National Agriculture and Fisheries Research for Development and Extension Agenda

2023–2028

Message from the Director

I am pleased and honored to present another important output of a series of consultations and collaborations with the best and the brightest key players in the agriculture and fisheries R&D sector—the National Agriculture and Fisheries Research for Development and Extension Agenda (NAREA) 2023-2028!

The NAREA, as our principal reference in the R4D programs, projects, and activities that we will prioritize and support in the next medium term, exemplifies the bureau's pursuit of a path that will lead us to better results and performance for the benefit of the agriculture sector, and the farmers and fisherfolk.

Anchored on the DA's goal of economic recovery, food security, and poverty alleviation, the bureau underscores in the NAREA an R4DE agenda that is propelled by market-driven, solution-oriented, sustainable, and farmer-centered agri-fishery technology innovations. With this, the Bureau shall continue to prioritize the adaptation, verification, dissemination, and commercialization of innovative agri-fishery technologies with existing markets and high demand as well as cross-cutting themes based on a sustainable growth and development perspective.

Fully acknowledging that significant outputs of research, bureau shall remain focused on ensuring that important outputs of R4D projects and programs are scaled out and used by targeted beneficiaries to increase their productivity. In so doing, the DA-BAR, as the national R4D coordinating agency of the DA, will continue to strengthen their R4DE linkages through the Regional Research for Development and Extension Networks, prioritizing areas in the country that are tagged as the poorest and with the lowest agricultural productivity.

Crafting this document was a laborious process but it is worth the effort knowing that all this hard work will serve our ultimate beneficiaries–the farmers and the fisherfolk. Our utmost gratitude and appreciation to all those who have taken part in the planning, conceptualization, brainstorming, and endless discussions that have led to the crafting of this document.

May the content of this document guide the bureau and our partners on how we undertake R4DE projects and programs to better serve our farmers and fishers and the whole agri-fishery sector.

Thank you!

JUNEL B. SORIANO, PhD
Director, DA-BAR

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Acronyms

ADB	Asian Development Bank
AFF	Agriculture, fisheries and forestry
AIS	Agricultural Indicators System
AMMDA	Agricultural Machinery Manufacturers and Distributors Association Foundation, Inc.
AMTEC	UPLB Agricultural Machinery Testing and Evaluation Center
APHIS	Animal and Plant Health Inspection Service
ASU	Aklan State University
ATI	Agricultural Training Institute
AVR	Avirulence
AWD	Alternate Wetting and Drying
BAFE	Bureau of Agricultural and Fisheries Engineering
BAFS	Bureau of Agriculture and Fisheries Standards
BAI	Bureau of Animal Industry
BAR	Bureau of Agricultural Research
BASC	Bulacan Agricultural State College
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
BFAR	Bureau of Fisheries and Aquatic Resources
BPH	Brown planthopper
BPI	Bureau of Plant Industry
BPO	Biotech Program Office
BPSU	Bataan Peninsula State University
BSU	Benguet State University
BSWM	Bureau of Soils and Water Management
CAR	Cordillera Administrative Region
CBC	DA-Crop Biotechnology Center
CBSUA	Central Bicol State University of Agriculture
CLUP	Comprehensive Land Use Plan
CPF	Charoen Pokphand Foods Public Company Limited
COVID	Coronavirus disease
CvSU	Cavite State University
DA	Department of Agriculture
DA-BAR	Department of Agriculture-Bureau of Agricultural Research
DEBESMSCAT	Dr. Emilio B. Espinosa, Sr. Memorial State College of Agriculture and Technology
DMMMSU	Don Mariano Marcos Memorial State University
DOC	Day-old Chicks
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
ELISA	Enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization of the United Nations

FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FAW	Fall armyworm
FDA	Food and Drug Administration
FDC	Food Development Center
FMD	Foot-and-Mouth Disease
FPA	Fertilizer and Pesticide Authority
FNRI	Food and Nutrition Research Institute
FYC	Fresh Young Coconut
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GHG	Greenhouse gases
GIS	Geographic Information System
GVA	Gross Value Added
Has	Hectare
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
ICTS	Information and Communications Technology Service
IEC	Information, Education and Communication
IPB	Institute of Plant Breeding
IPM	Integrated Pest Management
ISCOF	Iloilo State College of Fisheries
IWEP	UPLB College of Agriculture and Food Science-Institute of Weed Science, Entomology and Plant Pathology
LGU	Local Government Unit
MIMAROPA	Mindoro (Occidental Mindoro at Oriental Mindoro), Marinduque, Romblon at Palawan
MMSU	Mariano Marcos State University
MOET	Minus One Element Technique
MSC	Marinduque State College
MSI	University of the Philippines-Marine Science Institute
MT	Metric ton
NAREA	National Agriculture and Fisheries Research for Development and Extension Agenda
NCIP	National Commission on Indigenous Peoples
NCPC	UPLB College of Agriculture and Food Science-National Crop Protection Center
NDA	National Dairy Authority
NFDC	National Fisheries Development Center
NFRDI	National Fisheries Research and Development Institute
NGO	Non-Government Organization
NHVC	National High Value Crops Program
NIA	National Irrigation Administration
NMIS	National Meat Inspection Service
NRP	National Rice Program
NTA	National Tobacco Administration

NUPAP	National Urban and Peri-Urban Agriculture Program
OAW	Onion armyworm
OIE	World Organization for Animal Health
PCA	Philippine Coconut Authority
PCAARRD	Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development
PCC	Philippine Carabao Center
PhilFIDA	Philippine Fiber Industry Development Authority
PhilMech	Philippine Center for Postharvest Development of Mechanization
PhilRice	Philippine Rice Research Institute
PhP	Philippine Peso
PHTRC	UPLB College of Agriculture and Food Science-Postharvest Horticulture Training and Research Center
PNA	Philippine News Agency
POT	Package of Technology
PPR	Peste des Petits Ruminants
PRISM	Philippine Rice Information System
PRRI	Philippine Rubber Research Institute
PSA	Philippine Statistics Authority
PSAU	Pampanga State Agricultural University
PSU	Partido State University
RCM	Rice Crop Manager
RDI	Research and Development Institutions
RFO	Regional Field Office
R&D	Research and Development
R4D	Research for Development
R4DE	Research for Development and Extension
SARAI	Smarter Approaches for Reinvigorate Agriculture as an Industry
SEAFDEC	Southeast Asian Fisheries Development Center
SKSU	Sultan Kudarat State University
SOCCSKSARGEN	South Cotabato, Cotabato, Sultan Kudarat, Sarangani and General Santos
SPFS	Solar Powered Irrigation and Fertigation System
SPS	Sanitary and phytosanitary
SSC	Sorsogon State College
SSC	Sulu State College
SSIS	Small Scale Irrigation Systems
SRA	Sugar Regulatory Administration
SUC	State Universities and Colleges
TAU	Tarlac Agricultural University
UK	United Kingdom
UNP	University of Northern Philippines
UPLB	University of the Philippines Los Baños
UPV	University of the Philippines Visayas
USA	United States of America

USDA	US Department of Agriculture
USeP	University of Southeastern Philippines
VCO	Virgin Coconut Oil
VSU	Visayas State University
WPU	Western Philippines University
YTPI	Yokohama Tire Philippines, Inc.

Philippine Agriculture and Fisheries Research for Development and Extension (R4DE) Investments

based on the budget allocation of the Department of Agriculture for R4DE

Overall, the public funding for agri-fisheries R4DE at the DA and its attached bureaus and attached agencies, corporations, and regional field offices has remained relatively unchanging since the last medium term (2018-2022) **(Table 1)**. Based on the General Appropriations Act (GAA), the total R4D investments of the DA amounted to 16.7 Billion Pesos in 2018 to 2022. The fund allocations were recorded based on the prioritizations each agency's core funds for R4D as well as the R4D allotment for each of the banner programs: the National Rice Program, National Corn Program, National Livestock Program, National High Value Crops Program, and the National Organic Agriculture Program.

This trend in the budget allocation for agriculture indicates enduring focus on primary food crops, as justified by the government's commitment to food self-sufficiency. Consistent with this, the World Bank (2020) observes that the budget portfolio for agriculture leaves much to be desired in terms of promoting modernization, industrialization, land consolidation, along with market support, R&D, and extension.

