production, particularly large ruminants such as water buffalo and cattle.

Based on the prices reported by PSA, except for beef, other meats on the market are priced lower than buffalo meat (Table 20). The PSA reports as of January 2021 indicated that the most expensive meat is beef, some 2.28 times more expensive than chicken meat and 1.43 times more expensive than pork. On the other hand, while the price of carabeef is lower than beef, it is a known common practice by meat retailers to pass on the meat from young carabaos as beef.

Among the low-income consumers, it is easy to understand why the demand for chicken meat is much higher than beef or pork. But there are reports that pointed out that as income level increases, the consumer preference is shifted from chicken to pork, and then to beef.

TABLE 20. PRICE COMPARISON OF MEAT FROM VARIOUS SOURCES

Item	Low	High
Carabeef, PHP/kg	250.70 ^a	
Beef, PHP/kg	309.00 ^b	470.00 ^b
Indian carabeef, boneless, PHP/kg	139.00 [*]	
Chicken meat, PHP/kg	135.00 ^b	142.00 ^b
Pork, PHP/kg	215.00 ^b	250.00 ^b
MDM, US\$/kg FOB	0.7 ^c	0.9 ^c

Source: PSA, Jan 2021 Liveweight price converted into carcass price, 50% dressing %^a; Manila Supermarkets^b; APEDA 2021^{*}; Alibaba, 2021^c

Only 15% of raw materials for meat processing are sourced from local producers due to technical mismatch. The processors require “industrial grade” meat whereas local producers are primarily selling “table grade meat” for the wet markets. Also, main reason is cost consideration, MDM and Indian meats are relatively cheap compared to locally-available meat. In addition, the support facilities such as refrigeration requirements of processors are not met by local producers. These are the considerations why the volume of Indian carabeef imports has grown, as shown in Table 21.

TABLE 21. IMPORT OF INDIAN CARABEEF *

YEAR	Volume, MT	Value, US\$
2018-19	44,709.12	120,138,624.00
2019-20	31,638.29	78,503,837.00
2020-21	34,585.08	95,758,746.00

Source: APEDA, 2021

On the other hand, imports of MDM grew by 30.6% in 2019, to 235,696.105 MT, from the previous figure of 180,383.425 MT. In 2021, the deboned chicken meat is the largest in terms of volume and accounts for 53.43% of all chicken meat imports (BAI, 2021).

In terms of dairy products, buffalo's milk has a big competitive advantage because of its inherent properties. Other than the fact that there is no fresh buffalo's milk in the domestic market competing from outside sources, processed buffalo's milk such as the traditional "pastillas" and "kesong puti" has its own developed market. Likewise, premium ice cream in the domestic market are made primarily from buffalo's milk. In fact, the Philippine-made premium ice cream has already penetrated international markets.

Nondairy Alternatives

One competitor in the milk market is the growing interest on nondairy alternatives. The global market for alternative protein is set to be worth US\$16 billion by 2025, and the market for dairy-free milk has grown 8 percent every year over the past decade.

New nondairy alternatives are being developed recently by several new emerging companies. For example, a cow-free milk wins the Liveability Challenge 2020. The innovative lab-grown milk concept was developed by the Singapore-based biotechnology company TurtleTree Labs. The company's cell-based milk avoids the climate impact and animal welfare issues, which the US\$700 billion industrial dairy industry is associated with.

Another product has been introduced by the Sophie's Bionutrients, an algae-based milk comparable in nutritional value to cow's milk, but using a fraction of the energy, land, and water. The company grows the microalgae in large fermentation tanks, and feeds it food waste such as spent beer grains. The result is a water-soluble protein flour, which can be used to make milk proteins products.

Plant-based Meat Products

Advances in food science, ingredients characterization, processing, and production have resulted in a wave of plant-based meat products designed to replicate the sensory experience of the conventional meat. The popularity of plant-based meal is coming as increasing number of consumers seek protein alternatives that are tasty, nutritious,

familiar, and have a lighter environmental impact. A growing body of research predicts global expenditure on plant-based meats to reach up to US\$140 billion by 2029 or 10 percent of the US\$1.4 trillion global meat market (Terazono, 2019).

Vegan Leather

Innovative companies are coming out with new kind of leather from plant-based materials such as mushrooms, apple peels, and pineapples other than those from plastic-based materials such as polyvinyl chloride and polyurethane. There is a growing awareness of the leather industry's effects on the environment. Globally, North America holds the maximum share in the global vegan market but Europe is a substantial potential market owing to the increasing demand for animal-free and eco-friendly alternative products. Asian market for vegan leather is also experiencing rapid growth due to robust growth in automotive and footwear industries, particularly in China, Japan, and South Korea. The vegan leather market will be hitting US\$89.6 billion by 2025, with a compound annual growth rate of 49.9% (Infinium, 2021).

VISION, MISSION, OBJECTIVES

Vision

A vibrant and productive carabao (water buffalo) industry achieving self-sufficiency, harnessing the niche market for carabao-based products.

Mission

To improve productivity and efficiencies in the carabao sub-sector and develop internationally competitive carabao-derived products, thereby, increasing the income of the multitude of smallholder carabao raisers.

Objectives

The objectives of the Carabao Industry Roadmap (CIR) 2022-2026 are:

1. To achieve an average of 15% annual growth in milk production and farmers' income
2. To provide livelihood opportunities to at least 300,000 rural families in carabao impact areas
3. To attain improvement in daily milk production from 5.2 li to 6.0 li
4. To promote development of at least two buffalo-based business hubs

STRATEGIES AND POLICIES

The key areas of Carabao Industry Roadmap 2022-2026 are the following:

1. Increasing inventory and quality of water buffalo stocks
2. Increasing productivity and profitability
3. Consolidation and development of buffalo business hubs
4. Harnessing the niche market of buffalo-derived products, both local and international

The strategies and activities are grouped under three categories: (a) Industry wide efforts (more on meat and draft) - directed towards massive crossbreeding to cover as many breedable females as possible to produce 50:50 crossbreds that exhibit hybrid vigor for growth, more suitable for meat and also for draft, as crossbreds have larger body size and are highly trainable; (b) programs dedicated for specialized dairying - focus is on the propagation and sustained genetic improvement of purebred dairy stocks and directed backcrossing of crossbreds to increase the level of dairy blood to at least 75% so that these backcrosses can be moved to the fold of becoming good dairy animals; and (c) crosscutting programs - common to animals destined for meat as well as those for dairy. Serious attention shall be given to improving feed-based related issues. Development of the feed-based system will permit the envisaged expansion of the dairy herd, a prerequisite for dairy industry development.

The crosscutting programs will also cover issues on animal health, product safety, product development, and more importantly, market. The plan to penetrate the Asian market for buffalo-derived products require focus on interrelated areas of product development, product quality, product safety, and market facilitation, among others. Along this line, as well as in other areas, research for development and innovation are indispensable. And as industry is geared towards attempting to penetrate the Asian market, a strong linkage with entrepreneurs being the carrier of this endeavor should be developed.

Human resource development is another area needing focus. This is more pronounced at this period, as the government starts the implementation of the Mandanas-Garcia Supreme Court Ruling, clearly devolving direct extension services and corresponding funding support to the LGUs. Capacitating the program frontliners such as livestock technicians shall entail considerable time and efforts. Likewise, improving the competencies of the lead agency, as the interests on postproduction is magnified is a challenge. There is a need to increase the focus on the development of internationally competitive products, and also a better understanding of the international market.

Sector-Wide (Towards Meat and Draft) Program

By and large, the carabao subsector is presented in the official report of PSA as source of meat, and that being the case, the carabao industry performance is perceived in terms of volume of meat produced. Since the volume of meat produced is a function of the number and the dressing percentage of animals slaughtered, the program shall focus on these areas. The strategies and activities to address these concerns are as follow:

Massive Bull Entrustment

For years, it has been reported that the size of carabaos has been declining due to too much inbreeding coupled with the fact that the quality of the bulls retained for breeding is skewed towards smaller size since the bigger males are selected for draft and are castrated.

Aside from the quality of bulls, another observation is the limited number of available bulls in the villages, and this would mean that the percentage of females being breed is also low. This observation is supported by the substantial field data obtained by PCRDC and PCC technicians from conducted pregnancy diagnosis for several years in the villages prior to the conduct of AI, with reported average pregnancy rate of only 20%.

To address this issue, the CIR 2022-2026 shall include massive entrustment of the purebred riverine bulls. These animals are produced from the institutional herds, the NIZ,

and the RIZs, which are not selected as potential semen donors. They shall be subjected to “socialization” with native stocks, a step necessary to minimize the noted selective breeding behavior of riverine bulls produced and reared in a purely riverine herd.

Based on the current and the projected number of breedable female purebred buffaloes, the estimated numbers of males that can be available for bull entrustment program are shown in Table 22.

TABLE 22. ESTIMATED NUMBER OF POTENTIAL PUREBRED BULLS FOR BULL ENTRUSTMENT PROGRAM, 2022-2026

ITEM	2022	2023	2024	2025	2026
Breedable purebred females from stock infusion	500	1450	2305	2074	1867
Breedable female purebred riverine inventory ¹	5878	6289	6729	7,200	7,704
Total breedable purebred bred with sexed semen	6378	7739	9034	9274	9571
Total expected bulls*	244	284	403	413	427

1. Inventory growth rate of 10% breedable female (2022-2023); 16% (2024-2026); breedable female is 50% of the herd; therefore, the herd growth is 5% (2022-2023) and 8% 2024-2026.

2. No. of male calves per 100 breedable cow at sexed semen = 40% CR, 15% male, 7% mortality, 80% selection pressure = 0.04464 = 4.46 hd

Establishment of Municipal Breeding Stations

Active municipal breeding stations were common several years ago prior to the devolution of function of the Bureau of Animal Industry (BAI), and breeding animals, particularly bulls of large and small ruminants, technical support, and part of the maintenance cost of the animals were provided by the BAI. The common practice was that the farmers with breedable females bring their animals for natural mating in these breeding stations. After the devolution of function of the BAI, operations of many of these breeding stations were not sustained.

With the implementation of the Mandanas-Garcia Supreme Court Ruling, interested LGUs shall be identified and assisted technically in the rehabilitation of the existing breeding stations, or establishment of new breeding stations, as part of their livestock development program. Breeding bulls of purebred buffaloes shall be issued to these breeding stations,

together with the needed technical support. Stocks of frozen semen shall also be made readily available for use in artificial insemination, as needed.

Hiring and Training of Breeding Stations' Technicians

One common thing that happened after the implementation of the LGU devolution is the assignment of existing LGU livestock technicians as generalists, attending to several commodities. In such arrangement, the LGUs and the technicians are focused on the commodities that are providing financial incentives, as in the case of the rice development program. As a result, many LGUs have lost focus on the livestock development due to absence of full-time livestock technicians.

For LGUs with existing dairy development program, and for those without but are interested to pursue dairying, the program shall train their livestock technicians. Training shall consider all aspects of dairying, from rearing calves, breeding and herd management, and up to hygienic milking and milk handling practices. General herd management shall include the very important aspect of feeding and nutritional management. The aspect of breeding shall include technical proficiency in artificial insemination, and good breeding management. The estimated number of AI technicians to be trained to meet the requirements of the CIR 2022-2026 is presented in the Program Targets (see page 65), and the number can grow as more LGUs get involved in the future.

Support to the Establishment of “Livestock Hotel” and Fattening Facility

The smallholder nature of the carabao industry is characterized by non-formal marketing of animals. Most often, carabaos are sold on the basis of the need for cash by the raisers, as in the case of need to pay school's tuition for family member/s, or to cover hospital fees in the case of emergencies, or need for large amount of cash for special events. Under such situations, carabaos are sold irrespective of age, gender, and physical status. One thing certain is that the animal is sold through a middleman whose price tag for the animal is comparatively lower than its true value.

Livestock agents and “viajeros” seldom keep the animals for long because the main objective is to dispose the procured carabaos as soon as possible to generate income. The short route to achieve this objective is to bring the carabao to the slaughterhouse, irrespective of the conditions of the animal. Data gathered from slaughterhouses indicated that a considerable percentage of the female carabaos are pregnant. There are also data indicating that crossbred carabaos, and even in few instances purebred dairy buffaloes, are slaughtered.

Not so many farmers venture into buying from slaughterhouse or from “viajeros” good quality animals for rearing the same for future disposition. For example, a native pregnant carabao can be reared until the delivery before disposition, or a young carabao can be reared until fully grown, or crossbreds with high percentage of dairy blood can be reared and sold later as potential dairy animal. Consolidation of these potential animals, normally sold one head at a time, requires investment in terms of infrastructure and land to house the animals and to produce feeds, and ready cash for animal purchases. A special incentive program shall be provided to interested private entities in the form of assistance to access to credit facility with reasonable interest rate, technical support, and access to market, particularly for the potential dairy animals.

The advantage of carabaos reared and fattened for meat under a common consolidation facility is that the animals can be easily linked to category AA or AAA slaughterhouse for special meat cuts, which in turn can be linked with institutional buyers. This is possible because there are elements of volume, quality, and sustainability in such a semi-commercial or commercial operation.

Specialized Buffalo Dairying Program

Germplasm Infusion (live stocks and embryos from elite donors)

Harnessing the huge existing inventory of indigenous carabaos in the envisaged transformation of the animals from the traditional draft-meat type to becoming milk-meat type requires infusion of dairy genetics. The CDP that started in 1993 with the aim to carry out massive crossbreeding as a way of increasing income of the smallholder farmers was able to infuse a total of 7,573 head of purebred dairy buffaloes spread widely over a 20-year period. In view of the physiological attributes of the water buffaloes, the rate of increase in inventory of the infused stocks is rather slow. Since one of the major objectives of the CIR 2022-2026 is indeed to fast track the herd build-up in order to create sectoral impact, infusion of additional purebred stocks is inevitable.

As programmed, 500 hd purebred buffaloes shall be infused in 2022, and additional stocks of 1,000 hd per year for 2023 and 2024 shall be part of the herd build-up. Private participation is encouraged and shall be given corresponding incentives in the form of import facilitation as well as transport cost support.

Purebred buffaloes procured through the program fund shall be loaned out to existing smallholders, as a way of expanding their stock position, transitioning these farmers from subsistence to specialized dairy entrepreneurs.

There is also a need to infuse embryos from elite donors from outside sources to enhance the desired genetic improvement. Embryo-derived elite stocks shall form part of the nucleus of dairy buffaloes and shall be fully harnessed for wide scale genetic improvement as donors of semen for artificial insemination and embryos for further enhancing the propagation of superior stocks.

Directed Backcrossing

Expanding the transformation efforts of the carabaos to become milk-meat type has been facilitated with the use of artificial insemination, and augmented with bull entrustment program for natural mating. Over the years, many crossbred buffaloes have been

produced, however, only a small percentage of these animals join the fold of being milked by the farmers. The major reason has been that the milk yield of 50:50 crossbred is only sufficient for household consumption, and for those that would yield considerable volume, farmers in remote areas have lost the interest to milk crossbreds due to absence of ready market. With the approval of the R.A. 11037 mandating DepEd to include milk in elementary grade school's feeding program to address malnutrition, milk market is no longer an issue in areas far from the traditional market grid. Increasing milk productivity among the 50:50 crossbreds becomes the main challenge.

Backcrossing the 50:50 crossbreds with the purebred genetics to bring the blood composition to at least 75:25 can significantly increase milk production. Along this line, the program shall have a directed backcrossing component to cover all possible breedable crossbreds. As a prerequisite to this desired scheme, all crossbreds that will be enrolled into the program shall be ear tagged, with its owner name and address encoded. An incentive shall be given the participating farmers in order that the expected backcrosses shall be properly reared, and eventually used by the owner for milking purpose. Options shall also be provided in case backcross owners opt to rear the calves but offer the animals for sale at a later period.

Under this scheme, only sexed semen for inseminations shall be used so that the number of potential crossbred female calves is increased from the normal ratio of 50:50 to 85:15. Directed backcrossing shall be in the form of contract AI service, and the mode of payment shall be based on calves on the ground.

Use of Sexed Semen

Sexed semen has already been in commercial use in dairy cattle for considerable time. The objective is to enhance the production of replacement heifers. This has been made possible with the development of semen sexing machine permitting separation of X from the Y-bearing sperm cells.

Data on the use of sexed semen in water buffaloes are not as extensive as in dairy cattle, but there are good indications of successful usage in large scale AI (Campanile et al., 2011; Lu et al., 2015).

To maximize the production of female dairy buffalo calves, sexed semen shall be used for all the purebred as well as those for crossbreds for directed backcrossing. It is expected that there shall be significant reduction in the success rate in AI using the sexed semen vis-à-vis the unsexed semen, however, the increase in percentage female offspring from the use of sexed semen can amply compensate for the AI success rate reduction.

The use of sexed semen will also entail retraining of the AI technicians since in this case, the correct site of semen deposition in the female reproductive tract is critical to the success. This is also important since the sperm concentration per dose on sexed semen is significantly reduced compared to the traditional dose of unsexed semen.

Privatization and Expansion of AI system

The contributions of private AI technicians, commonly called VBAIT or Village-Based Artificial Insemination Technician, as percentage of the overall AI services is considerable. In fact, in areas where dairying has become more pronounced, VBAITs are the dominant provider of AI services as the dairy farmers are more than willing to pay for their services. This is quite a profound change from the experience of AI technicians in non-dairying communities where farmers are reluctant to pay for AI services.

Training of more VBAITs is contained in the CIR 2022-2026. As described earlier, AI services in directed backcrossing shall be on a contract basis and would involve VBAITs.

Buy Back Scheme

This scheme is mainly directed to saving suitable animals for dairying from being transported to slaughterhouse and instead be used for milk production, thus, contributing to herd build-up of dairy buffalo stocks.

Many dairy farmers have limited carrying capacity; thus, it is expected that as their animals reproduce, some extra animals are sold when ready for disposal. There are also many crossbred buffalo owners that are not interested to milk their good quality animals for some reasons, and, thus, animals are also disposed. As pointed out elsewhere, middlemen's and "viajeros'" immediate tendency is to bring the procured animals to the slaughterhouse to generate income, negating the fact that many of the animals have

potentials for dairying. This thing happens because of the absence of readily interested farmers to buy the animals from the “viajeros”.

In order to minimize the “wastage” of the potential dairy animals, the program shall provide adequate fund for animal procurement. However, the procurement system shall consider animal quality, specifically those with dairy blood of no less than 75%. Procured animals shall in turn be given on loan to interested farmers, so it becomes doubly important to ensure that recipient farmers shall not be discouraged in pursuing the desired dairying, as have been experienced by those that reared crossbreds with dairy blood lower than 75%.

Rearing of Replacement Heifers

Sustainability and growth of dairying is dependent on the ability to raise replacement heifers. This very critical aspect has often been neglected by less experienced dairy farmers, as they are so engrossed with the cash generated from the sale of the milk, neglecting to provide proper nutritional requirements of the newly born calves. Stunted calves are not acceptable replacement heifers even if these animals may physically recover at a later stage.

A review of the inventory growth of the imported purebred dairy buffaloes revealed that this is the single major reason for the rather abbreviated increase in their number. Malnourished calves can easily succumb to mortality, and if ever they recover at later stage, their milk production potential is already significantly reduced. This can be considered a double whammy since the next generation animals are expected to be better than the parents having able to use superior sires as their father.

Programs to bring the message to the farmers of the prime importance of rearing replacement heifers shall be instituted in CIR 2022-2026. In addition to bringing consciousness to individual dairy farmers, incentives shall also be provided for private investors for the establishment of a calf rearing facility, a scheme where female calves are procured for rearing from those dairy farmers who are not interested to rear their female calves for some reasons. The facility can also accept contract rearing of female calves. In effect, the calf rearing facility shall become the source of good quality replacement heifers for those farmers interested to engage in dairying, a better option than obtaining the needed animals from foreign sources.

Dairy Herd Improvement

Dairy Herd Improvement Program is the heart of a progressive dairy industry. Its main focus is continuing genetic improvement by way of selecting the best performing animals as parents of the next generation dairy animals. Sires are selected from outstanding dams and are used as semen donors for inseminating the herd. This, therefore, necessitates complete records of milk production performance of the participating cows, as basis for selection.

Associated with this continuing genetic improvement efforts is the aggressive feedback to producers on how to further improve management of the dairy animals, which include breeding, nutrition, and herd management, all directed towards improvement in overall production of milk.

The system will require continuing milk test, milk analysis laboratory, data analysis facility, and an organized feedback system. This will also entail establishment of an animal registry.

By 2023, the KOICA shall consider funding the expansion of the existing DHI system for dairy buffalo, with provisions to also include dairy cattle in close cooperation with the National Dairy Authority.

Dairy Buffalo Business Hub

Buffalo dairying in the country is essentially smallholder and in the early developmental years, market is not an issue since the volume of milk produced can be absorbed by the “backyard market”. As the numbers of farmers and dairy animals increase, the volume of milk produced can no longer be absorbed by the “backyard market”, and bigger milk volume needs to enter the “commercial market”, a market with different requirements in terms of quality, packaging, volume, and form. These requirements can no longer be met by the individual dairy farmers, thus, there is a need for consolidation, which makes the formation of primary dairy producer cooperatives very essential.

Entering the main market grid, i.e., the urban areas, makes the market system a bit complicated and would require further consolidation of the primary cooperatives. Further sophistication of the market becomes highly magnified, as potential export is considered.

Given such future developments, the establishment of Dairy Business Hub (DBH) is needed. The DBH should have a component to be able to address the investment requirements, both at the level of production and post-production, address the ancillary services needed by the producers such as AI services, availability of input requirements such as dairy equipment, concentrate feeds, corn silage, hay, veterinary medicines, among others. It shall have main milk consolidation and processing facility to meet the requirements for the production of world-class products ready for domestic and international markets. The CIR 2022-2026 includes the establishment of DBH in Central Luzon, and in the future, in Visayas and Mindanao.

Crosscutting Programs

Feed Base Development Program

Feed resources availability in a smallholder dairy system is a major item for consideration since dairying can be considered a new ground for most of the farmers in the country. They are familiar on how to feed the indigenous carabaos, meeting the nutritional requirements for growth, and mostly, for maintenance only. Meeting the nutritional requirements for milk production is not fully understood, resulting in undernutrition among lactating animals, and, thus, in low milk productivity. This is also the reason for long service period and calving interval extending to as long as 24 months, in many cases.

The program shall promote smallholder or homegrown forage production system by way of establishing forage demo plots, identifying “champion farmers” in dairy impact areas who shall be given incentives to demonstrate proper forage production, and influence the neighboring dairy farmers towards adoption of appropriate forages. This shall be done in cooperation with LGU livestock technicians who shall be fully capacitated to lead the smallholder forage production scheme in their respective areas of coverage.

Seeds and planting materials of suitable forages shall be produced and made easily available by the PCC regional centers, and where appropriate, to be produced by farmer contractors so that these materials are made readily available to dairy farmers.

Where suitable, commercialization of corn silage shall be promoted so that farmers intending to expand the production base shall not be constrained by the limitation of forage resource availability. In fact, there are cooperatives who have initiated commercial corn silage production in limited scale and has proven to be a viable option.

Maximization of usage of farm wastes such as rice straws, which are largely available in rice-producing areas shall also be pursued through incentives, technical assistance on improving nutritional value of such material, and link to potential market.

One interesting area for focus is the potential usage of large coconut areas in many parts of the country. There are areas that are suitable for forage production, and the combination of coconut and cattle dairying has been well demonstrated. Under such scheme, forages for grazing such as *Brachiaria sp.* are established with success. The suitability of similar approach for dairy buffalo shall be subjected to trial.

Animal Health and Safety Assurance Program

The growing demand for quality and food safety by consumers necessitate the serious attention to animal health and animal welfare concerns. Towards this end, in cooperation with the BAI and the NDA, the program shall aggressively promote GAHP and GMP. As the industry eyes on harnessing potential export, the more there is a need to intensify ensuring meeting the requirements of the international markets.

Product Development Center

For the past several years, the program focus has been more on production and productivity improvement. But as the industry moves forward, it is inevitable to also address the post-production concerns such as development of products of international quality. To be able to address this need, the program shall consider expanding the physical and human resource complements for milk and meat products development. It shall also heavily consider institutional linkages, both local and international, to harness best expertise as well as technologies in these specialized fields.

Business Center and Export Portal

As the Mandanas-Garcia Supreme Court Ruling takes effect with the direct extension activities of the PCC to be devolved to the LGUs, the Program service shall be elevated to address the improvement in business and market environments. In direct coordination with the Research, Development, and Innovation (RDI) Team, the program shall be more focused on the needs of the entrepreneurs along market and market requirements. These include assisting entrepreneur to meet their technical needs in terms of product development, better understanding of the market, particularly as the intent is to penetrate the international market, among others.

Special Credit Window Facilitation

The entry of private entrepreneurs or dairy producers' cooperatives planning to import animals and equipment, or set up the needed infrastructures for buffalo dairying would need assistance by way of easy access to special credit. The program shall ensure that available credit facilities are easily accessible, with reasonable conditionality.

There are existing credit windows for livestock projects, including dairying, however, based on the records of the major lending institutions such as Development Bank of the Philippines (DBP) and Land Bank of the Philippines (LBP), the number of loan applications related to dairying is very limited. The program shall try to review the underlying reasons for the low application to the existing credit program, and where needed, shall propose other options to entice investors to go into carabao production, particularly buffalo dairying.

Research, Development, and Innovation

Research directed to industry issues and aimed on improving production efficiency, profitability, and sustainability shall be carried out. Summary areas needing focus are presented in Annex 11, and issues or concerns are classified as to the need for research, or extension, or policy, or combinations in order to have industry impact.

The result of Value Chain Analysis (VCA) on Carabao Industry (Lantican et al., 2014-2017) and an in-depth review of the completed research as well as technologies on the commodity revealed the need to improve the flow of technologies, which are already developed and proven elsewhere, from the laboratory and test scale to industrywide scale.

One very important system innovation is the intensification on the use of IT for bringing technologies to the dairy farmers, including feedback from them using mobile apps. This scheme becomes more meaningful in this reduced person-to-person interaction due to the current COVID-19 pandemic, and also due to nearly complete access of farmers to cellphones and televisions. The ongoing project of PCC with Grameen Foundation on the development and use of mobile application solutions (quick response tools) or advisory services in animal health (iHealth) and animal nutrition (iFodder) is timely and should be rolled out in the PCC's major service areas.

The program shall also highlight the enhancement of linkages with the host universities of PCC regional centers in order to have mutually beneficial partnership in accessing expertise and funding support for research and extension services.

Lastly, a summary of recommendations resulting from the discussions on aligning RDE with the VCA of carabao industry is listed in ANNEX 12.

Human Resource Development

The implementation of Mandanas-Garcia Supreme Court Ruling will entail considerable capacitation of the LGU technicians in all aspects of buffalo dairying since the direct extension activities carried out traditionally by PCC are to be devolved already. This would lead to development of highly professionalized livestock technicians at the level of the LGUs.

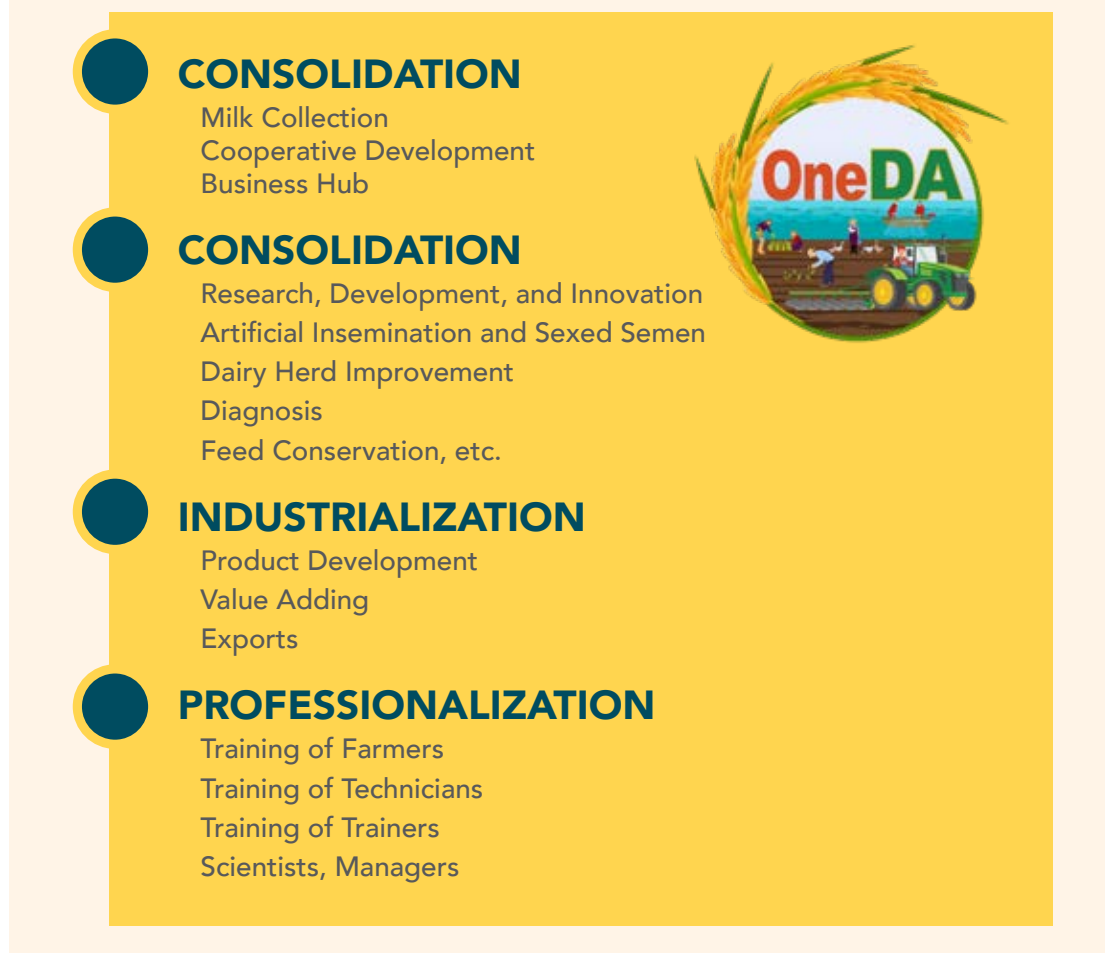
One area of program focus, in cooperation with CDA and selected SUCs, is strengthening leadership and management of buffalo dairy cooperatives by way of training co-op leaders. Along this line, there shall be consideration for establishment of Rural Management Institute where future co-op leaders shall undergo formal training in theory and in actual practice.

Human complements of the PCC in social science, product development, business management, and marketing shall likewise be strengthened in order to meet the program requirements.

One DA Reform Agenda

The Carabao Industry Roadmap 2022-2026 (CIR) supports the One DA Reform Agenda which channels investments in the more transformative interventions that will help consolidate, modernize, industrialize and professionalize Philippine Agriculture. The various strategies have been identified to comply with the main pillars of the One DA Reform Agenda as shown below:

FIGURE 3. THE ROADMAP STRATEGIES CATEGORIZED ACCORDING TO THE ONEDA PILLARS: CONSOLIDATION, MODERNIZATION, INDUSTRIALIZATION, AND PROFESSIONALIZATION



PROGRAM TARGETS

The program targets are summarized in the table below and are presented under five key result areas: (a) Herd Build-up; (b) Productivity Improvement; (c) Enterprise Development; (d) Research, Development, and Innovations; and (e) Human Resource Development. Targets are expressed as outcomes of the intended inputs and interventions.