Table 1. DA agencies' investments on R4D based on the GAA 2018-2022

Agency	Funding for R4D based on the General Appropriations Act 2018-2022					Total
	2018	2019	2020	2021	2022	
Bureaus						
BAI	114,942,000	117,567,000	102,341,000	108,527,000	99,836,000	543,213,000
BAR	1,124,292,000	1,005,552,000	820,155,000	827,672,000	767,695,000	4,545,366,000
BPI	135,892,000	110,060,000	120,098,000	120,224,000	130,827,000	617,101,000
BSWM	103,504,000	72,085,000	76,937,000	45,265,000	32,210,000	330,001,000
Total	1,478,630,000	1,305,264,000	1,119,531,000	1,101,688,000	1,030,568,000	**6,035,681,000**
Attached Agencies						
ACPC	-	38,134,000	252,328,000	31,897,000	33,465,000	355,824,000
NFRDI	-	-	232,438,000	238,556,000	258,341,000	729,335,000
PhilMech	270,627,000	100,297,000	264,063,000	260,868,000	324,005,000	1,219,860,000
PCC	108,071,000	87,526,000	89,243,000	94,242,000	88,262,000	467,344,000
PhilFIDA	82,070,000	49,741,000	44,525,000	46,787,000	57,488,000	280,611,000
PRRI	12,000,000	6,000,000	6,855,000	7,052,000	7,098,000	39,005,000
Total	472,768,000	281,698,000	889,452,000	679,402,000	768,659,000	**3,091,979,000**
Attached Corporations						
PCA	69,250,000	56,278,000	48,399,000	61,118,000	61,118,000	296,163,000

Agency	Funding for R4D based on the General Appropriations Act 2018-2022					Total
	2018	2019	2020	2021	2022	
PhilRice	657,366,000	523,223,000	358,217,000	325,815,000	325,815,000	2,190,436,000
Total	726,616,000	579,501,000	406,616,000	386,933,000	386,933,000	**2,486,599,000**
Regional Field Offices						
RFO CAR	59,961,000	48,253,000	47,858,000	34,446,000	34,377,000	224,895,000
RFO 1	68,944,000	109,877,000	77,945,000	91,024,000	94,872,000	442,662,000
RFO 2	176,586,000	129,182,000	117,491,000	98,236,000	110,575,000	632,070,000
RFO 3	117,978,000	87,100,000	70,671,000	68,763,000	85,783,000	430,295,000
RFO 4A	61,090,000	47,108,000	39,906,000	41,682,000	39,348,000	229,134,000
RFO 4B	58,966,000	59,399,000	59,965,000	90,653,000	49,232,000	318,215,000
RFO 5	180,576,000	69,583,000	108,099,000	91,936,000	121,058,000	571,252,000
RFO 6	83,065,000	79,089,000	74,375,000	83,482,000	70,303,000	390,314,000
RFO 7	83,070,000	68,203,000	67,819,000	70,996,000	65,137,000	355,225,000
RFO 8	63,036,000	48,230,000	52,942,000	38,736,000	39,794,000	242,738,000
RFO 9	71,564,000	63,260,000	66,846,000	65,076,000	47,935,000	314,681,000
RFO 10	60,599,000	53,669,000	50,300,000	47,087,000	50,183,000	261,838,000
RFO 11	64,324,000	47,663,000	43,939,000	44,409,000	49,627,000	249,962,000
RFO 12	64,924,000	57,483,000	57,875,000	58,377,000	57,052,000	295,711,000
RFO 13	39,927,000	37,047,000	34,065,000	31,984,000	32,525,000	175,548,000
Total	**1,254,610,000**	**1,005,146,000**	**970,096,000**	**956,887,000**	**947,801,000**	**5,134,540,000**
Grand Total	**3,932,624,000**	**3,171,609,000**	**3,385,695,000**	**3,124,910,000**	**3,133,961,000**	**16,748,799,000**

The DA's R4D investment from 2018 to 2021 accounted for around 0.19 percent of the agriculture, forestry, and fishing GVA (AFF GVA) for the same period (PSA, 2022a). Further, the annual DA’s R4D investment during these periods showed a consistent trend relative to the annual AFF GVA (at constant 2018 prices) (**Table 2**).

Table 2. DA's Investments in R4DE in relation to the Philippine Agriculture, Forestry, and Fisheries (AFF) GVA

	2018	2019	2020	2021	Total / Average
DA's total R4D investment (in thousands)	3,932,624	3,171,609	3,385,695	3,124,910	13,614,838
AFF GVA[1] (in thousands)	1,762,616,000	1,783,855,000	1,780,391,000	1,775,358,000	7,102,220,000
% share of DA R4D investment to the total AFF GVA	0.22%	0.18%	0.19%	0.18%	0.19%

[1] at constant 2018 prices

Rationale of the National Agriculture and Fisheries Research for Development and Extension Agenda 2023-2028

The National Agriculture and Fisheries Research for Development and Extension Agenda for 2023-2028 charts the DA's RDE investment strategy to better reflect prime concern for the development and modernization of the agri-fishery sector as a means to realize a food-secure and resilient Philippines with empowered and prosperous farmers and fishers. In employing an extensive stakeholder consultation process, the DA-BAR, in collaboration with the University of the Philippines Los Baños (UPLB), put together an expanded portfolio of thematic areas in which the DA can lodge its R4DE investments.

The NAREA provides an updated research agenda for the eight priority commodity groups, considered crucial for food security and expanding economic opportunities in the agri-fishery sector. Recognizing the complexity of issues underlying rural development, it also encourages cross-disciplinary efforts as outlined through the cross-cutting research agenda to understand and help address some of the enduring challenges faced by farmers, fisherfolks, and their communities.

Recognizing the interconnectedness of the commodity and the cross-cutting research areas, some commodity groups include cross-referencing to the cross-cutting thematic areas: 1) enhancing natural resources for agricultural development, 2) advancing the agricultural innovation system, 3) strengthening policy and institutions, 4) ensuring food safety through one health, and 5) assessing and evaluating impacts. The cross-referencing indicates that certain research areas as reflected under the commodity groups may be further elaborated in the discussion of the cross-cutting thematic areas.

Commodity R4D Areas

Priority R4D Commodity Thematic Areas

The Priority Research for Development (R4D) Thematic Areas 2023-2028 aim to consolidate all the research for development (R4D) priorities on agriculture and fisheries particularly in eight (8) commodity groups further segmented into the value chain.

Focused on elevating the quality of technologies to be translated and adopted by farmers and fisherfolk, the overarching R4D thematic priority across the commodity groups are:

1. **Productivity Enhancement** - Cost-efficient inputs, Improvement of varieties, pest and disease management control and proactive measures

2. **Competitiveness Improvement** - Expanded market access, product scaling, and commercialization initiatives

3. **Climate Resilience and Integrated Natural Resources Management** - Development of climate-resilient varieties and climate-risk related tools

4. **Agri-Enterprise Development** - Promotion of community-based and indigenous farming and fishing practices and strategies and assistance to a more market-oriented agribusiness ventures

Under the thematic priorities cited above, enumerated as follows are the harmonized R4D Priority Areas for 2023-28 for each of the sub-commodity group:

CROPS:

1. Development of strategies for low-cost inputs (e.g. alternative cost-effective and efficient fertilizers, among others)
2. Crop germination, collection, conservation, characterization, and profiling
3. Multi-location adaptability trials
4. Development and promotion of quality planting materials
5. Nutrient optimization and upscaling of appropriate fertilization management
6. Improvement of varieties resistant to pests and diseases
7. Development and authentication of new and marketable varieties
8. Adoption/utilization and promotion of new commercial varieties
9. Development of pest and disease management protocols
10. Intensification of crop diversification and farming systems
11. Development and assessment of sustainable production management
12. Climate-resilient production systems and agroecosystems
13. Sustainable farming practices and protocols
14. Micro and macro propagation of planting materials for various priority crops
15. Precision farming and digital agriculture
16. Modernization of farm equipment, machineries, and facilities
17. Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life

18. Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming
19. Scaling processed products to expand market linkaging and commercialization
20. Development and promotion of value-added products
21. Impact assessment of adopted standards for the specific commodity
22. Identification and assessment of supply, market demand, market potential, and consumer preferences

CAPTURE FISHERIES AND AQUACULTURE:

1. Broodstock and hatchery development
2. Site assessment and resource mapping
3. Validation studies on feed formulation using low-cost feeds
4. Depuration of toxins in marine waters
5. Development of disease management strategies and protocols
6. Improvement and upgrading of the existing breeding and hatchery facilities
7. Assessment studies on inland waters and marine commodities
8. Product traceability and quality assurance system
9. Strengthening the policies for the management of catch in fisheries, especially across border marine waters

LIVESTOCK AND POULTRY:

1. Development, conservation, and propagation of superior breeds as breeding stock
2. Development of vaccines to prevent and control the spread of new and existing infectious disease
3. Enhancement of disease detection and diagnosis methods
4. Development of innovative feed processing procedures/methods to increase digestibility and bioavailability of indigenous ingredients
5. Formulation and commercialization of new and existing feed ration using indigenous feedstuff/ingredients
6. Documentation and validation of ethno-veterinary/indigenous practices of native animals
7. Enhancement of disease detection and diagnosis methods
8. Development and commercialization of market-driven meat and dairy products
9. Identification and assessment of market demand, market potential, and consumer preferences in buying meat and dairy products

Cereal Crops

Commodity industry situation

Rice

The palay production in the Philippines from 2016 to 2021 showed an increasing trend **(Figure 1)**. Even during the height of the pandemic, rice production still increased. The lowest production for this time period was in 2016 but greatly increased by 1.6 million metric tons by 2017. The low volume of production in 2016 can be attributed to the contraction of harvest areas and lower yield as a result of the El Niño Phenomenon (PSA, 2016). A similar increasing trend can also be observed when it comes to the area harvested for palay. The lowest area harvest for palay was in 2016, and a slight dip in area in 2019. Even though the highest production was observed in 2021, the highest area harvested for palay was in 2017, which is only around 6,700 hectares higher than in 2021. As for yield, it also exhibited an increasing trend from the periods covered. Similar to the volume of production and area harvested, the highest yield per hectare was also observed in 2021. The average yield per hectare in 2021 was 4.15 million metric tons. The DA attributed this increase in production to strong partnership with organized farmers' groups, LGUs, the private sector, other institutions, and rice industry stakeholders. This was also a result of an increase in resources for the rice programs, palay procurement, and irrigation services. In addition to this, there were also better technology, modern high-yielding seeds, farm machinery and equipment, and training (PNA, 2022).

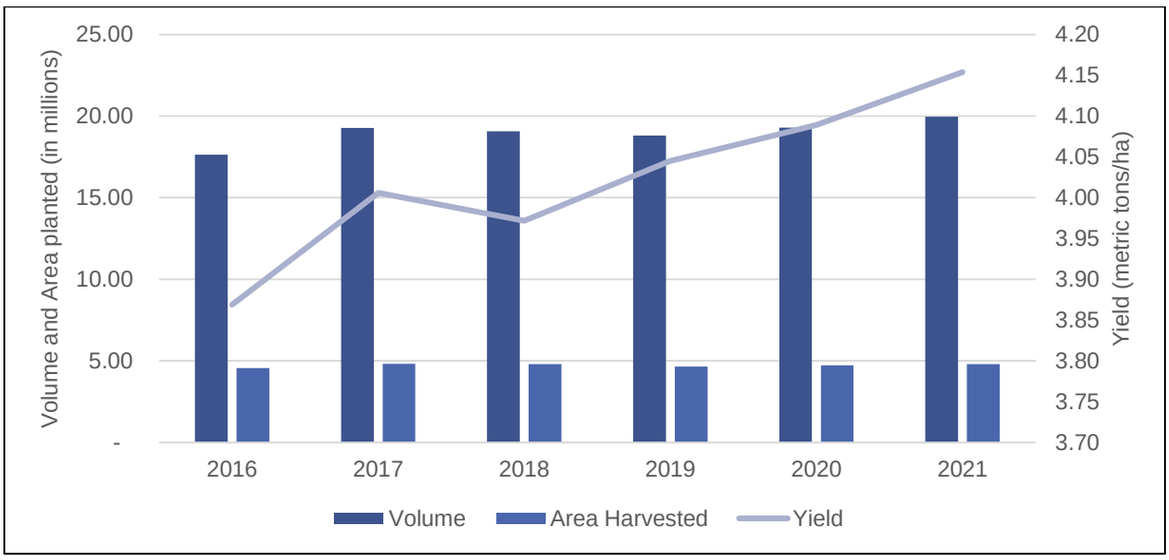


Figure 1. Rice production, area harvested and yield per year, 2016-2021
(Source: PSA)

In differentiating between different ecosystems, as expected, yield is higher in irrigated farms, compared to the rainfed farms **(Figure 2)**. The average yield from 2016 to 2021 was 4.41 tons per hectare for irrigated farms and 3.14 tons per hectare for rainfed area, with a 1.27 tons per hectare difference. Highest volume of production, area harvested, and yield for irrigated farms were all observed in 2021. While of the rainfed farms, all of the highest values were also observed in 2021, except for area harvested which was in 2017. This was similar to the overall area harvested for rice production.

In further comparing per type of ecosystem, on the average, around 76 percent of the palay came from irrigated rice farms, while 24 percent from rainfed areas. There is not much difference or no large increase in the percentage of irrigated farms was observed during the periods covered. For area harvested, on the average, around 69 percent of the area harvested for palay can be categorized as irrigated, while the rest are rainfed areas. Earlier discussion mentioned an increase in irrigation services in 2021. For the National Irrigation Administration alone, the government allotted PhP 30 billion pesos, and this contributed to

the increase in irrigation services.

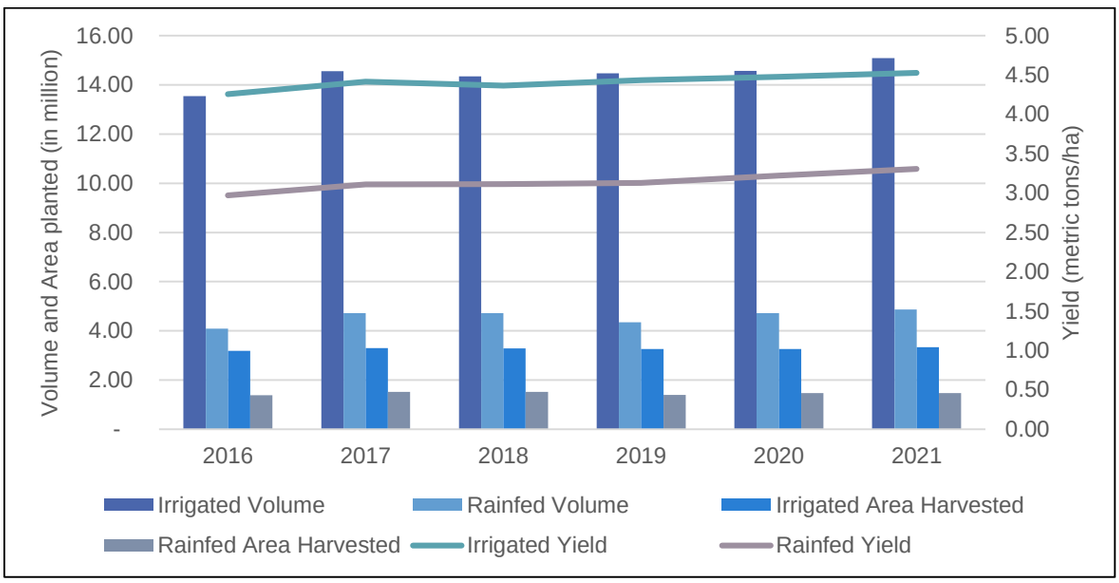


Figure 2. Annual production, area harvested and yield for rice by ecosystem, 2016-2021
(Source: PSA)

Corn

The corn production from 2016 to 2021 also shows an increasing trend **(Figure 3)**. Like rice production, lowest production year was observed in 2016, with the similar reason, which is decrease in harvested area and the El Niño Phenomenon. They were able to bounce back and increased the production by 0.6 million metric tons in 2017. In 2018, production slightly declined due to damages caused by typhoon Ompong affecting 214,546 hectares of corn farms (Ilagan, et. al, 2022), but continues to increase in 2019 to 2021.

There is not much difference when it comes to area harvested for corn from 2016-2021. The lowest area harvested was observed in 2016 with 2.48 million hectares and the highest was in 2021 with 2.5 million hectares, showing only around 80,000 hectare difference and a 65 percent average growth rate. But despite this, the corn yield still shows an increasing trend. The highest yield was observed in 2021 with 8.29 metric tons per hectare. This is 1.07 metric ton per hectare higher than average yield in 2016. Contributory to these increases is the pour of resources for corn programs. In 2021, the DA spent PhP 1.5 billion for the Philippines' corn program. Similar to rice production, there were also better technologies utilized and trainings provided to these corn farmers (PNA, 2022).