PROGRAM	ITEM	2022	2023	2024	2025	2026	TOTAL
Outcome	Registered commercial dairy farm	14 (12 lh, acdi and javier)	16 (Mangaldan and lamac)	18	21	25	25
	LTO for dairy farm (endorsed by pcc for fda lto issuance)			10	40	70	70
	LTO for food manufacturer	37% (14/37)	42%	47%	52%	57%	57%
	Adoption of feed technologies at the clients	Roll out of technologies	Roll out of technologies	10% of PCC supported farms	30% of PCC supported farms	60% Of pcc supported farms	60% of PCC supported farms
Herd build up	(a) Purebred dairy buffalos infused	500	1,000	1,000			2,500
	– Maintenance of swamp type conservation sites (MOA with LGU) as source of genetic materials for meat draft	2	2	2	2	2	2
	(b) Calves born from AI						
	Purebred	1,611	1,896	1,534	1,641	1,800	8,482
	Backcrosses	4,661	5,483	4,768	5,531	6,633	27,076
	CB 50:50	19,354	18,708	20,568	23,648	26,220	108,498
	(c) Calves born of bull entrustment						
	Crossbred (various blood comp)	3251	5,970	6,980	8,075	9,285	33561
	(d) Potential dairy buffaloes procured (buy back)	2,183	2,495	2,806	3,118	3,430	14,032
(e) New ai technicians trained	470	187	132	116	120	1025	

cont'd ►

PROGRAM	ITEM	2022	2023	2024	2025	2026	TOTAL
Productivity improvement	(a) DHI						
	Milk laboratory established		1	1			
	Data processing facility established		1				
	Animal registry system operational		1				
	(b) Feed resource development program						
	planting stock/seed production set up	3	3	3	3		
	Corn silage system established	2		2		2	
	Smallholder forage system set up	1	1	2	2	2	
Enterprise development	(a) Dairy buffalo hub established	1			1		
	(b) Special credit window	1					
	(c) Buffalo product center established		1				
	(d) Buffalo business center and export portal established	1					
	(e) Expanded linkage with DepEd and DSWD SBMFP	1	1	1	1	1	
	(d) Compliance to all regulatory standards	1	1	1	1	1	
Research, development, and innovation	(a) improving efficiency, profitability and sustainability	*	*	*	*	*	
Human resource development	Dairy technicians trained	60	60	60			
	Dairy entrepreneurs trained	200	200	200	200	200	
	Dairy science courses offered in selected SUCs		2	2	2	2	
	Dairy field school established	10	10	10	10	10	
	Rural management institute established		1				

BUDGETARY REQUIREMENTS, in million pesos

PROGRAM	ITEM	2022	2023	2024	2025	2026	TOTAL
Herd build up	(a) Purebred dairy buffalos infused	125	250	250			625
	– Maintenance of swamp type conservation sites (MOA with LGU) as source of genetic materials for meat/draft	Partnership with LGU	Partnership with LGU	Partnership with LGU	Partnership with LGU	Partnership with LGU	
	(b) calves born from AI						
	Purebred	4.51	5.3	4.29	4.59	5.04	23.73
	Backcrosses	13.05	15.35	13.35	15.48	18.58	75.81
	CB 50:50	54.11	52.31	57.50	66.11	73.31	303.34
	(c) Calves born of bull entrustment						
	Crossbred (various blood comp)	3.25	5.97	6.98	8.07	9.28	33.55
	(d) Potential dairy buffaloes procured (buy back)	98.23	112.27	126.27	140.31	154.35	631.43
	(e) New AI technicians trained	14.10	5.61	3.96	3.48	3.60	30.75
Productivity improvement	(a) DHI						
	Milk laboratory established		30.0	30.0	20	20	100
	Data processing facility established		28.0	15	15	15	73
	Animal registry system operational		32.0	10	10	10	62
	(b) Feed resource development program						
	Planting stock/seed production set up	15	15	15	15	15	75
	Corn silage system established	20		20		20	60
	Smallholder forage system set up	30	30	30	35	35	160

cont'd ►

PROGRAM	ITEM	2022	2023	2024	2025	2026	TOTAL
Enterprise development	(a) Dairy buffalo hub established	50			50		100
	(b) Special credit window	*					
	(c) Buffalo product center established/operational		65.0	15	15	15	110
	(d) Buffalo business center and export portal established/operational	20.0	15	15	15	15	80
	(e) Expanded linkage with DepEd and DSWD SBMFP	*	*	*	*	*	
	(d) Compliance to all regulatory standards	15	15	15	15	15	75
Research, development, and innovation	(a) Improving efficiency, profitability and sustainability	50	60	70	80	90	350
Human resource development	Dairy technicians trained	1.8	1.8	1.8			5.4
	Dairy entrepreneurs trained	3.0	3.0	3.0	3.0	3.0	15.0
	Dairy science courses offered in selected SUCs	25	25	25			75
	Dairy field school established	10	10	10	10	10	50
	Rural management institute established		80	20	20	20	140
Total		563.25	867.81	768.35	554.04	560.16	3,313.61

IMPLEMENTATION SCHEDULE

STRATEGIES/ACTIVITIES	2022	2023	2024	2025	2026
Stock Infusion					
Buy Back Scheme					
Directed Backcrossing					
Expanded AI					
Massive Bull Entrustment					
Municipal Breeding Stations					
Feed Base Improvement/Development					
Dairy Herd Improvement					
Research, Development, and Innovation					
Knowledge Resource Management					
Credit Facilitation					
Buffalo Business Hub Development					
Business Center and Export Portal					
Product Development					
Training of Farmers					
Training of Trainers					
Training of Entrepreneurs					
Dairy Science Courses Offerings					
Rural Management Institute					

RESPONSIBILITY MATRIX

KRA	STRATEGY/ACTIVITIES	RESPONSIBLE ENTITY
Herd Build Up	Stock Infusion	PCC, Private Sector, BAI
	Buy Back Scheme	PCC, NDA
	Directed Backcrossing	PCC, VBAIT
	Expanded AI	PCC, BAI, LGUs, VBAIT Association
	Massive Bull Entrustment	PCC, LGUs
	Establishment of Municipal Breeding Stations	LGUs
Productivity Improvement	Feed Base Improvement/Development	PCC, BAI, SUCs
	Dairy Herd Improvement	PCC, NDA, PCAARRD, BAR
	Research, Development, and Innovation	PCC, BAR, PCAARRD, BAI
	Knowledge Resource Management	PCC, LGUs
Enhancing Entrepreneurship	Credit Facilitation	PCC, ACPC,LBP,DBP
	Buffalo Business Hub Development	PCC
	Business Center and Export Portal	PCC, DTI
	Product Development	PCC, DTRI
Human Resource Development	Training of Farmers	LGUs
	Training of Trainers	PCC, UPLB, CLSU
	Training of Entrepreneurs	PCC
	Dairy Science Courses Offerings	CLSU, UPLB, CMU
	Rural Management Institute	CLSU

CONCLUSIONS

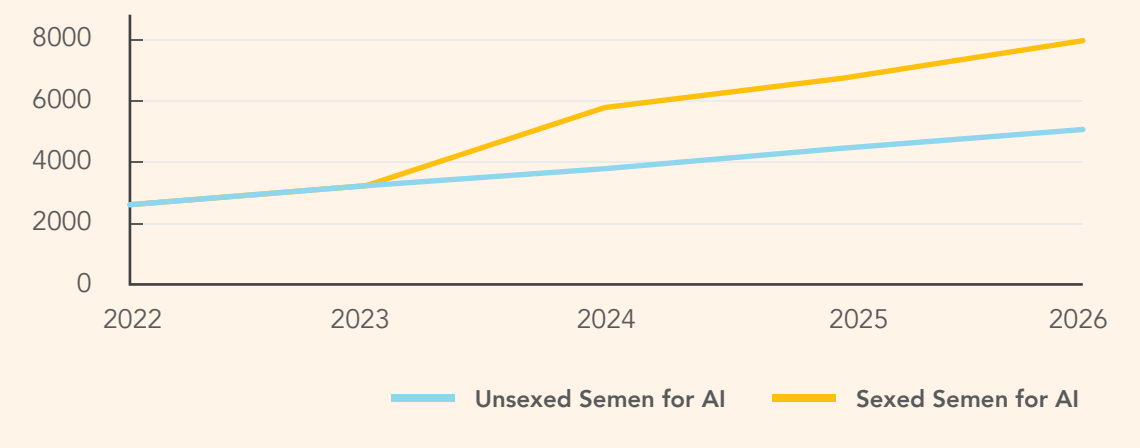
The results of interventions designed to achieve the objectives are summarized below:

1. Increase in inventory growth of dairy buffaloes aimed at an average of at least 15% per year during the planned period can be attained through these measures: (a) improving production of females using sexed semen on the purebred stocks as well for the crossbreds covered in the directed backcrossing; (b) expanded use of artificial insemination and massive bull entrustment for breeding indigenous stocks to produce crossbreds with high production potentials for meat and draft, and at the same time produce 50:50 crossbreds, which can be backcrossed in the future to produce the desired 75:25 backcrosses; and (c) stock infusion of purebred dairy buffalo. All together, the increase in inventory of female stocks, as sources of milk is estimated to have average annual growth of 18.87%, as shown below.

TABLE 23. ESTIMATED INVENTORY OF FEMALE DAIRY BUFFALO STOCKS AS POTENTIAL SOURCES OF MILK, 2022-2026

ITEM	2022	2023	2024	2025	2026
Stock infusion, 2 nd and 3 rd gen	500	1,575	2,712	2,723	2,486
Purebred (10% GR)	5,878	6,465	7,111	7,822	8,604
Crossbred for backcrossing (50:50), 2 nd and 3 rd generation	18,950	21,844	26,730	31,783	37,593
Female buy back (50:50/75:25), 2 nd and 3 rd gen.	2,183	3,042	4,060	5,036	6,186
TOTAL	27,511	32,926	40,613	47,364	54,869
% Change	---	19.68	23.34	16.62	15.84

FIGURE 4. ESTIMATED EFFECT OF USE OF SEXED SEMEN ON WATER BUFFALOES FOR THE PRODUCTION OF FEMALE OFFSPRING, 2022-2026



The effect of using sexed semen on the production of female offspring is shown in Figure 3, indicating a significant improvement of 52.7% above the traditional unsexed semen.

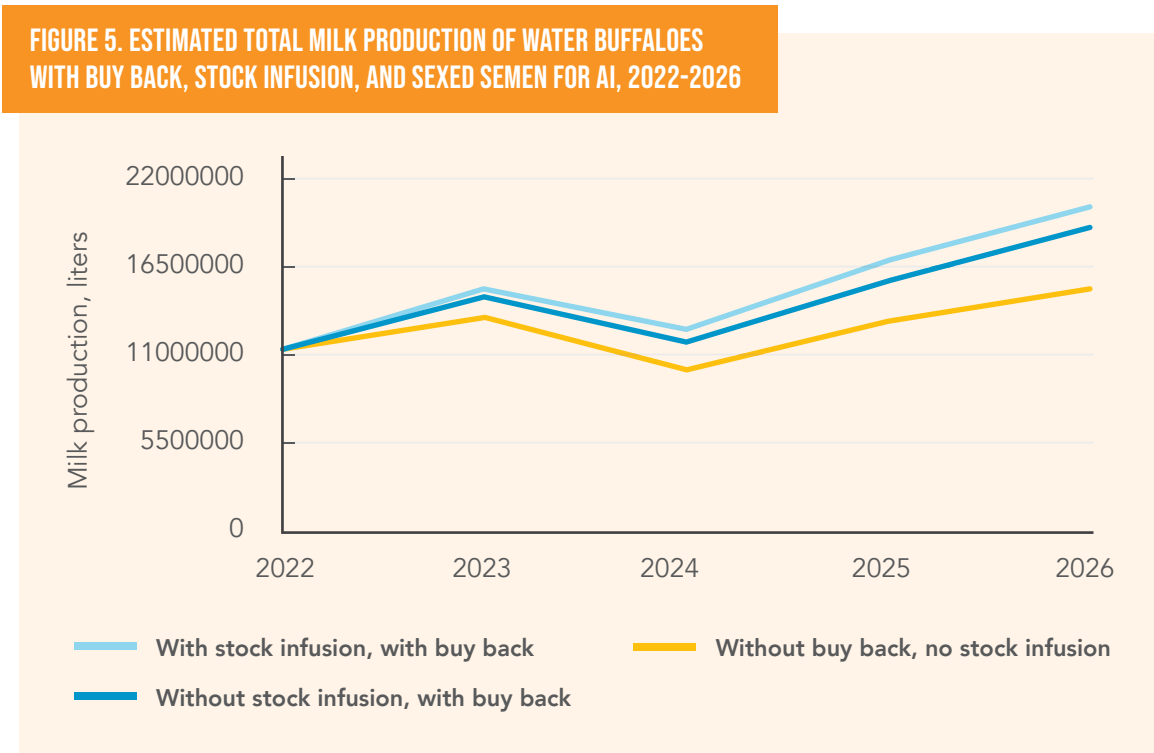
2. The target of livelihood created, expressed as job generated, for 300,000 rural families can be estimated from the volume of milk produced during the planned period. The assumption is there shall be an estimated 18 jobs involved per 100 liters of milk produced along the supply chain. These include forage harvesting, feeding and rearing of dairy animals, milking, milk collection, processing, wholesale, and retail marketing.

TABLE 24. SUMMARY MILK PRODUCTION OF DAIRY BUFFALOES, WITH SEXED SEMEN FOR AI, DIRECTED BACKCROSSING, BUY BACK, AND STOCK INFUSION, '000 LITERS, 2022-2026

MILK SOURCE	2022	2023	2024	2025	2026
Stock infusion (plus 2 nd gen.)	---	420	812	1,290	1,232
Purebred (GR 10%/year)	4,443	4,936.4	3,620.4	3,981.6	4,379.2
Crossbreds for backcrossing (plus backcrosses)	7,282	8,568	6,568.8	9,244.7	10,826.7
Buy back (crossbreds and backcrosses)	---	1,282.8	1,748.3	2,673.4	3,873.1
TOTAL	11,725	1,5207.2	12,749.5	17,189.7	20,311
% Change	---	29.68	-16.16	34.82	18.15

From the base line of 11,725,000 liters in 2022, the milk production is estimated to be 20,311,000 liters by 2026, an equivalent to an average annual growth of 16.6%. The negative growth in milk production in 2024 is a result of shift on the use of sexed semen in 2023 that caused reduction in conception rate from an average of 60% to only 40%. While there will be reduction in milk production due to this shift in semen usage, a rebound in milk production in subsequent years and a significant increase in the production of female offspring are expected.

The effect of the various interventions such as stock infusion, sexed semen, and buy back on milk production are shown in the graph below.



On the other hand, the job equivalent generated out of the massive bull entrustment program resulting in the production of 50:50 crossbreds intended for increasing meat as well as draft potentials of the carabaos is also substantial.

3. The objective of improving average milk production per unit animal shall be addressed at the genetic and environmental fronts. The non-genetic intervention includes the aggressive implementation of smallholder forage resources development

program that should result in better availability and adequacy of forages. Moreover, the improvement in nutritional management shall be a major component of the expanded Dairy Herd Improvement (DHI) to be implemented with the assistance from KOICA. The genetic aspect of the DHI is the accurate data capture and analysis from much larger population of dairy buffaloes that will allow higher level precision of selection of the best animals for genetic improvement.

4. Establishment of at least one Buffalo Business Hub in Luzon is highly achievable based on the recent developments in the National Impact Zone. Most of the active dairy-based cooperatives have already agreed to form a federation called “Federation of Agriculture Cooperatives of Nueva Ecija (FAGCONE)” with the needed documentation already submitted to CDA for registration as early as May 2021. There is also pronouncement from the PCC Management that the privatization of Milka Krem and its facilities can be facilitated upon the official approval of the registration of FAGCONE with the CDA.

The efforts of expanding buffalo-based production in other areas can lead to development of another Buffalo Business Hub in later years.

The Buffalo Business Hub, in cooperation with PCC and other development agencies can then venture to aggressively enter the commercial market with its potential to consolidate the needed volume of raw milk, process value-added products that meet international standards, and, thus, the likelihood of entrance to markets beyond the country boundary can happen.

5. Milestones in the implementation of the CIR 2022-2026 are enumerated in ANNEX 14.

CARABAO ROADMAP MILESTONE 2022-2026

Year	GIP	Knowledge Dissemination	R4D	Business Development	Institutional Capacitation (HR)
2022	<ul style="list-style-type: none"> *Regional and provincial AI coordination strengthened for Region I,II, III, IV,V; *Sexed semen of dairy buffalo in use; *500 hd of superior dairy buffalo genetics infused from outside sources 	<ul style="list-style-type: none"> *250 AI technicians of LGU and VBAIT trained; *25 Dairy technologist of LGUs and co-ops trained; *Feed base development program launched 	<ul style="list-style-type: none"> *Special buffalo meat jerky developed/ launched; *Benchmarking and market scanning for Mozzarella di Bufala export in Asian Market 	<ul style="list-style-type: none"> *Kardeli outlet launched; *Legislation on fresh milk labelling approved; *Special incentive window for export oriented enterprises established; *Formal inauguration of 1st Dairy Business Hub and Privatization of Milka Krem 	2 MS and 2 PhD in Meat and Dairy Product Science started study program/ hired
2023	DHI expanded - KOICA assisted launched (include both dairy buffalo and dairy cattle); Municipal breeding stations Launched (in concert with expanded bull entrustment program)	<ul style="list-style-type: none"> *250 AI technicians of LGU and VBAIT trained; *25 Dairy technologist of LGUs and co-ops trained; *15 Farmers dairy school inaugurated 	<ul style="list-style-type: none"> *Dairy product research center launched; *Improved Mozzarella di Bufala and Burrata developed; 	<ul style="list-style-type: none"> *Philippine Mozzarella di Bufala certification system developed; *Organic Buffalo milk certification launched; 	1 MS and 1 PhD in Animal Genetics and Breeding started study program/ hired
2024	<ul style="list-style-type: none"> *Animal herd registry launched; *1000 hd dairy buffalo infused by the private sector 	<ul style="list-style-type: none"> *15 Farmers dairy school inaugurated 	<ul style="list-style-type: none"> *Special buffalo-milk based beverage developed 	<ul style="list-style-type: none"> *Special buffalo-milk based beverage commercialized 	---
2025	Enrollment of Philippines in International Committee on Animal Recording (ICAR)	---	---	---	---
2026	Company for export of frozen semen of superior dairy buffalo genetics assisted	---	---	<ul style="list-style-type: none"> *Formal Inauguration of 2nd Dairy Business Hub 	---

MONITORING AND EVALUATION

The lead implementing agency of this Carabao Industry Roadmap 2022-2026, the Philippine Carabao Center, shall submit bi-annual reports about the progress and status of the plan to the Department of Agriculture, through the office of Undersecretary for Livestock. Annual Reports shall also be furnished to the House of Representatives and the Senate, more specifically the Committees on Food, Agriculture, and Agrarian Reform of both chambers.

Every two years from the start of program implementation, and at the completion of the roadmap, evaluation shall be carried out through the Philippine Council for Agriculture and Fisheries (PCAF).

Policy

Industry Level

1. The private commercial processing sector should be required, in gradual proportion, to establish their own milk source domestically. There is a provision in R.A. 7884, requiring the commercial processing sector to source their milk from domestic producers. In view of the limited supply of milk from the domestic dairy industry, this provision has never been in effect since its approval in 1995. When the local dairy sector has done the upscaling of the dairy herd and is in a capacity to produce adequate milk, the provision in the R.A. would be meaningful.
2. Legislation should be passed defining what is “fresh milk”. The locally produced milk are presented to the market in truly fresh form. This is the only way to prevent labelling of the UHT processed milk as fresh milk.
3. The government should fully support the implementation of Good Animal Husbandry Practices as well as Good Manufacturing Practices in all farms and establishments producing and processing milk to guarantee milk quality and food safety. Strict

adherence to these practices is also necessary for compliance of locally produced products to enter export market.

4. There should be a policy that guarantee that tariffs collected from importation of dairy products should be invested to the development of the domestic dairy sector.
5. There should be a review on how the growing dairy sector cannot be totally stunted by the massive influx of low-cost milk products from foreign sources. Our neighboring countries are protecting their domestic dairy sector by imposition of tariff for in quota as well as for out quota for powdered milk, cheese, and other products.
6. The government should consider all possible incentives to promote investment in the development of local dairy sector and should aim for significantly increasing self-sufficiency above the current level.
7. Expanding the current school-based milk feeding program to cover not only the identified undernourished children in the grade school but also all the grade school pupils is a good investment on human resource development and at the same time will promote development of the domestic dairy industry.
8. To set the pace for private investment in herd build up, as the milk feeding requirements for milk shall grow in time, the percentage of locally produced milk as a component of the school-based milk feeding program should increase from the current minimum allowable level of 10%, to at least 5% every year. This will also aim at developing the palate of our future milk consumers for fresh milk, departing from their taste from toned milk. Of course, this should be accompanied by corresponding measures to make acquisition of the needed animals by the private sector less restrictive, funding and source wise.

Program Level

1. Backcrossing shall be concentrated within the impact zones where inventories of crossbred buffaloes are complete, with names and addresses of the owners.
2. Sexed semen shall be used only for purebred and for backcrossing.
3. Expanded AI shall give premium on areas with higher carabao densities.
4. Contract AI shall be the mode for directed backcrossing with calves on the ground as the main basis for payment.
5. Heifers qualified for buy back scheme shall be those with blood of dairy breed above the 50:50.



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ANNEXES

ANNEX I WATER BUFFALO INVENTORY IN THE WORLD, ASIA, PHILIPPINES AND SELECTED COUNTRIES, 2000-2019

Year	World	Asia	Phil	Thailand	Vietnam	Malaysia	Indonesia	Taiwan	China	India	Brazil	Pakistan
	88,321,107	86,019,158	3,452,000	4,963,580	2,252,000	345,151	2,893,281	324,516	8,043,000	51,207,920	63,000	6,700,000
	107,262,244	104,474,437	4,431,500	5,734,500	2,270,700	310,402	2,885,000	211,993	15,500,000	56,118,000	118,000	9,345,000
	121,493,490	118,085,115	2,870,270	5,650,794	2,313,000	285,339	2,457,000	62,604	18,377,008	66,070,000	495,000	11,547,000
	148,184,015	143,302,442	2,764,950	5,094,270	2,854,100	205,163	3,335,079	26,827	21,395,008	80,570,000	1,397,097	17,373,008
2000	164,254,815	159,383,735	3,024,403	1,711,573	2,897,220	142,042	2,405,277	7,767	22,587,000	93,831,000	1,102,551	22,669,000
2001	166,280,333	161,388,335	3,065,812	1,523,627	2,807,874	148,186	2,333,429	6,531	22,758,000	95,173,000	1,118,823	23,335,000
2002	168,745,134	163,663,878	3,122,026	1,612,534	2,814,452	131,245	2,402,990	5,370	22,684,000	96,534,000	1,113,400	24,030,000
2003	171,513,784	166,343,094	3,179,536	1,689,762	2,834,886	133,000	2,459,434	4,912	22,724,000	97,922,000	1,148,808	24,800,000
2004	174,014,534	168,750,093	3,269,980	1,737,698	2,869,802	133,368	2,403,298	4,962	22,282,000	99,724,000	1,133,622	25,500,000
2005	177,006,343	171,675,348	3,327,000	1,770,625	2,922,155	133,232	2,128,491	4,101	22,361,000	101,559,000	1,173,629	26,300,000
2006	180,607,366	175,277,422	3,360,680	1,763,444	2,921,000	128,938	2,166,606	3,538	22,495,000	103,427,000	1,156,870	27,334,984
2007	184,069,033	178,568,300	3,383,620	1,743,546	2,996,400	130,775	2,085,779	3,452	22,717,000	105,340,000	1,131,986	28,147,000
2008	185,741,188	180,202,411	3,338,570	1,699,469	2,897,700	131,230	1,930,716	3,599	23,268,000	106,014,000	1,146,690	29,002,000
2009	194,135,166	188,785,794	3,321,000	1,670,511	2,886,600	127,152	1,932,927	3,862	30,107,580	106,693,000	1,135,191	29,883,000
2010	194,034,343	188,634,118	3,270,400	1,622,646	2,877,000	129,878	1,999,604	3,844	29,459,910	107,375,000	1,184,511	29,413,000
2011	195,181,279	189,533,629	3,075,300	1,587,731	2,712,000	128,205	1,305,078	3,844	28,152,000	108,063,000	1,278,075	31,725,000
2012	196,409,774	190,602,815	2,963,800	1,542,167	2,627,813	124,985	1,438,294	3,627	27,411,750	108,702,122	1,261,922	32,687,000
2013	196,776,730	191,095,886	2,912,842	1,288,812	2,559,539	123,646	1,109,636	3,177	26,957,280	109,400,000	1,332,284	33,555,000
2014	198,288,978	192,399,108	2,847,445	1,020,088	2,521,400	121,259	1,335,147	2,511	26,957,280	110,000,000	1,319,478	34,553,000
2015	199,650,185	193,930,946	2,854,838	990,000	2,524,000	118,569	1,346,917	2,437	27,021,840	110,313,638	1,370,488	35,580,000
2016	200,516,773	195,037,459	2,877,091	960,869	2,519,411	119,133	1,355,124	2,311	27,167,370	110,174,947	1,371,089	36,600,000
2017	201,076,185	195,535,997	2,881,894	965,306	2,491,662	114,013	1,321,904	2,037	26,503,470	110,180,508	1,375,168	37,700,000
2018	202,768,896	197,004,451	2,882,655	929,857	2,425,105	106,988	894,278	2,057	27,116,250	110,140,128	1,389,873	38,848,000
2019	204,342,419	198,414,255	2,873,561	897,368	2,387,887	107,347	1,141,298	1,972	27,336,130	109,851,678	1,434,141	40,002,000

Source: FAOSTAT 2020

ANNEX II CHANGES IN SWAMP BUFFALO INVENTORIES IN ASIAN COUNTRIES, 2009 VS. 2009

Country	2009	2019	10-yr % Change
Laos	1,178,000	1,209,712	2.67%
Myanmar	2,874,855	4,082,914	-42.02%
Brunei	4,116	2,292	-44.31%
Cambodia	739,646	605,638	-18.11%
China	30,107,580	27,336,130	-9.20%
Indonesia	1,932,927	1,141,298	-40.95%
Malaysia	127,152	107,347	-15.57%
Philippines	3,321,000	2,873,561	-13.47%
Taiwan	3,862	1,972	-48.93%
Thailand	1,670,511	897,368	-46.28%
Vietnam	2,886,600	2,387,887	-17.27%

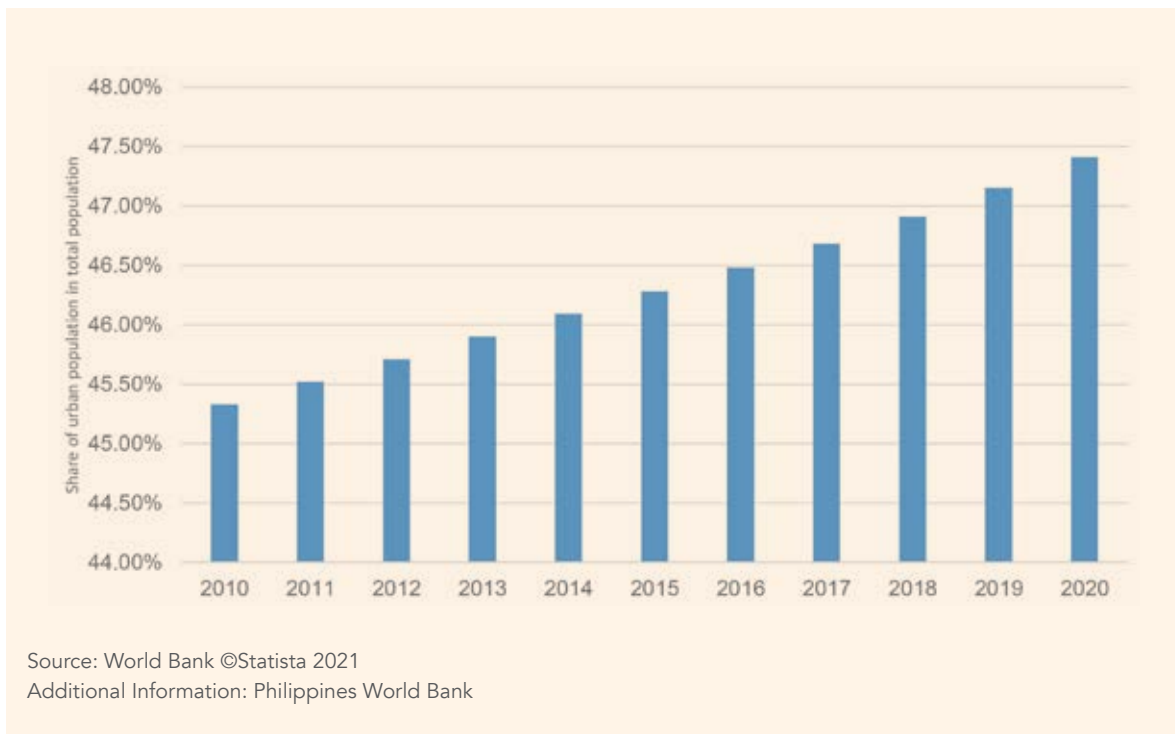
ANNEX III CARABAO INVENTORY, EXTRACTION RATE AND SELF SUFFICIENCY, PHILIPPINES, 2000-2020

Year	Inventory, hd	% Change	Slaughtered at slaughterhouse, hd	Total slaughter, hd	% Extraction rate	Production, '000 ton, liveweight	Production, carcass wt, '000 tons	Imports, '000 ton	Total Supply, '000 ton	% Self sufficiency
2000	3,024.40		267,060			123.97	61.98	35.72	97.70	63.43
2001	3,065.81	1.36	269,522			125.14	62.57	39.62	102.19	61.22
2002	3,122.03	1.83	289,627			132.41	66.20	40.69	106.89	61.93
2003	3,179.54	1.84	281,925			132.38	66.19	41.22	107.41	61.62
2004	3,269.98	2.84	286,508			138.05	69.02	45.06	114.08	60.50
2005	3,326.83	1.73	265,345			133.52	66.76	45.42	112.18	59.51
2006	3,360.68	1.01	250,804			130.41	65.20	41.73	106.93	60.97
2007	3,383.62	0.68	245,177			136.96	68.48	36.05	104.53	65.51
2008	3,338.57	-1.33	238,680			140.42	70.21	38.44	108.65	64.62
2009	3,320.97	-0.52	236,812			140.91	70.45	31.77	102.22	68.91
2010	3,270.41	-1.52	218,208			148.02	74.01	31.76	105.77	69.97
2011	3,075.26	-5.96	214,720			147.52	73.76	27.33	101.09	72.96
2012	2,963.98	-3.61	213,095			142.73	71.36	30.29	101.65	70.20
2013	2,912.84	-1.72	208,074	457,053	15.60	141.48	70.74	24.98	95.72	73.90
2014	2,847.44	-2.24	217,104	461,493	16.05	143.03	71.51	31.96	103.47	69.11
2015	2,854.84	0.25	219,062	453,699	15.84	142.04	71.02	33.74	104.76	67.79
2016	2,877.09	0.77	228,902	464,687	16.15	144.68	72.34	31.48	103.82	69.67
2017	2,881.89	0.166	246,454	464,006	16.10	144.41	72.20	32.00	104.20	69.28
2018	2,882.66	0.026	248,601	467,550	16.21	143.41	71.70	44.70	116.40	61.59
2019	2,866.00	-0.57	251,000	462,722	16.03	140.67	70.33	31.60	101.93	68.99
2020	2,922.00	1.95	189,161	400,276	13.69	120.41	60.20	34.50	94.70	63.56
Ave.	-0.26	-0.171			15.70					65.96