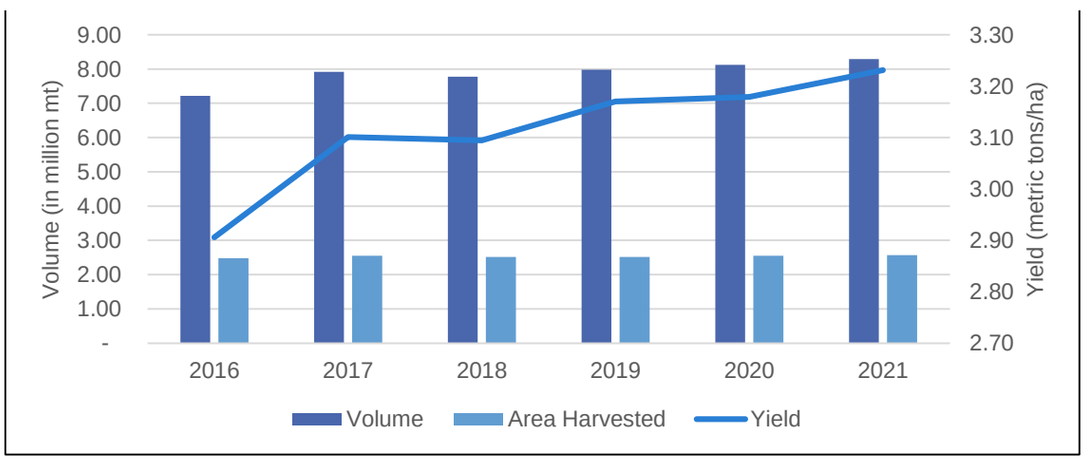


Figure 3. Annual production, area harvested and yield of corn per year, 2016-2021
(Source: PSA)

Majority of the corn produced in the Philippines is yellow corn **(Figure 4)**. On the average, from 2016 to 2021 production data, 73 percent of the produced corn is yellow corn, while 27 percent is white corn. Similar to the general trend, highest production for yellow corn was observed in 2021, with 6.04 million metric tons produced. The lowest production year was 2016 with 5.1 million metric tons, having a 0.85 million metric ton difference. For white corn, 2021 was noted the highest production (2.24 million metric tons), but with only 0.22 million metric ton difference with the lowest production year, which was once again 2016.

Yellow corn is mostly used for animal feed and white corn mainly for food consumption. Around 74 percent of the yellow corn produced are used for feed (Ilagan, et al., 2022). Since there is a higher demand for yellow corn, more than half or 56 percent of the area harvested for corn is yellow corn.

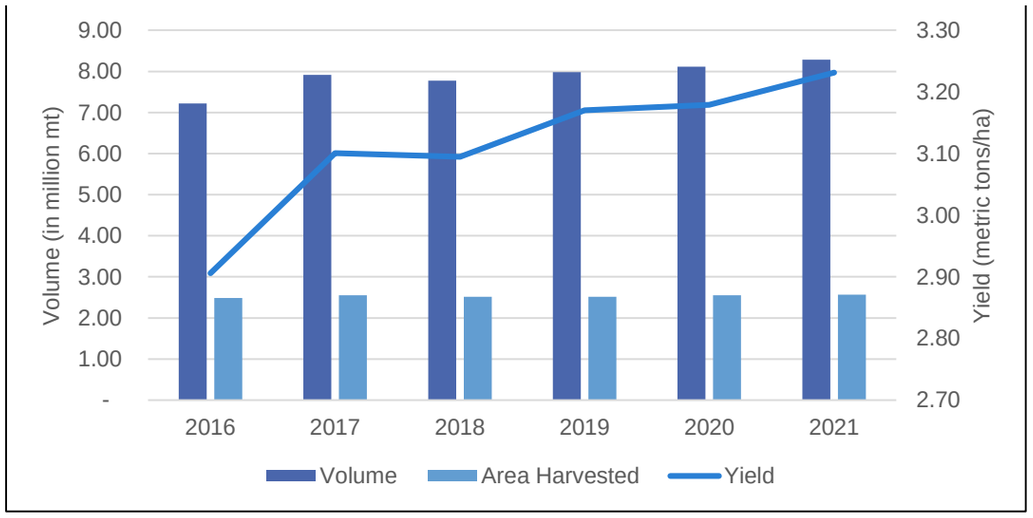


Figure 4. Annual production, area harvested and yield for corn per year, per type of corn, 2016-2021
(Source: PSA)

Other Cereals

Based on the data of PSA for agricultural commodities, only data on sorghum can be collected from the other cereal commodity group. Compared to rice and corn, the average production of sorghum from 2016 to 2021 is only 583.19 metric tons. **Figure 5** shows a decreasing trend from production, area harvested and yield. Unlike rice and corn, the highest volume of sorghum produced was observed in 2016. The total production for this year was 616.08 metric tons. The lowest volume was observed in 2020 with only 560.81 metric tons produced. The highest area harvested for sorghum was also observed in 2016 with 122.18 hectares and slowly declined to 101.80 hectares in 2018 as the lowest area harvested. Despite the highs and lows in production and area harvested for sorghum, only its yield showed a slightly increasing trend, but the average growth rate was only 4 percent.

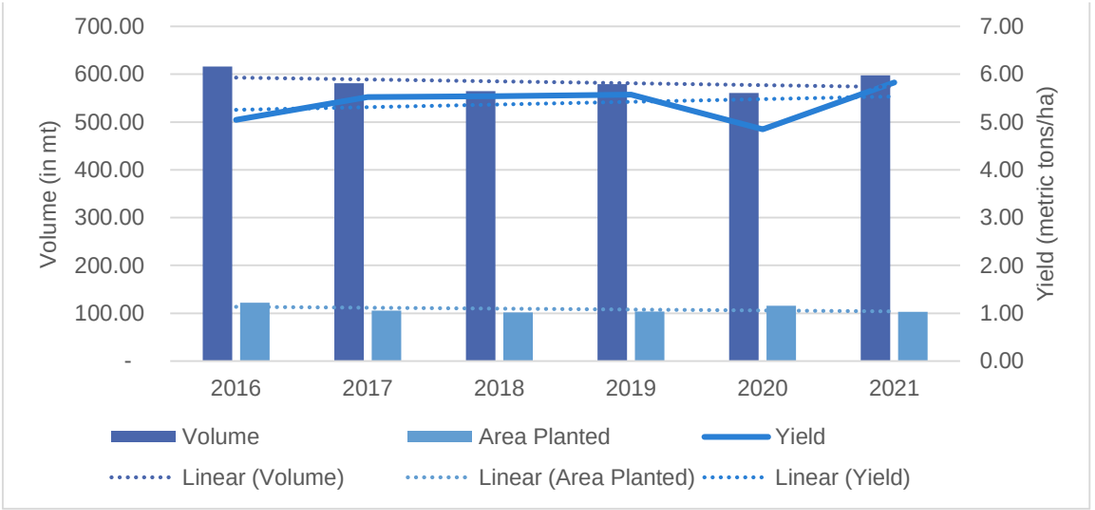


Figure 5. Annual production, area harvested and yield for corn per year, 2016-2021
(Source: PSA)

Performance outlook and key production areas in the Philippines

Rice

Regions in the Philippines produce different commodities that are compatible in their respective areas. From 2016 to 2021, the average rice production in the Philippines is 19 million metric tons. Competing as the top rice producing regions are regions II, III, and VI. These three regions already represent 44 percent of the total rice production in the Philippines from 2016 to 2021. Highest producing region is Region III or Central Luzon with 19 percent of the total rice production. This is then followed by Region II (Cagayan Valley) with 14 percent and Region VI (Western Visayas) with 11 percent. Central Luzon alone was able to produce 3.74 million metric tons of palay in 2021. These three regions also represent the top regions with the highest area harvested for rice. They represent 41 percent of the total area harvested for palay in the Philippines, which is 4.72 million hectares, with Central Luzon covering 15 percent. When it comes to yield, the average for the period covered is 4.02 metric tons per hectare. Central Luzon (5.02 mt/ha) is still at the top for the highest yielding region followed by Northern Mindanao (4.62 mt/ha), which are both higher than the general average. Third in the list is Bicol Region (3.69 mt/ha) which is already below the national average. Northern Mindanao and Bicol Region are both not included on the top regions for production and area harvested. In comparison, the average yield of the top producing areas are 4.45 metric tons per hectare for Cagayan Valley and 3.39 metric tons per hectare for Western Visayas. From the list of top producing regions, many provinces under these regions have hybrid rice farmers that produces higher yields. These provinces include Cagayan and Isabela in region II, Nueva Ecija and Tarlac in region III, and Iloilo in Region VI.

In differentiating them per type of ecosystem, the average production from irrigated rice farms is 14.43 million metric tons from 2016 to 2021. On the average, the top producing regions are Central Luzon (23%), Cagayan Valley (17%), and Ilocos Region (9%). These three regions already represent almost half or 49 percent of the total production from irrigated rice. As for area harvested, the average area harvested for the periods covered is 3.27 million hectares. Most of these are harvested from Central Luzon (20%), Cagayan Valley (16%), and Western Visayas (9%). Highest yielding regions for irrigated rice was Central Luzon (5.11 mt/ha), Northern Mindanao (4.76 mt/ha), and Ilocos Region (4.72 mt/ha). Central Luzon and Ilocos are both included in the top producing regions. For palay produced from rainfed rice farms, the average production for the periods coverage is 4.58 million metric tons and 24 percent of this came from Western Visayas, and 11 percent each from ARMM and Ilocos. On the average, the highest yielding region for rainfed rice is also Central Luzon (4.04 mt/ha), even though it is not included in the regions with the highest production and area harvested. This is followed by Ilocos Region (4.02 mt/ha) and Northern Mindanao (3.63 mt/ha).

The Philippine rice production faces several challenges when it comes to productivity. Based on the study conducted by Mataia et al. (2020) that surveyed the top 20 producing provinces, the following are the production constraints faced by rice famers: low yield, high production cost, inadequate water supply, climate change, limited drying and storage facilities, mismatch with farmer's preference and available high-quality variety seeds, pest and diseases, low adoption of new crop management technologies, low access to low cost credit and crop insurance, and unstable price specifically for fresh paddy resulting in low rice farm income.

Corn

The Philippines produces a lot of corn since this is second to rice as a staple food. The average corn production in the Philippines from 2016 to 2021 was 7.88 million metric tons. More than half or 54 percent of the produced corn belongs to the top three regions which are Cagayan (23%), Northern Mindanao (17%) and SOCCSKSARGEN (15%). Cagayan Valley alone was able to produce 1.89 million metric tons of palay in 2021. These three also represents the top 3 regions for the largest area harvested for corn which is 47 percent of the total area planted. As for yield, the national average from 2016 to 2021 is 3.11 metric tons per hectare and the top yielding regions have higher yields than this average. Their average yields are 5.88 metric tons per hectare for Ilocos Region, 5.75 metric tons per hectare for Central Luzon, and 4.30 metric tons per hectare for Cagayan Valley.

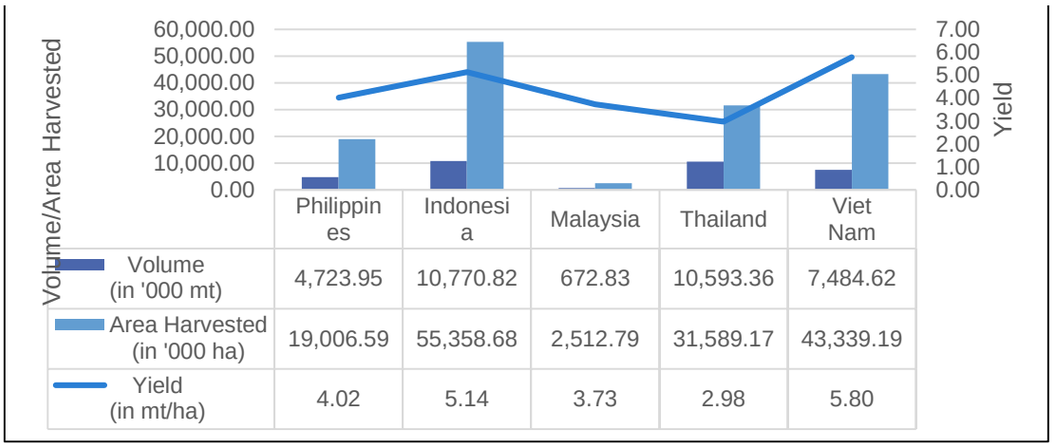
When looking at the two types of corn, the average white corn production from 2016 to 2021 is 2.12 million metric tons. Twenty-three percent of this came from Northern Mindanao, while 22 percent and 10 percent came from ARMM and SOCCSKSARGEN, respectively. As for area harvested for white corn, the national average harvested yield for the periods covered is 1.14 million hectares. Seventeen percent of this is from Northern Mindanao, followed by 16 percent from ARMM and 13 percent from Central Visayas. This could be explained by the fact that white corn is mostly consumed in Visayas and Mindanao. In terms of yield, the national average for white corn is 1.86 metric tons per hectares. Top yielding regions are Ilocos Region (3.75 mt/ha), Central Luzon (3.22 mt/ha), and Cagayan Valley (2.87 mt/ha).

As for yellow corn, the average production per year from 2016 to 2021 is 5.77 million metric tons. Most of this corn is produced from Cagayan Valley (31%), SOCCSKSARGEN (16%), and Northern Mindanao (14%). These regions area also the areas with most yellow corn harvested. Of the 1.39 million hectares harvested for yellow corn, on the average, 29 percent was in Cagayan Valley, 20 percent from SOCCSKSARGEN, and 13 percent in Northern Mindanao. Yellow corn has higher national average yields compared to white corn which is 4.15 metric tons per hectare. The high yielding regions are Central Luzon (6.56 mt/ha), Ilocos Region (6/20 mt/ha), and Cagayan Valley (4.43 mt/ha).

Corn production also faced a lot of production challenges. Based on the Philippine Yellow Corn Industry Roadmap 2021-2040, these include natural calamities like El Niño and typhoons, weather patterns, and its impact on crop produce and grain quality, dependence on and high costs of imported inputs, pest and diseases (corn borer and corn downy mildew, fall armyworm, corn leafhoppers, Fusarium ear rot, and bacterial stalk rot to name a few), and mechanization.

Comparison with selected Southeast Asian countries

Looking at the Philippines' rice performance in Southeast Asia, the Philippines is fourth among the selected countries shown in **Figure 6**. The highest producing country is Indonesia with an average of 10.77 million metric tons from 2016 to 2021. Philippines is fourth behind Thailand and Viet Nam.



	Philippines	Indonesia	Malaysia	Thailand	Viet Nam
Volume (in '000 mt)	4,723.95	10,770.82	672.83	10,593.36	7,484.62
Area Harvested (in '000 ha)	19,006.59	55,358.68	2,512.79	31,589.17	43,339.19
Yield (in mt/ha)	4.02	5.14	3.73	2.98	5.80

Figure 6. Average volume, area planted, and yield of selected Asian countries, 2016-2022

(Source: PSA)

Comparing the area harvested for palay, Indonesia still has the highest area harvested but yields are higher in Viet Nam. Considering that the difference between the area harvested between Indonesia and Viet Nam, other Southeast Asian countries has a lot to improve when it comes to yield. Philippines is still fourth when it comes to area harvested and yield.

Value of Production

The value of production from the agriculture sector is composed of the value from crops, livestock, poultry and fisheries and other commodities. For this section, only data from rice and corn will be discussed due to unavailability of data for other cereals. The average value of production from agriculture in 2016 to 2021 is PhP 1.78 trillion. Of this, 19 percent is from palay and 6 percent from corn. These two commodities alone amount to PhP 450 billion in 2021. Looking at **Figure 7**, highest value was observed in 2018 for palay and 2021 for corn, the lowest can be observed in 2016 for both rice and corn.

Rice and corn combined accounted for 44 percent of the total value of production of crops and 24 percent of the agriculture and fisheries, at current prices. On the average (2016-2021), this amounts to PhP 436 billion. In 2021 alone, this amounts to PhP 450 billion. At current prices, the highest value of production for rice was observed in 2018 with PhP 385 billion, while the lowest was in 2016 with PhP 305 billion pesos. As for the value of production of corn, highest value was observed in 2021 that amounted to PhP 118 billion. The lowest was in 2016 amounting to only PhP 85 billion.