ANNEX IV INVENTORY AND MEAT PRODUCTION, '000 TONS, 1982-2020, PHILIPPINES



ANNEX V PHILIPPINES: URBANIZATION FROM 2010 - 2020



ANNEX VI PRIORITY RANKING OF ISSUES/CONSTRAINTS IN THE CARABAO INDUSTRY YCA, PHILIPPINES, 2014/2017

PRE-FARM GATE				IN-FARM				POST-FARM GATE			
Rank	Issue	Rank	PRODUCTION	Rank	PRODUCT	Rank	PROCESSING	Rank	MARKETING		
1	Limited access to credit	1	Issue of profitability (for meat and for milk)	1	Poor milk handling (hygiene)	1	Less organised producers	1	Poor product packaging and labelling		
2	LGU's lack of complete understanding of CBED	2	Insufficient forage/feed	2	Need to improve cold storage facilities	2	Smallholder processors need adequate cold storage facilities	2	Inadequate advocacy on milk consumption		
3	Limited number of LGU extensionists	3	Poor reproductive performance	3	Pricing scheme not properly evaluated	3	Lack of processing equipment	3	Less advocacy on good aspects of buffalo meat		
4	Low capability of existing extensionists on dairying	4	Absence of directed production of backcrosses	4	Pricing based on volume rather than milk components, e.g. fat, protein	4	Inadequate good slaughter-housing facilities	4	Less organised producer or processor		
5	Limited number and quality of training institutions on dairying	5	Low success rate in AI	5	Issue of fresh milk and APT test vs somatic cell count	5	Inadequate trained butchers	5	High % of inactive primary co-ops		
6	Low capability to translate and transfer knowledge on dairying to actual practice	6	High % of inactive VBAIT	6	Short shelf life of milk and dairy products	6	High transport cost and poor transport facilities	6	Less formal link between processors and supermarkets		
7	Poor coordination among players	7	Low efficiency of bulls loaned	7	Lack of expert in meat science	7	Inadequate raw materials for meat processing	7	Limited and delayed access to market information		
8	High cost of business permit	8	High % of males to female out of AI	8	Poor road to market	8	Milk spillage during transport	8	Buying of price animals based on eyeball and not on live weight		
*	*Political environment frequently changes and such impact on program priorities and funding support	9	High mortality of puered animals	9	High transport cost			9	No assured and sustainable market and pricing scheme		
*	*Strong lobby group by multinationals to the disadvantage of smallholders	10	Limited focus of rearing of replacement heifers					10	Smallholder retailers need for cold storage		
*	*Zero tariff on milk and dairy products due to AANZTA, AITA	11	Long calving interval					11	Poor facilities for auction market		
		12	High % of crossbreeds not fully utilised for dairying					12	FDA certification is not easy to obtain		
		13	Dairy farmers getting older, issue of next generation								
TOTAL	8	13	13/50 = 26.0%	9	9/50 = 18.0%	8	8/50 = 16.0%	12	12/50 = 24.0%		
%	8/50=16.0%										

LEGEND

Constraints reported in YCA (Lantican et al. 2014;2017)
Additional industry perceived constraints

ANNEX VII PROJECTED INCOME STATEMENT (ZERO DEBT, 5-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (ZERO DEBT, 5-COW DAIRY BUSINESS MODULE)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	23,300.00	197,090.50	344,315.10	292,905.47	330,505.66	467,573.88	689,605.00	594,418.54	619,661.70
Revenue from Sale of Animals		-	-	46,350.00	15,913.50	32,781.81	50,647.90	382,560.44	71,643.14	73,792.43	38,003.10
Other Revenues		-	1,165.00	12,172.03	18,011.43	16,284.36	19,057.68	42,506.72	38,062.41	33,410.55	32,883.24
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		100,000.00	15,000.00	105,000.00	65,000.00	105,000.00	145,000.00	(160,000.00)	205,000.00	225,000.00	280,000.00
Total Farm Revenues		100,000.00	39,465.00	360,612.52	443,240.02	446,971.65	545,211.24	732,641.04	1,004,310.55	926,621.52	970,548.04
Expenses											
Total Direct Material		39,171.40	61,675.78	86,023.52	96,085.20	117,130.24	146,547.21	148,928.13	155,840.64	197,162.63	251,541.78
Direct Labor		21,156.75	27,503.78	33,850.80	40,197.83	52,891.88	65,585.93	74,048.63	82,511.33	88,858.35	107,899.43
Total Overhead Expenses		14,784.90	23,420.37	27,855.84	33,691.31	43,962.25	54,233.19	61,547.15	57,661.11	62,096.58	75,402.99
Total Selling and Admin Expense		806.40	1,048.32	1,290.24	1,532.16	2,016.00	2,499.84	2,822.40	3,144.96	3,386.88	4,112.64
Total Expense		75,919.45	113,648.25	149,020.40	171,506.50	216,000.37	268,866.17	287,346.31	299,158.04	351,504.44	438,956.84
Farm Net Income/Net Loss		24,080.55	(74,183.25)	211,592.12	271,733.53	230,971.28	276,345.07	445,294.73	705,152.51	575,117.08	531,591.21
ROI		31.72%	-65.27%	141.99%	158.44%	106.93%	102.78%	154.97%	235.71%	163.62%	121.10%
PROJECTED CASH FLOW			466.00	3,627.00	6,491.00	5,361.00	5,873.00	7,986.67	11,430.67	9,626.33	9,703.33
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	443,509.26										
Working Capital	71,483.98										
Total Initial Investment	514,993.24										
FLOW	(514,993.24)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
NPV	PHP 242,981.36	0	(82,157.13)	114,948.88	216,640.92	139,159.96	147,615.03	623,758.88	517,450.85	368,746.05	274,212.10
IRR	23.56%										
Payback Period		(514,993.24)	(597,150.37)	(482,201.50)	(265,360.57)	(126,200.62)	21,414.41	645,173.29	1,162,624.13	1,531,370.19	1,805,582.29
Flows	PHP 796,851.62	5.97	Years								
Profitability Index	1.55										

Source: PCC-BDCU, 2021

CONT. ANNEX VII PROJECTED INCOME STATEMENT (ZERO DEBT, 5-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (50% DEBT)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales			23,300.00	197,050.50	344,315.10	292,905.47	330,505.66	467,573.88	689,605.00	594,418.54	619,661.70
Revenue from Sale of Animals		-	-	46,350.00	15,913.50	32,781.81	50,647.90	382,560.44	71,643.14	73,792.43	38,003.10
Other Revenues		-	1,165.00	12,172.03	18,011.43	16,284.36	19,057.68	42,506.72	38,062.41	33,410.55	32,883.24
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		100,000.00	15,000.00	105,000.00	65,000.00	105,000.00	145,000.00	(160,000.00)	205,000.00	225,000.00	280,000.00
Total Farm Revenues	100,000.00	100,000.00	39,465.00	360,612.52	443,240.02	446,971.65	545,211.24	732,641.04	1,004,310.55	926,621.52	970,548.04
Expenses											
Total Direct Material		39,171.40	61,675.78	86,023.52	96,085.20	117,130.24	146,547.21	148,928.13	155,840.64	197,162.63	251,541.78
Direct Labor		21,156.75	27,503.78	33,850.80	40,197.83	52,891.88	65,585.93	74,048.63	82,511.33	88,858.35	107,899.43
Total Overhead Expenses		14,784.50	23,420.37	27,855.84	33,691.31	43,962.25	54,233.19	61,547.15	57,661.11	62,096.58	75,402.99
Total Selling and Admin Expense		806.40	1,048.32	1,290.24	1,532.16	2,016.00	2,499.84	2,822.40	3,144.96	3,386.88	4,112.64
Total Expense		75,919.45	113,648.25	149,020.40	171,506.50	216,000.37	268,866.17	287,346.31	299,158.04	351,504.44	438,956.84
Farm Net Income/Net Loss	24,080.55	(74,183.25)	211,592.12	211,592.12	271,733.53	230,971.28	276,345.07	445,294.73	705,152.51	575,117.08	531,591.21
Less: Interest Expense		38,624.49	30,899.59	23,174.70	15,449.80	7,724.90					
Earnings after Interest		(14,543.94)	(105,082.84)	188,417.43	256,283.73	223,246.38	276,345.07	445,294.73	705,152.51	575,117.08	531,591.21
ROI		-12.70%	-72.70%	109.42%	137.08%	99.79%	102.78%	154.97%	235.71%	163.62%	121.10%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment			443,509.26								
Working Capital			71,483.98								
Total Initial Investment			514,993.24								
Interest Payment		38,624.49	30,899.59	23,174.70	15,449.80	7,724.90					
ANNUAL NET CASH FLOW	(514,993.24)	(38,624.49)	(113,056.73)	91,774.18	201,391.13	131,435.06	147,615.03	623,758.88	517,450.85	368,746.05	274,212.10
NPV			\$171,155.36								
IRR			21.10%								
Payback Period			(553,617.73)	(574,900.28)	(373,509.15)	(242,074.10)	(94,459.07)	529,299.81	1,046,750.65	1,415,496.71	1,689,708.81
Present Value of Cash Flows			6.15								
Profitability Index			\$713,533.45								
			1.39								

CONT. ANNEX VII PROJECTED INCOME STATEMENT (ZERO DEBT, 5-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (60% DEBT)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	23,300.00	197,090.50	344,315.10	292,905.47	330,505.66	467,573.88	689,605.00	594,418.54	619,661.70
Revenue from Sale of Animals		-	-	46,350.00	15,913.50	32,781.81	50,647.90	387,560.44	71,643.14	73,792.43	38,003.10
Other Revenues		-	1,165.00	12,172.03	18,011.43	16,284.36	19,057.68	42,506.72	38,062.41	33,410.55	32,883.24
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		100,000.00	15,000.00	105,000.00	65,000.00	105,000.00	145,000.00	(160,000.00)	205,000.00	225,000.00	280,000.00
Total Farm Revenues	100,000.00	100,000.00	39,465.00	360,612.52	443,240.02	446,971.65	545,211.24	732,641.04	1,004,310.55	926,621.52	970,548.04
Expenses											
Total Direct Material	39,171.40	61,675.78	86,023.52	96,085.20	117,130.24	146,547.21	155,840.64	197,162.63	251,541.78	197,162.63	251,541.78
Direct Labor	21,156.75	27,503.78	33,850.80	40,197.83	52,891.88	65,585.93	82,511.33	88,858.35	107,899.43	88,858.35	107,899.43
Total Overhead Expenses	14,784.90	23,420.37	27,855.84	33,691.31	43,962.25	54,233.19	61,547.15	57,661.11	62,096.58	62,096.58	75,402.99
Total Selling and Admin Expense	896.40	1,048.32	1,290.24	1,532.16	2,016.00	2,499.84	2,822.40	3,144.96	3,144.96	3,386.88	4,112.64
Total Expense	75,919.45	113,648.25	149,020.40	171,506.50	216,000.37	268,866.17	287,346.31	287,346.31	299,158.04	351,504.44	438,956.84
Farm Net Income/Net Loss	24,080.55	(74,183.25)	211,592.12	271,733.53	230,971.28	276,345.07	445,294.73	705,152.51	705,152.51	575,117.08	531,591.21
Less: Interest Expense	46,349.39	37,079.51	27,809.63	18,539.76	9,269.88						
Earnings after Interest	(22,268.84)	(111,262.76)	183,782.49	253,193.77	221,701.40	276,345.07	445,294.73	705,152.51	705,152.51	575,117.08	531,591.21
ROI	-18.21%	-73.82%	103.93%	133.23%	98.42%	102.78%	154.97%	235.71%	235.71%	163.67%	121.10%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	443,509.26										
Working Capital	71,483.98										
Total Initial Investment	514,993.24										
Interest Payment	205,997.30										
Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
	(514,993.24)	(46,349.39)	(119,236.65)	87,139.24	198,301.17	129,890.08	147,615.03	623,758.88	517,450.85	368,746.05	274,212.10
ANNUAL NET CASH FLOW											
NPV	\$156,790.16										
IRR	20.63%										
Payback Period	(561,342.63)	(680,579.28)	(593,440.04)	(395,138.87)	(265,248.79)	(117,633.76)	506,125.11	1,023,575.96	1,392,322.01	1,666,534.11	
Present Value of Cash Flows	6.19										
Profitability Index	\$696,869.82										
	1.35										

CONT. ANNEX VII PROJECTED INCOME STATEMENT (ZERO DEBT, 5-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (70% DEBT)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	
REVENUES												
Raw Milk Sales		-	23,300.00	197,090.50	344,315.10	292,905.47	330,505.66	467,573.88	689,605.00	594,418.54	619,661.70	
Revenue from Sale of Animals		-	-	46,350.00	15,913.50	32,781.81	50,647.90	382,560.44	71,643.14	73,792.43	38,003.10	
Other Revenues		-	1,165.00	12,172.03	18,011.43	16,284.36	19,057.68	42,506.72	38,062.41	33,410.55	32,883.24	
Unrealized Gain on Change in PV of Biological Assets (PAS 41)		100,000.00	15,000.00	105,000.00	65,000.00	105,000.00	145,000.00	(160,000.00)	205,000.00	225,000.00	280,000.00	
Total Farm Revenues		100,000.00	39,465.00	360,612.52	443,240.02	446,971.65	545,211.24	732,641.04	1,004,310.55	926,621.52	970,548.04	
Expenses												
Total Direct Material		39,171.40	61,675.78	86,023.52	96,085.20	117,130.24	146,547.21	148,928.13	155,840.64	197,162.63	251,541.78	
Direct Labor		21,156.75	27,503.78	33,850.80	40,197.83	52,891.88	65,585.93	74,048.63	82,511.33	88,858.35	107,899.43	
Total Overhead Expenses		14,784.90	23,420.37	27,855.84	33,691.31	43,962.25	54,233.19	61,547.15	57,661.11	62,096.58	75,402.99	
Total Selling and Admin Expense		806.40	1,048.32	1,290.24	1,532.16	2,016.00	2,499.84	2,822.40	3,144.96	3,386.88	4,112.64	
Total Expense		75,919.45	113,648.25	149,020.40	171,506.50	216,000.37	268,866.17	287,346.31	299,158.04	351,504.44	438,956.84	
Farm Net Income/Net Loss		24,080.55	(74,183.25)	211,592.12	271,733.53	230,971.28	276,345.07	445,294.73	705,152.51	575,117.08	531,591.21	
Less: Interest Expense		54,074.29	43,259.43	32,444.57	21,629.72	10,814.86						
Earnings after Interest		(29,993.74)	(117,442.68)	179,147.55	250,103.81	220,156.42	276,345.07	445,294.73	705,152.51	575,117.08	531,591.21	
ROI		-23.07%	-74.85%	98.72%	129.50%	97.06%	102.78%	154.97%	235.71%	163.62%	121.10%	
PROJECTED CASH FLOW												
ASSUMPTIONS												
HURDLE RATE used for Discounting Purposes												
Capital Investment			443,509.26									
Working Capital			71,483.98									
Total Initial Investment			514,993.24									
Interest Payment		54,074.29	43,259.43	32,444.57	21,629.72	10,814.86						
ANNUAL NET CASH FLOW		(54,074.29)	(125,416.57)	82,504.30	195,211.21	128,345.10	147,615.03	623,758.88	517,450.85	368,746.05	274,212.10	
NPV			\$142,424.96									
IRR			20.17%									
Payback Period			(569,067.53)	(611,979.79)	(416,768.59)	(288,423.49)	(140,808.46)	482,950.42	1,000,401.26	1,369,147.31	1,643,359.42	
Present Value of Cash Flows			6.23									
Profitability Index			\$680,206.19									
			1.32									