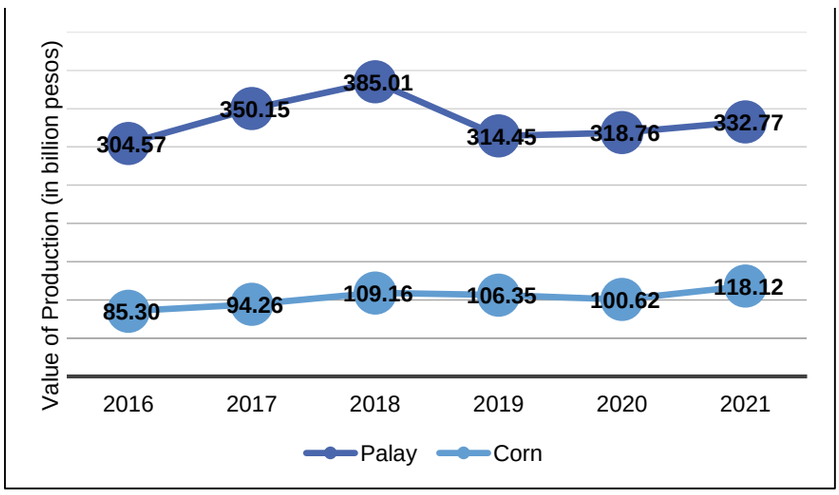


Figure 7. Value of rice and corn production, at current prices, 2016-2021

(Source: PSA)

Looking at the production value at constant prices will give a better comparison per year. Using constant 2018 prices, the year with the highest value of production is 2021 amounting to PhP 404 billion pesos **(Figure 8)**. This result is consistent with the year with the highest volume of production, which is also 2021. And similar again to the volume of production, the lowest value was also observed in 2016 amounting to PhP 356 billion. As for corn, similar pattern is observed since the highest value was also in 2021 (PhP 117 billion), and the lowest as also in 2016 (PhP 102 billion).

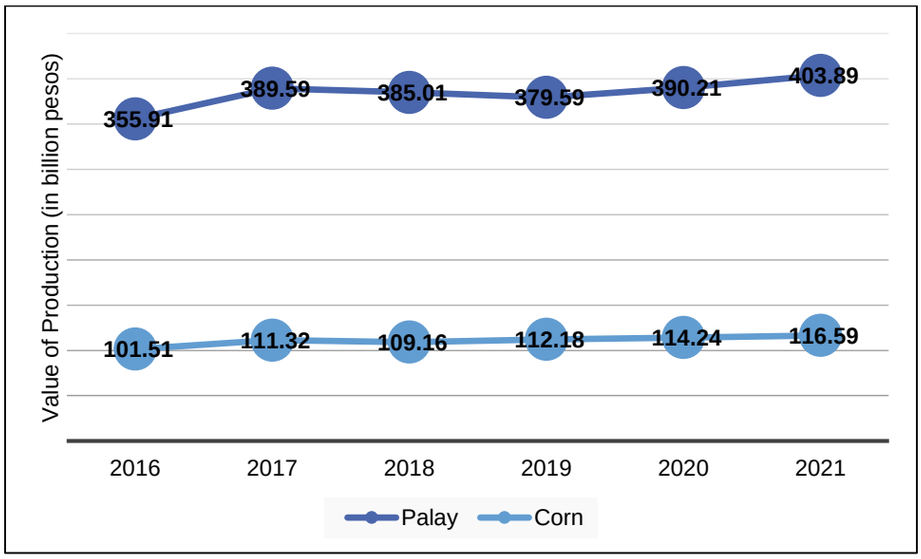


Figure 8. Value of rice and corn production, at constant 2018 prices, 2016-2021
(Source: PSA)

Economic importance

The Gross Value Added or GVA for agriculture, forestry, and fishing (SFF) is composed of different sectors, and palay, corn, and other cereal crops are included in agricultural crops. The GVA of rice and corn at current and at constant 2018 prices have an increasing trend. The GVA of rice at current prices in 2016 was PhP 299 billion and increase to PhP 346 billion in 2021. As for corn, it also increased from PhP 76 billion in 2016 to PhP 104 billion. But when comparing the percentage share of rice and corn from the GVA in AFF from 2016 to 2021, the share of rice is declining, compared to corn which is slightly increasing **(Figure 9)**. In 2016, rice percent share was at 19 percent and declined to 18 percent in 2021.

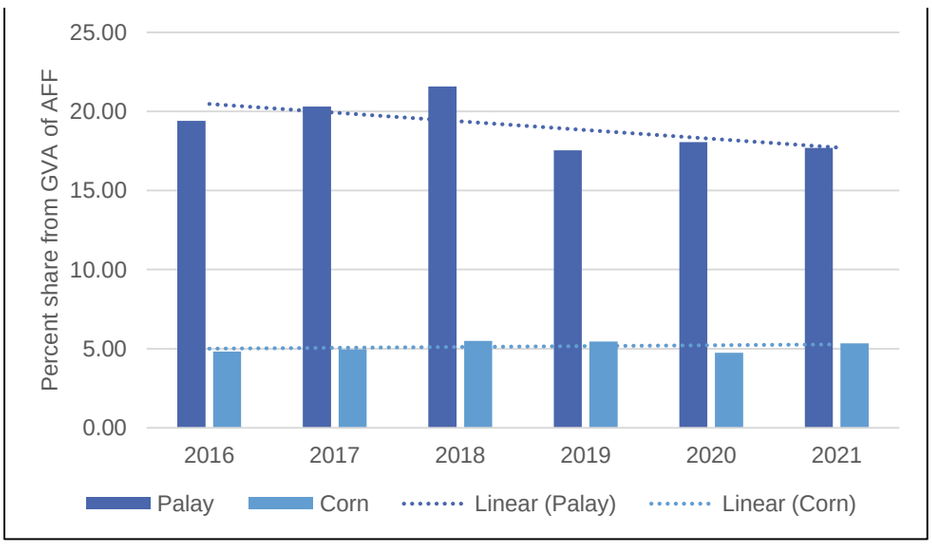


Figure 9. Percent share of palay and corn from the GVA of AFF, at current prices, 2016-2021
(Source: PSA)

Using GVA at constant 2018 price, the trend is still similar to the current prices. Decreasing trend can be observed at the percent share of palay, while a slightly increasing trend for corn **(Figure 10)**. Compared to the current prices, palay share in GVA in AFF increased but by only 0.07 percent. As for corn, it also only increased by 0.51 percent.

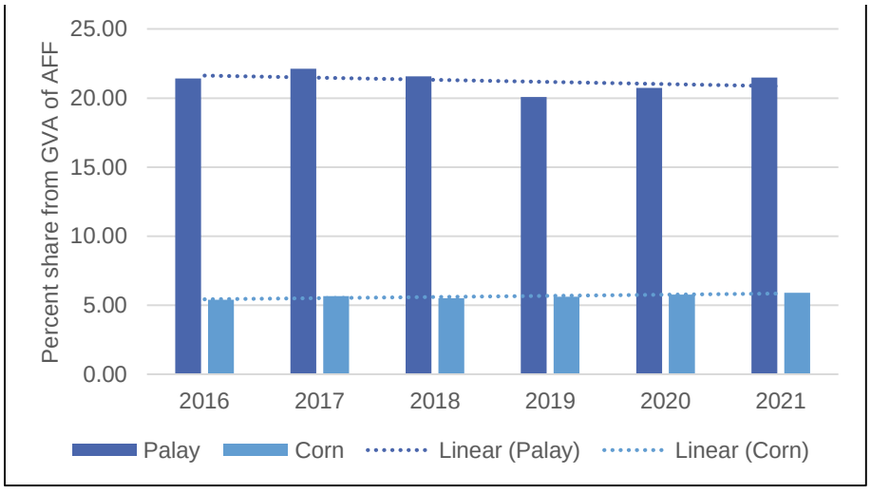
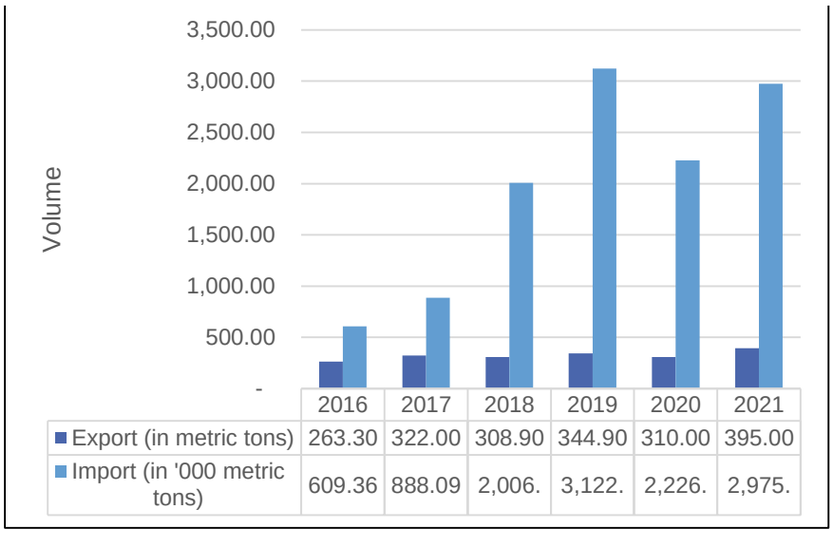