ANNEX VIII PROJECTED INCOME STATEMENT (ZERO DEBT, 10-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (ZERO DEBT, 10-COW DAIRY BUSINESS MODULE)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	69,085.71	353,599.00	762,029.31	626,366.73	673,785.85	938,324.72	1,422,529.94	1,183,024.46	1,435,160.02
Revenue from Sale of		-	-	77,250.00	63,654.00	49,172.72	67,530.53	817,288.22	161,197.06	166,032.97	95,007.76
Other Revenues		-	3,454.29	21,542.45	41,284.17	33,776.97	37,065.82	87,780.65	79,186.35	67,452.87	76,508.39
Unrealized Gain on Change in PV of Biological Assets		200,000.00	40,000.00	40,000.00	255,000.00	220,000.00	335,000.00	(435,000.00)	415,000.00	455,000.00	555,000.00
Total Farm Revenues	200,000.00	200,000.00	112,540.00	707,391.45	991,967.48	929,316.41	1,113,382.20	1,408,393.59	2,077,913.35	1,871,510.30	2,161,676.16
Expenses											
Total Direct Material		84,948.18	132,414.76	188,483.69	208,453.42	251,541.98	318,594.26	315,368.40	319,362.34	407,075.56	509,689.32
Direct Labor		46,544.85	63,470.25	82,511.33	88,858.35	107,899.43	143,865.90	160,791.30	165,022.65	173,485.35	207,336.15
Total Overhead Expenses		32,526.78	44,354.70	57,661.11	62,096.58	75,402.99	100,537.32	112,365.24	115,322.22	121,236.18	144,892.02
Total Selling and Admin		1,774.08	2,419.20	3,144.96	3,386.88	4,112.64	5,483.52	6,128.64	6,289.92	6,612.48	7,902.72
Total Expense		165,793.89	242,658.91	331,801.09	362,795.23	438,957.04	568,481.00	594,653.58	605,997.13	708,409.57	869,820.21
Farm Net Income/Net Loss		34,206.11	(130,118.91)	375,590.37	629,172.25	490,359.38	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
ROI		20.63%	-53.62%	113.20%	173.42%	111.71%	95.85%	136.84%	242.89%	164.18%	148.52%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	753,587.22										
Working Capital	156,035.86										
Total Initial Investment	909,623.08										
ANNUAL NET CASH FLOW		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
NPV	(909,623.08)	0	(156,812.50)	137,888.70	522,801.22	292,980.28	240,062.39	1,282,449.58	1,091,512.88	744,471.58	780,323.56
IRR	26.33%										
Payback Period		(909,623.08)	(1,066,435.58)	(928,546.88)	#####	(112,765.38)	127,297.01	1,409,746.59	2,501,259.48	3,245,731.06	4,026,054.62
Present Value of Cash Flows		5.47	Years								
Profitability Index		1.82									

Source: PCC-BDCU, 2021

CONT. ANNEX VIII PROJECTED INCOME STATEMENT (ZERO DEBT, 10-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (50% Dairi)									
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES										
Raw Milk Sales	-	69,085.71	353,599.00	762,029.31	626,366.73	673,785.85	938,324.72	1,423,529.94	1,183,024.46	1,435,160.02
Revenue from Sale of Animals	-	-	77,250.00	63,654.00	49,172.72	67,530.53	817,288.22	161,197.06	166,032.97	95,007.76
Other Revenues	-	3,454.29	21,542.45	41,284.17	33,776.97	37,065.82	87,780.85	79,186.35	67,452.87	76,508.39
Unrealized Gain on Change in FV of Biological Assets (PAS 41)	200,000.00	40,000.00	255,000.00	125,000.00	220,000.00	335,000.00	(435,000.00)	415,000.00	455,000.00	555,000.00
Total Farm Revenues	200,000.00	112,540.00	707,391.45	991,967.48	929,316.41	1,113,382.20	1,408,393.59	2,077,913.35	1,871,510.30	2,161,676.16
Expenses										
Total Direct Material	84,948.18	132,414.76	188,483.69	208,453.42	251,541.68	318,594.26	315,368.40	310,362.94	407,075.56	509,689.32
Direct Labor	46,544.85	65,470.25	82,511.33	88,958.35	107,899.43	143,865.90	160,791.30	165,022.65	173,485.35	207,336.15
Total Overhead Expenses	32,526.78	44,354.70	57,661.11	62,096.58	75,402.99	100,537.32	112,365.24	113,322.22	121,236.18	144,892.02
Total Selling and Admin Expense	1,774.08	2,419.20	3,144.56	3,386.88	4,112.64	5,483.52	6,178.54	6,289.92	6,612.48	7,902.72
Total Expense	165,793.89	242,658.91	331,801.69	362,795.23	438,957.04	568,481.00	594,653.58	605,997.13	708,409.57	869,820.21
Farm Net Income/Net Loss	34,206.11	(130,118.91)	375,590.37	629,172.25	490,359.38	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,109,830.75
Less: Interest Expense	68,221.73	54,577.38	40,933.04	27,288.69	13,644.35					
Earnings after interest	(34,015.62)	(184,696.29)	334,657.33	601,883.56	476,715.03	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,109,830.75
ROI	-14.54%	-62.14%	89.78%	154.30%	108.33%	95.85%	136.84%	242.89%	164.18%	148.52%
PROJECTED CASH FLOW										
ASSUMPTIONS										
HURDLE RATE used for Discounting Purposes	1.0%									
Capital Investment										
Working Capital										
Total Initial Investment	753,187.22									
Interest Payment										
ANNUAL NET CASH FLOW	(909,623.08)	60,221.73	40,933.04	27,288.69	13,644.35					
NPV	\$518,218.16	(68,221.73)	(211,389.88)	495,512.53	279,335.93	240,062.39	1,282,449.38	1,091,512.88	744,471.58	780,323.56
IRR	23.96%									
Payback Period										
Present Value of Cash Flows	\$1,510,756.14									
Profitability Index	1.66									

CONT. ANNEX VIII PROJECTED INCOME STATEMENT (ZERO DEBT, 10-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (60% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	69,085.71	353,599.00	762,029.31	626,366.73	673,785.85	938,324.72	1,422,529.94	1,183,024.46	1,435,160.02
Revenue from Sale of Animals		-	-	77,250.00	63,654.00	49,172.72	67,530.53	87,288.22	161,197.06	166,032.97	95,007.76
Other Revenues		-	3,454.29	21,542.45	41,284.17	33,776.97	37,065.82	87,780.65	79,186.35	67,452.87	76,508.39
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		200,000.00	40,000.00	255,000.00	125,000.00	220,000.00	335,000.00	(435,000.00)	415,000.00	455,000.00	555,000.00
Total Farm Revenues		200,000.00	112,540.00	707,391.45	991,967.48	929,316.41	1,113,382.20	1,408,393.59	2,077,913.35	1,871,510.30	2,161,676.16
Expenses											
Total Direct Material		84,948.18	132,414.76	188,483.69	208,453.42	251,541.98	318,594.26	315,368.40	319,362.34	407,075.56	509,689.32
Direct Labor		46,544.85	63,470.25	82,511.33	88,858.35	107,899.43	143,865.50	160,791.30	165,022.65	173,485.35	207,336.15
Total Overhead Expenses		32,526.78	44,354.70	57,661.11	62,096.58	75,402.99	100,537.32	112,365.24	115,322.22	121,236.18	144,892.02
Total Selling and Admin Expense		1,774.08	2,419.20	3,144.96	3,386.88	4,112.64	5,483.52	6,125.64	6,289.92	6,617.48	7,902.72
Total Expense		165,793.89	242,658.91	331,801.09	362,795.23	438,957.04	568,481.00	594,051.58	605,997.13	700,409.57	869,820.21
Farm Net Income/Net Loss		34,206.11	(130,118.91)	375,590.37	629,172.25	490,359.38	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
Less: Interest Expense		81,866.08	65,492.86	49,119.65	32,746.43	16,373.22					
Earnings after Interest		(47,659.97)	(195,611.77)	326,470.72	596,425.82	473,986.16	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
ROI		-19.24%	-63.48%	85.71%	150.79%	104.10%	95.85%	136.84%	342.89%	164.18%	148.52%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment		753,587.22									
Working Capital		156,035.86									
Total Initial Investment		909,623.08									
Interest Payment			81,866.08	65,492.86	49,119.65	32,746.43	16,373.22				
ANNUAL NET CASH FLOW		(909,623.08)	(81,866.08)	(222,305.36)	490,054.79	276,607.05	240,062.39	1,282,448.58	1,091,512.88	744,471.58	780,323.56
NPV		592,845.17									
IRR		23.51%									
Payback Period			(991,489.15)	(1,213,794.51)	(1,125,025.46)	(634,970.07)	(118,301.22)	1,164,148.36	2,255,661.25	3,000,132.83	3,780,456.39
Present Value of Cash Flows		6.09									
Profitability Index		1.63									

CONT. ANNEX VIII PROJECTED INCOME STATEMENT (ZERO DEBT, 10-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (70% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales			69,085.71	353,599.00	762,029.31	626,366.73	673,785.85	938,324.72	1,422,579.94	1,183,024.46	1,435,160.02
Revenue from Sale of Animals		-	-	77,250.00	63,654.00	49,172.72	67,530.53	81,738.22	161,197.06	166,032.97	95,007.76
Other Revenues		-	3,454.29	21,542.45	41,284.17	33,776.97	37,065.82	87,780.65	79,196.35	67,452.87	76,508.39
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		200,000.00	40,000.00	255,000.00	125,000.00	220,000.00	335,000.00	(435,000.00)	415,000.00	455,000.00	555,000.00
Total Farm Revenues		200,000.00	112,540.00	707,391.45	991,967.48	929,316.41	1,113,382.20	1,408,933.59	2,077,913.35	1,871,510.30	2,161,676.16
Expenses											
Total Direct Material		84,948.18	132,414.76	188,483.69	208,453.42	251,541.98	318,594.26	315,368.40	319,362.34	407,075.56	509,689.32
Direct Labor		46,544.85	63,470.25	82,511.33	88,858.35	107,899.43	143,865.90	160,791.30	165,022.65	173,485.35	207,336.15
Total Overhead Expenses		32,576.78	44,354.70	57,661.11	62,096.58	75,402.99	100,537.32	112,365.24	115,322.22	121,236.18	144,832.02
Total Selling and Admin Expense		1,774.08	2,419.20	3,144.96	3,386.88	4,112.64	5,483.52	6,128.64	6,289.92	6,612.48	7,932.72
Total Expense		165,793.89	242,658.91	331,801.09	362,795.23	438,957.04	568,481.00	594,653.58	605,997.13	708,409.57	869,820.21
Farm Net Income/Net Loss		34,206.11	(130,118.91)	375,590.37	629,172.25	490,359.38	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
Less: Interest Expense		95,510.42	76,408.34	57,306.25	38,204.17	19,102.06					
Earnings after Interest		(61,304.31)	(206,527.25)	318,284.11	590,968.08	471,257.29	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
ROI		-23.46%	-64.73%	81.89%	147.37%	102.88%	95.85%	136.84%	242.89%	164.18%	148.52%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment		753,587.22									
Working Capital		156,035.86									
Total Initial Investment		909,623.08									
Interest Payment			95,510.42	76,408.34	57,306.25	38,204.17	19,102.06				
ANNUAL NET CASH FLOW		(909,623.08)	(95,510.42)	(233,220.84)	484,597.05	273,878.19	240,062.39	1,282,449.56	1,091,512.88	744,471.58	780,323.56
NPV		\$467,472.18									
IRR		23.06%									
Payback Period			(1,005,133.50)	(1,238,354.34)	(1,157,771.89)	(399,296.65)	(159,234.25)	(1,123,215.32)	2,214,728.21	2,959,190.79	3,739,523.35
Present Value of Cash Flows		6.12									
Profitability Index		1.00									

ANNEX IX PROJECTED INCOME STATEMENT (ZERO DEBT, 15-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (ZERO DEBT, 15-COW DAIRY BUSINESS MODULE)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales	-	115,345.45	556,232.77	1,154,365.29	960,521.93	1,004,603.58	1,387,284.84	2,123,657.29	1,742,971.65	2,283,295.49	
Meat Revenue	-	123,600.00	111,394.50	65,563.62	84,413.16	991,179.33	501,501.96	202,829.19	190,015.51	763,292.31	
Other Revenues	-	11,947.27	33,381.36	60,996.45	52,246.75	99,789.15	94,439.34	116,329.32	96,649.36	152,329.39	
Unrealized Gain on Change in FV of Biological Assets (PAS 41)	300,000.00	65,000.00	360,000.00	160,000.00	160,000.00	330,000.00	520,000.00	(360,000.00)	380,000.00	740,000.00	815,000.00
Total Farm Revenues	300,000.00	315,892.73	1,081,008.64	1,440,925.36	1,427,181.85	2,615,572.06	1,603,226.15	2,822,915.80	2,769,636.52	4,013,917.19	
Expenses											
Total Direct Material	124,119.58	196,548.36	280,037.30	305,997.94	369,593.89	471,362.82	496,325.04	505,618.63	617,756.36	778,973.64	
Direct Labor	67,701.60	95,205.38	122,709.15	126,940.50	154,444.28	213,663.18	253,881.00	258,112.35	264,459.36	313,119.90	
Total Overhead Expenses	47,311.68	66,532.05	85,752.42	86,709.40	107,529.77	149,327.49	177,418.80	180,375.78	184,811.25	218,816.52	
Total Selling and Admin Expense	2,580.48	3,628.80	4,677.12	4,838.40	5,886.72	8,144.64	9,676.80	9,838.08	10,080.00	11,934.72	
Total Expense	241,713.34	361,914.59	493,175.99	526,486.24	637,954.66	842,518.13	937,301.64	953,944.84	1,077,106.99	1,322,844.78	
Farm Net Income/Net Loss	58,286.66	(46,021.86)	587,832.65	914,439.12	789,327.19	1,773,053.94	665,924.51	1,868,970.96	1,692,529.54	2,691,072.41	
ROI	24.11%	-12.72%	119.19%	173.69%	123.75%	210.45%	71.05%	195.92%	157.14%	203.43%	
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment	1,262,413.88										
Working Capital	227,519.84										
Total Initial Investment	1,489,933.72										
ANNUAL NET CASH FLOW	(1,489,933.72)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
NPV	PHP1,168,093.81	0	(91,062.24)	233,558.37	781,051.94	491,706.13	1,297,852.19	1,099,150.15	1,543,083.69	1,007,972.91	1,941,717.37
IRR	27.71%										
Payback Period		(1,489,933.72)	(1,580,995.96)	(1,347,437.59)	(566,385.65)	(74,679.53)	1,223,172.66	2,322,322.81	3,865,406.50	4,873,379.41	6,815,096.78
Present Value of Cash Flo	PHP2,844,922.54										
Profitability Index	1.91										

Source: PCC-BDCU, 2021

CONT. ANNEX IX PROJECTED INCOME STATEMENT (ZERO DEBT, 15-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (50% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	115,345.45	556,232.77	1,154,365.29	980,521.93	1,004,603.58	1,387,284.84	2,123,657.29	1,742,971.65	2,283,295.49
Meat Revenue		-	-	123,600.00	111,394.50	65,563.62	84,413.16	156,502.00	286,572.55	202,929.19	190,015.51
Other Revenues		-	5,767.27	33,991.64	61,287.99	51,904.28	54,450.84	77,189.34	120,511.49	97,295.04	123,665.55
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		300,000.00	65,000.00	380,000.00	160,000.00	330,000.00	520,000.00	(380,000.00)	380,000.00	740,000.00	815,000.00
Total Farm Revenues	300,000.00	300,000.00	186,112.73	1,093,824.41	1,489,047.78	1,407,289.83	1,663,467.58	1,240,976.18	2,910,741.33	2,783,195.88	3,411,976.55
Expenses											
Total Direct Material	124,119.58	196,548.36	280,037.30	305,997.94	369,593.89	471,362.82	456,325.04	505,618.63	617,756.36	778,973.64	
Direct Labor	67,701.60	95,205.38	122,709.15	126,940.50	154,444.28	213,683.18	253,881.00	258,112.35	264,459.38	313,119.90	
Total Overhead Expenses	47,311.68	66,532.05	85,752.42	86,709.40	107,929.77	149,327.49	177,418.80	180,375.78	184,811.25	218,816.52	
Total Selling and Admin Expense	2,580.48	3,628.80	4,677.12	4,838.40	5,886.72	8,144.54	9,676.80	9,838.08	10,080.00	11,934.72	
Total Expense	241,713.34	361,914.59	493,175.99	526,486.24	637,854.66	842,518.13	937,301.64	953,944.84	1,077,106.99	1,322,844.78	
Farm Net Income/Net Loss	58,286.66	(175,801.86)	600,648.42	962,561.54	769,535.18	820,949.46	303,674.54	1,956,796.49	1,706,088.90	2,089,131.77	
Total Expense	111,745.03	89,396.02	67,047.02	44,698.01	22,349.01						
Earnings after Interest	(53,458.37)	(265,197.88)	533,601.40	917,863.53	747,186.17	820,949.46	303,674.54	1,956,796.49	1,706,088.90	2,089,131.77	
ROI	-15.12%	-58.76%	95.25%	160.69%	97.44%	113.18%	32.40%	205.13%	158.40%	157.93%	
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	1,262,413.88										
Working Capital	227,519.84										
Total Initial Investment	1,489,933.72										
Interest Payment		111,745.03	89,396.02	67,047.02	44,698.01	22,349.01					
ANNUAL NET CASH FLOW	(1,489,933.72)	(111,745.03)	(310,238.27)	179,327.13	784,476.35	449,565.10	345,747.70	736,900.18	1,630,909.23	1,021,532.27	1,339,776.73
NPV	\$360,174.92										
IRR	18.78%										
Payback Period		(1,601,678.74)	(1,911,917.01)	(1,732,589.88)	(948,113.53)	(498,548.43)	(152,800.73)	584,099.46	2,215,008.68	3,236,540.95	4,576,317.68
Present Value of Cash Flows	\$1,907,736.63										
Profitability Index	1.28										

CONT. ANNEX IX PROJECTED INCOME STATEMENT (ZERO DEBT, 15-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (60% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	69,085.71	353,599.00	762,029.31	626,366.73	673,785.85	938,324.72	1,422,529.94	1,183,024.46	1,640,169.79
Revenue from Sale of Animals		-	-	77,250.00	63,654.00	49,172.72	67,530.53	817,288.22	161,197.06	166,032.97	548,004.74
Other Revenues		-	3,454.29	21,542.45	41,284.17	33,776.97	37,065.82	87,780.65	79,186.35	67,452.87	76,508.39
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		200,000.00	40,000.00	255,000.00	125,000.00	220,000.00	335,000.00	(435,000.00)	415,000.00	455,000.00	265,000.00
Total Farm Revenues		200,000.00	112,540.00	707,391.45	991,967.48	929,316.41	1,113,382.20	1,408,993.59	2,077,913.35	1,871,510.30	2,562,583.25
Expenses											
Total Direct Material		84,948.18	132,414.76	188,483.69	208,453.42	251,541.98	318,594.26	315,368.40	319,362.34	407,075.56	509,689.32
Direct Labor		46,544.85	63,470.25	82,511.33	88,858.35	107,899.43	143,865.90	160,791.30	165,022.65	173,485.35	207,336.15
Total Overhead Expenses		32,526.78	44,354.70	57,661.11	62,096.58	75,402.99	100,337.32	112,365.24	115,322.22	121,236.18	144,892.02
Total Selling and Admin Expense		1,774.08	2,419.20	3,144.96	3,386.88	4,112.64	5,483.52	6,128.64	6,389.92	6,612.48	7,902.72
Total Expense		165,793.89	242,658.91	331,801.09	362,793.23	438,957.04	568,481.00	594,653.58	605,997.13	708,409.57	869,820.21
Farm Net Income/Net Loss		34,206.11	(130,118.91)	375,590.37	629,174.25	490,359.38	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
Less: Interest Expense		81,866.08	65,492.86	49,119.65	32,746.43	16,373.22					
Earnings after Interest		(47,659.97)	(195,611.77)	326,470.72	596,427.82	473,986.16	544,901.20	813,740.01	1,471,916.22	1,163,100.73	1,291,855.95
ROI		-19.24%	-63.48%	85.71%	150.79%	104.10%	95.85%	136.84%	242.89%	164.19%	148.52%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	753,587.22										
Working Capital	156,035.86										
Total Initial Investment	909,623.08										
Interest Payment	363,840.23										
		81,866.08	65,492.86	49,119.65	32,746.43	16,373.22					
		(81,866.08)	(222,305.36)	88,769.05	450,054.79	276,607.06	240,062.39	1,282,449.58	1,091,512.88	744,471.58	780,323.56
ANNUAL NET CASH FLOW		(909,623.08)									
NPV		\$492,845.17									
IRR		23.51%									
Payback Period			(991,489.15)	(1,213,794.51)	(1,125,025.46)	(634,970.67)	(358,363.61)	1,164,148.36	2,255,661.25	3,000,132.83	3,780,456.39
Present Value of Cash Flows		6.09									
Profitability Index		1.63									

CONT. ANNEX IX PROJECTED INCOME STATEMENT (ZERO DEBT, 15-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (70% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales			115,345.45	556,232.77	1,154,365.29	960,521.93	1,004,603.58	1,387,284.84	2,123,657.29	1,742,971.65	2,283,295.49
Meat Revenue			-	123,600.00	111,394.50	65,563.62	84,413.16	156,502.00	286,572.55	202,929.19	190,015.51
Other Revenues			5,767.27	33,991.64	63,287.99	51,304.28	54,450.84	77,189.34	120,511.49	97,295.04	123,665.55
Unrealized Gain on Change in FV of Biological Assets (PAS 41)			65,000.00	380,000.00	160,000.00	330,000.00	520,000.00	(380,000.00)	380,000.00	740,000.00	815,000.00
Total Farm Revenues	300,000.00	300,000.00	186,112.73	1,093,824.41	1,489,047.78	1,407,389.83	1,663,467.58	1,240,976.18	2,910,741.33	2,783,195.88	3,411,976.55
Expenses											
Total Direct Material	124,119.58	196,548.36	280,037.30	305,997.94	369,593.89	471,362.82	496,325.04	505,618.63	617,756.36	778,973.64	778,973.64
Direct Labor	67,701.60	95,205.38	122,709.15	126,940.50	154,444.28	213,683.18	253,881.00	258,112.35	258,112.35	264,459.38	313,119.80
Total Overhead Expenses	47,311.68	66,532.05	85,752.42	88,709.40	107,979.77	149,327.49	177,418.80	180,375.78	184,811.25	218,816.52	218,816.52
Total Selling and Admin Expense	2,580.48	3,628.80	4,677.12	4,838.40	5,886.72	8,144.64	9,676.80	9,838.08	10,080.00	11,934.72	11,934.72
Total Expense	241,713.34	361,914.59	493,175.99	526,486.24	637,854.66	842,518.13	937,301.64	933,944.84	1,077,106.99	1,322,844.78	1,322,844.78
Farm Net Income/Net Loss	58,286.66	(175,801.86)	600,648.42	962,561.54	769,535.18	820,949.46	303,674.54	303,674.54	1,956,796.49	1,706,088.90	2,089,131.77
Total Expense	156,443.04	125,154.43	93,865.82	62,577.22	31,288.61	820,949.46	303,674.54	303,674.54	1,956,796.49	1,706,088.90	2,089,131.77
Earnings after Interest	(98,156.38)	(300,956.29)	506,782.60	899,984.32	738,246.57	820,949.46	303,674.54	303,674.54	1,956,796.49	1,706,088.90	2,089,131.77
ROI	-24.85%	-61.79%	86.33%	152.78%	110.33%	97.44%	32.40%	205.13%	158.40%	157.95%	157.95%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	1,262,413.88										
Working Capital	227,519.84										
Total Initial Investment	1,489,933.72										
Interest Payment	446,980.11										
Year 0	156,443.04	125,154.43	93,865.82	62,577.22	31,288.61						
Year 1	(156,443.04)	(843,996.67)	152,508.32	766,597.14	440,635.50						
ANNUAL NET CASH FLOW	(1,489,933.72)	(843,996.67)	152,508.32	766,597.14	440,635.50	345,747.70	796,900.18	1,630,909.23	1,021,532.27	1,339,776.73	
NPV	\$277,054.62										
IRR	18.26%										
Payback Period		(1,646,376.76)	(1,992,373.43)	(1,839,865.11)	(1,073,267.96)	(632,642.46)	(286,894.76)	450,005.42	2,080,914.65	3,102,446.92	4,442,223.65
Present Value of Cash Flows		6.39									
Profitability Index		1.22									

ANNEX X PROJECTED INCOME STATEMENT (ZERO DEBT, 20-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (ZERO DEBT, 20-COW DAIRY BUSINESS MODULE)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	161,700.00	728,879.50	1,558,249.92	1,270,131.23	1,326,496.55	1,666,978.16	2,469,310.10	1,924,147.91	2,619,775.54
Meat Revenues		-	-	139,050.00	127,306.00	98,345.43	118,176.43	1,338,961.56	322,394.12	184,461.08	247,020.17
Other Revenues		-	8,085.00	43,396.48	84,277.90	68,423.83	72,233.75	150,296.99	139,595.21	105,431.45	143,339.79
in FV of Biological Assets (PAS 41)											
Total Farm Revenues	400,000.00	400,000.00	259,785.00	1,421,325.98	1,889,835.82	1,756,900.49	2,026,908.72	2,391,236.70	3,501,289.43	2,929,060.44	3,740,135.49
Expenses											
Total Direct Material	163,290.98	258,224.14	369,133.09	397,705.15	458,689.66	562,225.15	547,017.48	532,193.76	658,771.14	803,244.56	803,244.56
Direct Labor	88,858.35	122,709.15	158,675.63	162,906.98	186,179.40	243,302.63	279,269.10	277,153.43	281,384.78	321,582.60	321,582.60
Total Overhead Expenses	62,096.58	85,752.42	110,886.75	113,843.73	130,107.12	170,026.35	195,160.68	193,662.19	196,639.17	224,730.48	224,730.48
Total Selling and Admin	3,386.88	4,677.12	6,048.00	6,209.28	7,096.32	9,273.60	10,644.48	10,563.84	10,725.12	12,257.28	12,257.28
Total Expense	317,632.79	471,362.83	644,743.47	680,665.14	762,072.50	984,827.73	1,032,091.74	1,013,593.22	1,147,520.21	1,361,814.92	1,361,814.92
Farm Net Income/Net ROI	82,367.21	(211,577.83)	776,582.51	1,309,170.68	1,358,144.96	1,042,080.99	1,358,144.96	1,358,144.96	2,487,696.22	1,781,540.24	2,378,320.57
	25.93%	-44.89%	120.45%	192.34%	124.65%	105.91%	131.69%	245.43%	155.25%	174.64%	
PROJECTED CASH ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment	1,644,342.66										
Working Capital	299,003.82										
Total Initial Investment	1,943,346.48										
ANNUAL NET CASH	(1,943,346.48)	0	(275,852.10)	299,848.54	1,123,323.60	693,860.13	593,088.90	2,182,693.16	1,975,800.87	1,125,531.99	1,715,739.71
NPV	PHP1,115,254.78										
IRR	24.99%										
Payback Period	5.18 years										
Present Value of Cash Flows	PHP3,237,042.02										
Profitability Index	1.67										

Source: PCC-BDCU, 2021

CONT. ANNEX X PROJECTED INCOME STATEMENT (ZERO DEBT, 20-COW DAIRY BUSINESS MODULE)

	PROJECTED INCOME STATEMENT (50% Debt)										
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales			161,700.00	728,879.50	1,558,249.92	1,270,131.23	1,326,496.55	1,666,978.16	2,469,310.10	1,924,147.91	2,619,775.54
Revenues from sale of calves		-	-	139,050.00	127,308.00	98,345.43	118,178.43	1,338,961.56	322,394.12	184,481.08	247,020.17
Other Revenues		-	8,085.00	43,396.48	84,277.90	68,423.83	72,233.75	150,296.99	139,585.21	305,431.45	143,339.79
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		400,000.00	90,000.00	510,000.00	220,000.00	320,000.00	510,000.00	(765,000.00)	570,000.00	715,000.00	730,000.00
Total Farm Revenues		400,000.00	259,785.00	1,421,325.98	1,989,835.82	1,756,900.49	2,026,908.72	2,391,286.70	3,501,289.43	2,929,060.44	3,740,135.49
Expenses											
Total Direct Material		163,390.98	258,224.14	369,133.09	397,705.15	458,689.66	562,225.15	547,017.48	532,193.76	658,771.14	803,244.56
Direct Labor		88,858.35	122,709.15	158,675.63	162,006.98	186,179.40	243,302.63	279,269.10	277,153.43	281,364.78	321,582.60
Total Overhead Expenses		62,096.58	85,752.42	110,886.75	113,843.73	130,107.12	170,026.35	195,160.68	193,682.19	196,639.17	224,730.48
Total Selling and Admin Expense		3,386.88	4,677.12	6,048.00	6,209.28	7,096.32	9,273.60	10,644.48	10,563.84	10,725.12	12,257.28
Total Expense		317,632.79	471,362.83	644,743.47	690,665.14	782,072.50	984,827.73	1,032,091.74	1,013,593.22	1,147,520.21	1,361,814.92
Farm Net Income/Net Loss		82,367.21	(211,577.83)	776,582.51	1,309,170.68	974,827.99	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
Less: Interest Expense		145,750.99	116,600.79	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59
Earnings after Interest		(63,383.78)	(328,178.62)	689,131.92	1,250,870.29	945,677.79	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
ROI		-13.68%	-55.82%	94.12%	169.27%	116.57%	105.81%	131.69%	245.43%	155.25%	174.64%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes											
Capital Investment		1,644,342.66									
Working Capital		299,003.82									
Total Initial Investment		1,943,346.48									
Interest Payment		145,750.99	116,600.79	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59	87,450.59
ANNUAL NET CASH FLOW		(1,843,346.48)	(392,452.89)	212,397.94	1,065,023.41	664,709.93	583,088.90	2,182,093.16	1,875,800.87	1,125,531.99	1,715,739.71
NPV		PHP 844,216.63									
IRR		22.51%									
Payback Period			(2,481,550.35)	(2,269,152.41)	(1,204,129.00)	(539,419.07)	43,669.82	2,226,362.99	4,202,163.86	5,327,695.84	7,043,435.56
Present Value of Cash Flows			5.98	years							
Profitability Index			1.50								