Figure 10. Gross Value Added of palay and corn, at constant 2018 prices, 2016-2021
(Source: PSA)

Export and Import

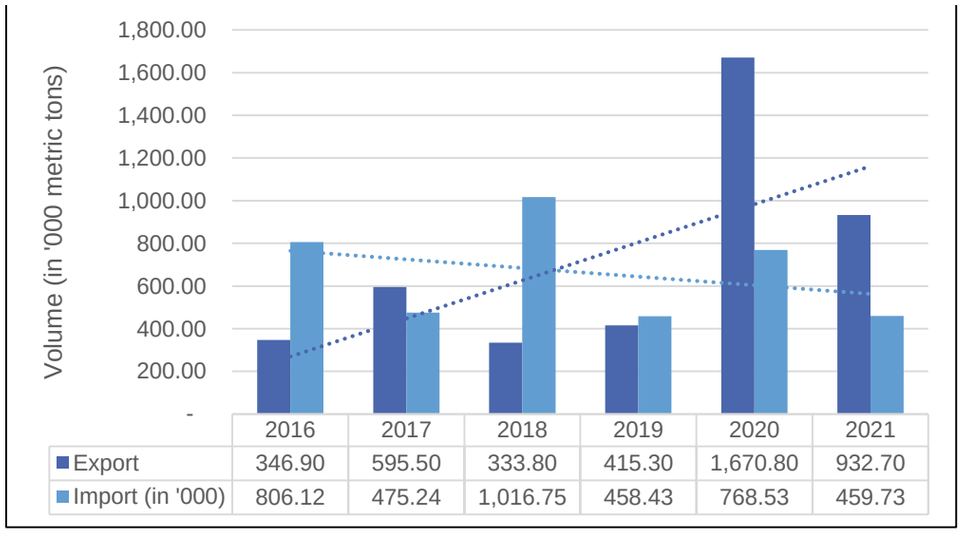
To support its growing population, the Philippines imports, on the average, is 1.97 million metric tons of palay per year. In 2019 alone, imported palay was 3.12 million metric tons, which was also the largest importation for the period covered **(Figure 11)**. Even though the highest volume of production of the Philippines was in 2021, it still imported 2.98 million metric tons more than the 2020 values. The Philippines mainly imports palay, but it also exports a small volume. In 2016, the Philippines exported 0.26 metric tons of palay and increased to 0.40 million metric tons in 2021, which is also the highest volume exported for the period covered. This amounted to PhP 29.42 million. As for imports, the 3.12 million metric tons from 2021 amounted to PhP 55.90 billion. Rice is third of the top imported agricultural commodity in 2021.



	2016	2017	2018	2019	2020	2021
Export (in metric tons)	263.30	322.00	308.90	344.90	310.00	395.00
Import (in '000 metric tons)	609.36	888.09	2,006.	3,122.	2,226.	2,975.

Figure 11. Gross Value Added of palay and corn, at constant 2018 prices, 2016-2021
(Source: PSA)

For this period, opposing trends can be observed for the import and export volumes of corn **(Figure 12)**. Overall trend for export is increase, while its the opposite for import. In 2020, the export of corn skyrocketed in 2020, amounting to 1,670.80 million metric tons. That was 1,255.50 metric tons more than its 2019 values. As for imports, though the overall trend is decreasing, there was still a large increase in 2018, and it is the highest for this period. In 2021, the value of the corn import was PhP 7.70 billion, and the value of corn export was PhP 150.42 million.



	2016	2017	2018	2019	2020	2021
Export	346.90	595.50	333.80	415.30	1,670.80	932.70
Import (in '000)	806.12	475.24	1,016.75	458.43	768.53	459.73

Figure 12. Volume of corn imported and exported, 2016-2021
(Source: PSA)

All the wheat that is used for food in the Philippines is imported and because of this, this is the top imported commodity in the Philippines from 2016 to 2021. Largest import year was 2019 with 7.21 million metric tons, amounting to $ 1.67 billion. Volume of wheat imported, including spelt and Meslin, from 2016 to 2021 is shown in **Figure 13**.

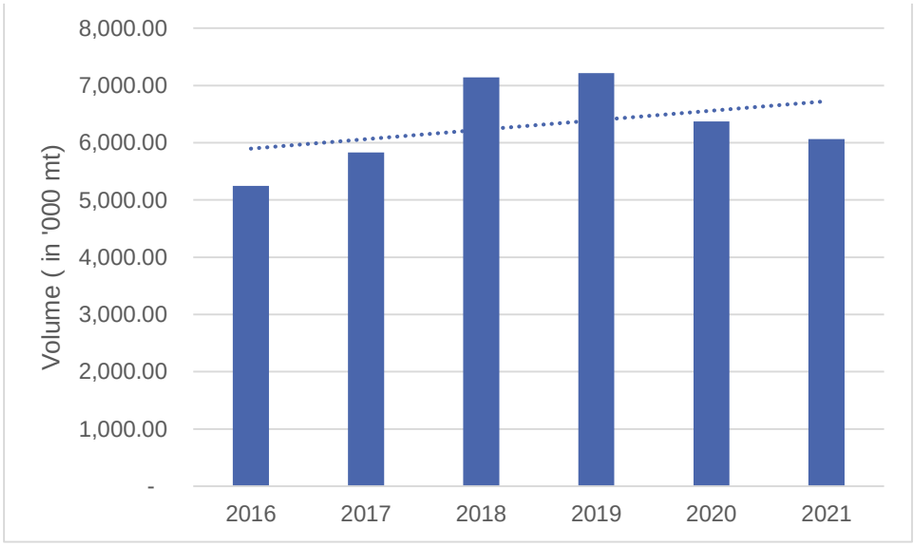


Figure 13. Volume of wheat (including Spelt) and Meslin imported, 2016-2021
(Source: PSA)