CONT. ANNEX X PROJECTED INCOME STATEMENT (ZERO DEBT, 20-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (60% Debt)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	161,700.00	728,879.50	1,558,249.92	1,270,131.23	1,326,496.55	1,666,978.16	2,469,310.10	1,924,147.91	2,619,775.54
Revenues from sale of calves		-	-	139,050.00	127,308.00	98,345.43	118,178.43	1,338,961.56	322,394.12	184,481.08	247,020.17
Other Revenues		-	8,085.00	43,356.48	84,277.90	68,423.83	72,233.75	150,256.99	139,585.21	105,431.45	143,339.79
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		400,000.00	90,000.00	510,000.00	220,000.00	320,000.00	510,000.00	(765,000.00)	570,000.00	715,000.00	730,000.00
Total Farm Revenues		400,000.00	259,785.00	1,421,325.98	1,989,835.82	1,756,900.49	2,026,908.72	2,391,236.70	3,501,289.43	2,929,060.44	3,740,135.49
Expenses											
Total Direct Material		163,290.98	258,224.14	369,133.09	397,705.15	458,680.66	562,225.15	547,017.48	532,193.76	658,771.14	803,244.56
Direct Labor		88,858.35	122,709.15	158,675.63	162,906.98	186,179.40	243,302.63	279,269.10	277,153.43	281,384.78	321,592.60
Total Overhead Expenses		62,096.58	85,752.42	110,886.75	113,843.73	130,107.12	170,026.35	195,160.68	193,682.19	196,639.17	224,730.48
Total Selling and Admin Expense		3,386.88	4,677.12	6,045.00	6,209.28	7,096.32	9,273.60	10,644.48	10,563.84	10,725.12	12,257.28
Total Expense		317,632.79	471,362.83	644,743.47	680,665.14	782,072.50	964,827.73	1,032,091.74	1,013,593.22	1,147,520.21	1,361,814.92
Farm Net Income/Net Loss		82,367.21	(211,577.83)	776,582.51	1,309,170.68	974,827.99	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
Less: Interest Expense		174,901.18	139,920.95	104,940.71	69,960.47	34,980.24					
Earnings after Interest		(92,533.97)	(351,498.78)	671,641.80	1,239,210.21	939,847.75	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
ROI		-18.79%	-57.50%	89.59%	165.09%	115.03%	105.81%	131.69%	245.43%	155.25%	174.64%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes			16%								
Capital Investment		1,644,342.66									
Working Capital		299,003.82									
Total Initial Investment		1,943,346.48									
Interest Payment			174,901.18	139,920.95	104,940.71	69,960.47	34,980.24				
ANNUAL NET CASH FLOW		(1,943,346.48)	(174,901.18)	(415,773.05)	194,907.83	658,879.89	583,088.90	2,182,693.16	1,975,800.87	1,125,531.99	1,715,739.71
NPV		PHP790,009.00									
IRR		22.04%									
Payback Period			(2,118,247.66)	(2,339,112.88)	(1,285,749.56)	(626,869.67)	(43,780.77)	2,138,912.39	4,114,713.27	5,240,245.25	6,955,984.96
Present Value of Cash Flows			6.02	years							
Profitability Index			1.47								

CONT. ANNEX X PROJECTED INCOME STATEMENT (ZERO DEBT, 20-COW DAIRY BUSINESS MODULE)

PROJECTED INCOME STATEMENT (70% Debt)											
	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
REVENUES											
Raw Milk Sales		-	161,700.00	728,879.50	1,558,249.92	1,270,131.23	1,326,496.55	1,666,978.16	2,469,310.10	1,924,147.91	2,619,775.54
Revenues from sale of calves		-	-	139,050.00	127,308.00	98,345.43	118,178.43	1,338,961.56	322,394.12	184,481.08	247,020.17
Other Revenues		-	8,085.00	43,396.48	84,277.90	68,423.83	72,233.75	150,296.99	139,585.21	105,431.45	143,339.79
Unrealized Gain on Change in FV of Biological Assets (PAS 41)		400,000.00	90,000.00	510,000.00	220,000.00	320,000.00	510,000.00	(765,000.00)	570,000.00	715,000.00	730,000.00
Total Farm Revenues		400,000.00	259,785.00	1,421,325.98	1,889,835.82	1,756,900.49	2,026,908.72	2,391,236.70	3,501,289.43	2,929,060.44	3,740,135.49
Expenses											
Total Direct Material		163,290.98	258,224.14	369,133.09	397,705.15	458,689.66	562,225.15	547,017.48	532,193.76	658,771.14	803,244.56
Direct Labor		88,858.35	122,709.15	158,675.63	162,906.98	186,179.40	243,302.63	279,269.10	277,153.43	281,384.78	321,582.60
Total Overhead Expenses		62,096.58	85,752.42	110,886.75	113,843.73	130,107.12	170,026.35	195,160.68	193,682.19	196,639.17	224,790.48
Total Selling and Admin Expense		3,386.88	4,677.12	6,048.00	6,209.28	7,096.32	9,273.00	10,644.48	10,563.84	10,725.12	12,257.28
Total Expense		317,632.79	471,362.83	644,743.47	680,665.14	782,072.50	964,827.73	1,032,091.74	1,013,593.22	1,147,520.21	1,361,814.92
Farm Net Income/Net Loss		82,367.21	(211,577.83)	776,582.51	1,309,170.68	974,827.99	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
Less: Interest Expense		204,051.38	163,241.10	122,430.83	81,620.55	40,810.28					
Earnings after Interest		(121,684.17)	(374,818.93)	654,151.68	1,227,550.13	934,017.72	1,042,080.99	1,359,144.96	2,487,696.22	1,781,540.24	2,378,320.57
ROI		-23.33%	-59.06%	85.27%	161.04%	113.51%	105.81%	131.69%	245.43%	155.25%	174.64%
PROJECTED CASH FLOW											
ASSUMPTIONS											
HURDLE RATE used for Discounting Purposes		16%									
Capital Investment	1,644,342.66										
Working Capital	299,003.82										
Total Initial Investment	1,943,346.48										
Interest Payment		204,051.38	163,241.10	122,430.83	81,620.55	40,810.28					
ANNUAL NET CASH FLOW		(1,943,346.48)	(439,093.21)	177,417.71	1,041,703.25	653,049.85	583,088.90	2,182,693.16	1,975,800.87	1,125,531.99	1,715,739.71
NPV		PHP 735,801.37									
IRR		21.58%									
Payback Period		(2,147,397.86)	(2,586,491.06)	(2,409,073.36)	(1,367,370.11)	(714,320.26)	(131,231.36)	2,051,461.80	4,077,262.67	5,152,794.66	6,868,534.37
Present Value of Cash Flows		6.06									
Profitability Index		1.44									

ANNEX XI IMPORTANT AREAS IN CARABAO SECTOR VC FOR RDE

	Focus	Research	Extension/ Training	Priority
PRE-FARM GATE				
• appropriate credit window for infusion of stocks, etc.	Sufficiency	X		1
• assured market and milk pricing to entice investors	Sufficiency	X	X	1
IN-FARM				
Improve on reproduction rate	Profitability		1	
• increase calf drop				
• higher success rate of AI				
» good quality semen		X	X	
» more proficient AI tech			X	
» proper care after AI			X	
» extension on proper feeding		X	X	
• higher efficiency of bulls loaned		X	X	
• reduce calving interval				
» early pregnancy diagnosis		X	X	
» early resumption of estrus postpartum		X	X	
» early rebreeding postpartum		X	X	
» reduce mortality				
» reduce preweaning mortality		X	X	
» reduce post-weaning mortality		X	X	
• improve rearing of replacement heifers		X	X	
• select for ease of breeding and fecundity		X		
• aim for more female offspring; semen sexing		X	X	
Improve on milk yield/saleable milk	Profitability		1	
• selection for high yield and persistency of lactation		X		
• proper feeding and feeding management		X	X	
• balancing ration based on farm by-products		X	X	
• proper feeding requirement for high production		X	X	
• proper milking procedure				
• minimizing mastitis		X	X	

CONT. ANNEX XI IMPORTANT AREAS IN CARABAO SECTOR VC FOR RDE

	Focus	Research	Extension/ Training	Priority
• proper mineral supplementation		X	X	
• hygienic milk handling			X	
• milk replacer				
improve utilization of crossbreds for dairying	Sufficiency		1	
• directed backcrossing to attain riverine blood equal or above 87.5%			X	
• system for ready market for milk in the production area		X	X	
• develop model using backcrosses for profitable dairying		X	X	
Improve availability of low-cost feed materials	Profitability			
POST-FARM GATE				
Processing				
• longer shelf life		X	X	
• new product development		X		
• product quality and safety		X	X	
Marketing				
• packaging		X		
• advocacy			X	
• branding		X	X	

ANNEX XII RECOMMENDATIONS ON ALIGNING RDE WITH THE VCA CONCERNS

Several recommendations in order to achieve the desired alignment of PCC RDE along the carabao industry value chain are herein enumerated:

1. Cluster related issues along the value chain into broader themes, and create multi-disciplinary team to develop appropriate RDE approaches for each identified theme. This may entail involvement of team member-scientists outside of PCC as the need for expertise so warrant. Each team should regularly meet to assess the progress of the RDE being implemented against the background of the set objectives and targets.
2. Review and revise if needed, the basis for evaluation of research proposals, either for in-house or outside funding to ensure alignment with the VC priority concerns.
3. Conduct a comprehensive research audit every other year, with the objective of finding how the time as well as human and material resources of PCC can be fitted to the requirements of the industry based on the issues identified in the VCA.
4. Conduct annual major program components review following the ISO process and ensure that NCs are appropriately closed to enhance program implementation flow. The areas should include Genetic Improvement Program (Sire selection, semen production and usage, AI system, bull/natural mating system), and enterprise development to include the NIZ and RIZ and the expansion of the enterprise beyond the impact zones.
5. Strengthen HR capacity and capability in research and extension. A long-term human development program towards this end is basic, with considerations on developing qualified staff while young. Give priority to animal nutrition, policy, social/rural development and extension, product development, and marketing.
6. Install a comprehensive training program on extension, with the objective of developing in-house staff and partner LGUs extension personnel on the conduct of correct extension on buffalo-based dairying.
7. Develop, support, and harness successful, efficient, and profitable dairy operation models, both smallholder and semi commercial as appropriate training grounds.

These facilities can serve as “Dairy Production School” for would be dairy farmers, extension personnel, among others.

8. Support strongly the long-term development plan for the dairy industry, and take the leadership in the identification of RDE initiatives deemed critical to achieving the goals, objectives and targets set in the long-term plan, keeping focus on competitiveness, profitability and sustainability.
9. Conduct regular comprehensive review of literature, leading to defining the state of the art in each of the major disciplines of research, with priority on those disciplines and research areas with direct bearing on industry VC. This can be carried out in-house or contract out international-caliber experts to do the review and consolidation of cutting-edge knowledge and information. The review should be followed by wide scale seminars involving the concerned research communities to keep abreast of the latest developments in their areas of research. This should also result in publishable papers or monographs.
10. Put emphasis on translational research with the objective of improving capabilities for innovation and transformation of information and technologies developed in laboratories into practical and applicable technologies for field use. Focus on areas that would impact on improving production efficiencies and profitability.
11. Increase research on critical policy issues. In the absence of in-house expertise, link with appropriate institution/s in the conduct of the needed research, and at the same time ensure that capacitation of in-house expertise happens.
12. In cooperation with ACPC and qualified researchers elsewhere, lead in the conduct of research to be used as bases for policy development on “special credit window” for smallholders, with special focus on dairying.
13. Increase research on identification of suitable extension modalities with the objective of finding appropriate schemes for enhancing technology adoption by smallholders and semi-commercial sector as well. The proposed “National Dairy Herd Improvement Program (NDHIP)” for KOIKA funding consideration fits well under this issue.

14. In cooperation with appropriate entity/ies, e.g. DA-AMAS, initiate studies on creating a platform for e-marketing of large animals with the objective of promoting transparent and ease of marketing to benefit the smallholder producers.
15. Increase RDE on the use of commonly available farm wastes such as rice straw, corn stover, cassava leaves, and the commonly available farm by-products such as rice bran, copra meal, molasses, among others. Appropriate locality-based “feed menu” should be developed and promoted, according to the availability of these potential feed materials, with the aim of meeting the nutritional requirements for optimum production at least cost.
16. PCC should install a ‘Feed Audit’ system for intended project zones with the objective of assessing the community carrying capacity. Such feed audit should include possible interventions as may be needed vis-a-vis potential magnitude of herds at some distant future.
17. Develop a strong forage research team in collaboration with other institutions with the needed expertise in forage R and D with the objective of enhancing forage production under smallholder and semi-commercial dairy production systems.
18. In cooperation with UPLB IAS and BAI-APDC and other appropriate entities with expertise in meat-based product development, initiate research on improving quality of existing buffalo-derived products, and develop new market-driven products. This effort should also consider developing at least basic in-house capabilities in this aspect.
19. Create a strong linkage with DOST/DTI Packaging Center to assist buffalo-based cooperatives in improving packaging of buffalo-derived products.
20. Initiate cooperation with institutions with high caliber expertise in R and D towards identifying and isolating special compounds in buffalo milk with medicinal uses for high value adding.
21. Lead in the development of an international semen exchange program, initially among Asian countries with dairy buffaloes to enhance improvement of dairy stocks. This important initiative is long overdue as to address the need to hasten

improvement in genetic potential of the dairy buffaloes. The absence of such program will render the dairy buffaloes less competitive in not so distant future.

22. In relatively remote areas where milk is produced in considerable volume for market, revisit the use of hydrogen peroxide for extending milk quality in the absence of cooling facilities. This has been recommended for use in many developing economies with sizeable milk producing communities.

ANNEX XIII CARABAO ROADMAP MILESTONE 2022-2026

Year	GIP	Knowledge Dissemination	RDI	Business Development	Institutional Capacitation (HR)
2022	(1)Regional and provincial AI coordination strengthened for Region I,II, III, IV,V; (2) 500 hd of superior dairy buffalo genetics infused from outside; (3) Municipal breeding stations launched (in concert with expanded bull loan program)	(1) 479 AI technicians of LGU and VBAIT trained; (2) 25 Dairy technologist of LGUs and co-ops trained; (3) Feed base development program launched; (4) Regular conduct of buffalo farm field day launched	(1) Special buffalo meat jerky developed/ launched; (2) Benchmarking and market scanning for Mozzarella di Bufala export in Asian Market	(1) Kardeli outlet launched; (2) Legislation on fresh milk labelling approved; (3) Special incentive window for export oriented enterprises established; (4) Formal inauguration of 1 st Dairy Business Hub and Privatization of Milka Krem	(1) 2 MS and 2 PhD in Meat and Dairy Product Science started study program/ hired; (2) International experts in cheese/ dairy and meat products engaged
2023	(1) Sexed semen of dairy buffalo in use (2) DHI expanded - KOICA assisted launched (include both dairy buffalo and dairy cattle) (3) 1000 hd dairy buffalo infused	(1) 207 AI technicians of LGU and VBAIT trained; (2) 25 Dairy technologist of LGUs and co-ops trained; (3) 15 Farmers dairy school inaugurated; (4) Forage seed production contracted and expanded	(1) Dairy product research center launched; (2) Improved Mozzarella di Bufala and Burrata developed; (3) Practical field test for pregnancy diagnosis for buffalo developed	(1) Philippine Mozzarella di bufala certification system developed; (2) Organic Buffalo milk certification launched; (3) Practical field test for pregnancy diagnosis for buffalo developed	(1) 1 MS and 1 PhD in Animal Genetics and Breeding started study program/ hired; 2 PhD in Social Science; (2) Formal Dairy Science degree offered by UPLB/ CLSU
2024	(1) Animal Herd Registry launched; (2) 1000 hd dairy buffalo infused by the private sector	(1) 15 Farmers dairy school inaugurated; (2) 147 AI technicians trained, with emphasis on the use of sexed semen	(1) Special buffalo-milk based beverage developed; (2) High value buffalo milk-derived compound isolated	(1) Special buffalo-milk based beverage commercialised; (2) High value buffalo milk-derived compounds commercialised	---
2025	(1) Enrollment of Philippines in International Committee on Animal Recording (ICAR) (2) International buffalo semen exchange program initiated	(1) 116 AI technicians trained, with emphasis on the use of sexed semen	---	---	---
2026	Company for export of frozen semen of superior dairy buffalo genetics assisted	(1) 120 AI technicians trained	---	* Formal inauguration of 2 nd Dairy Business Hub	---