Priority Research Areas

Rice

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of varieties (breeding, crop physiology, crop protection, grain quality)	inbred, hybrid, rainfed, lowland, transplanted, direct seeded rice, irrigated, upland, high yielding potential tolerance to biotic (pest and diseases, emerging diseases, rice varieties with resistance to tungro and bacterial blight) abiotic stresses and resilient to climate change(droughts, salinity, submergence) with good grain and eating quality (lower amylose content) short and medium maturing (depending on ecosystem) crop physiology (system and resource use efficiency and cost-reducing) special purpose (rice varieties with beta carotene, antioxidant levels, pigmented rice, aromatic, glutinous, etc.)	DA-PhilRice, DA-CBC, DA-BPI, DA-RFOs, UPLB, SUCs
2023	Germplasm management and utilization	collection, maintenance, characterization, pre-breeding products	DA-PhilRice, SUCs
2024-25	Enhancement/improvement of rice seed system	rice seed delivery system enhanced/improved	DA-PhilRice, DA-BPI, SUCs
2024-25	Developing techniques as potential tools for screening rice seeds and recommended feasible in the SOP of screening quarantined seeds	tools for screening rice seeds developed	DA-PhilRice, BPI
2024-25	Assessment of water quality in Small-scale Irrigation System (SSIS) for rice irrigation and other agricultural uses	water quality assessment of the SSIS	DA-BSWM, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement of the cultivation techniques/management/ production system for increasing cost and resource efficiency under different rice ecosystem (identification of yield limiting factors and narrowing of yield gap)	crop establishment (soil and ecosystem) nutrient (soil, plant requirement, inorganic and organic, biofertilizers) water management (optimization of crop management system for all ecosystems, mitigation of GHG emissions) appropriate rice-based cropping system (climatic type) decision-aided tools (RCM, Palay Check, mapping of MOET deficient areas) mechanization and cultural management specific to ecosystem	DA-RFOs, SUCs, private sector
2023	Adoption and enhancement of existing production machineries (across ecosystem)	land preparation, seeding, transplanting, weeding, and harvesting machineries adopted and enhanced	DA-PhilMech, DA-PhilRice, DA-RFOs, SUCs, AMMDA, machine developers
2023	Upscaling and enhancement of the inter-commodity system of rice and other crop, fisheries, and livestock	identification of areas suitable for inter-commodity system of rice diversification of other crops, poultry and fisheries (commodities such as high value crop, duck, fresh-water shrimp, mud crab, or fresh-water fishes)	DA-RFOs, LGUs
2023	Crop Protection	pest management for rice fall armyworm	DA-PhilRice, SUCs, private sector
2024-25	Crop Protection	weed management (mechanization and land preparation, weed shift) insect pests (BPH, emerging pest like rice black bug, green leaf hopper, fall army worm, bio control, biocontrol agents, biopesticides) pathogens (*Magnaporthe oryzea* Avirulence (AVR) gene-based diagnosis platform, biocontrol agents, biopesticides) cropping system management	DA-RFOs, SUCs, private sector
2024-25	Precision and digital farming	smart sensors for irrigations and drones for fertilizer and pesticide application and spraying developed laser levelling enhanced	DA-PhilRice, NGOs
2024-25	Development of appropriate, technically feasible and socially acceptable production machineries (across ecosystems)	developed production machineries utilization of open-systems agricultural machinery for the manufacture of customized, locally-made and low-cost farm machineries	DA-PhilMech, DA-PhilRice, AMMDA, DA-RFOs, SUCs, machine developers

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement/Enhancement of the postharvest machinery adaptability for resiliency to climate change	Resilient and adaptable machineries	DA-PhilMech, UPLB AMTEC, DA-PhilRice, and other machinery developers
2023	Development of machines for value-adding, product development	developed machines for value-adding, product development	DA-PhilMech, DA-PhilRice, machinery developers
2024-25	Development of appropriate product standards for locally produced rice	product standards	DA-BAFS
2024-25	Development/enhancement of value-added rice products	value-added rice products developed/ enhanced (e.g., rice flour)	DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of enterprises on commercial utilization of rice by-products (i.e., carbonized rice hull, charcoal briquette, as substrate for mushroom production)	enterprises developed business plans and models for the commercial utilization of the rice by-products	DA-PhilRice, DA-RFOs, LGUs, private sector

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development and enhancement of food and non-food rice by-products	developed/enhanced rice nutraceuticals products (e.g., rice bran phospholipids for use in nano liposomal technologies)	DA-RFOs, SUCs
2026-28	Non-food rice by-products	developed non-food rice by-products (e.g., seed priming agent, cosmeceuticals, and hygiene products, etc.)	DA-RFOs, SUCs

OTHERS - SOCIO-ECONOMICS AND POLICY			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Impact assessment of production related products and technologies	precision and digital farming assessed	DA-PhilRice, SUCs, with private sector (ICT companies)
2023	Impact assessment of production related products and technologies	Solar Powered Irrigation and Fertigation System (SPFS) assessed	DA-BSWM, DA-RFOs, SUCs, NGOs, private sector
2023	Impact assessment of production related products and technologies	upland and lowland rice production assessed (i.e., irrigated highlands)	DA-PhilRice, SUCs, NGOs
2023	Impact assessment of production related	decision support tools assessed (e.g., Rice Crop Manager [RCM], inorganic-organic fertilizers, soil	DA-PhilRice, SUCs, NGOs

OTHERS - SOCIO-ECONOMICS AND POLICY			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	products and technologies	ameliorants, foliar fertilizers, biological control agents)	
2023	Assessment on the adoption of newly released varieties and technologies	rice varieties and technologies assessed	DA-PhilRice, SUCs, NGOs
2023	Assessment of rice intervention approaches	community-based participatory breeding	DA-PhilRice, SUCs
2023	Impact assessment of rice related programs	integration of RCM/PRISM/SARAI	DA-PhilRice, SUCs, with private sector (ICT companies)
2023	Assessment of irrigation facilities	irrigation policy innovations in the design of SSIS	DA-BSWM, NIA, SUCs, NGOs
2023	Iron fortified rice use study	socio-economic study on perception and adoption of iron fortified rice	DA-PhilRice, SUCs
2024-25	Assessment of rice intervention approaches	cluster farming assessed	DA-PhilRice, SUCs
2024-25	Impact assessment of production related products and technologies	Alternate Wetting and Drying (AWD) strategy for rice technology promotion models and approaches	SUCs, NGOs
2024-25	Assessment of seed system (formal and informal)	utilization of certified rice seeds	DA-BPI, DA-PhilRice, SUCs
2024-25	Assessment of rice-based agro-ecosystem	rice-based agro-ecosystem assessed productivity and profitability analysis of inter-commodity system of rice and crop and non-crop commodity	DA-PhilRice, SUCs, NGOs
2024-25	Policy studies related to rice	integration of Comprehensive Land Use Plan (CLUP) and protected areas	SUCs, NGOs
2024-25	Land reform	land reform relative to rice competitiveness	SUCs, NGOs
2024-25	Socio-economic evaluation of a mechanized farming system	mechanized farming system assessed (e.g., transplanter, harvester, pesticide and fertilizer applicator, irrigation, fertigation, etc.)	DA-PhilRice, DA-PhilMech, UPLB, SUCs
2026-28	Assessment of rice-based Cooperatives	rice-based cooperatives assessed	DA-PhilRice, SUCs, NGOs
2026-28	Marketing studies for rice product developed	newly developed rice products assessed rice crop insurance program implementation assessed	DA-PhilRice, SUCs, NGOs

Corn

INPUT			
Period	**Researchab.e Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development/improvement of management strategies for fall armyworm (FAW) and other emerging/resurging pests and diseases	developed/improved pests and disease management recommendations	DA-BPI, DA-RFOs, SUCs
2023	Improvement of white corn varieties (yield and other agronomic traits, nutritional quality, etc.)	identified genes for specific quality/traits improved white corn varieties	DA-BPI, DA-CBC, DA-RFOs, SUCs
2024-25	Improvement of corn varieties for resistance/tolerance to biotic and abiotic stress	identified genes with resistance/tolerance to stresses improved corn varieties	DA-BPI, DA-CBC, DA-RFOs, SUCs
2024-25	Evaluation of soil health and balanced nutrient management strategies	soil health enhancement POTs and nutrient management recommendations developed alternative fertilizer sources	DA RFOs, SUCs
2024-25	Development of alternative cost-effective fertilizers and other soil amendments	alternative fertilizer and soil amendments	DA RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Community-based participatory seed selection to improve traditional corn varieties	seed selection protocol	DA-RFOs, SUCs
2024-25	Intensification, diversification and integration of corn-based farming systems	recommended package of technologies (POTs) under corn-based farming systems	DA-RFOs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Evaluation of rapid detection kits for corn postharvest pathogens	policy recommendations recommended rapid detection kit for specific corn pathogens	DA RFOs, NCPC-UPLB, IWEP-UPLB
2024-25	Assessment of protocols on storage and packaging technologies for white corn	recommended storage and packaging technologies	DA-PhilMech, DA-RFOs, PHTRC-UPLB
2024-25	Development and/or processing of corn products (food and feed)	new and improved corn products	DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Consumer acceptability and/or demand studies for corn and corn products	location-specific products preferred by consumers information on corn products for further development policy recommendations	SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development and utilization of corn by-products (waste-to-energy, biochar, alternative fertilizer source, mushroom production medium, etc.)	new and improved corn by-products	DA-RFOs, SUCs

Other Cereal Crops

INPUT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	quinoa, grain sorghum	Germplasm collection, characterization, and purification	Identified varieties with good yielding abilities	DA-RFOs, UPLB, SUCs
2023	adlay	Improvement and evaluation of adlay seed production and seed system strategies	seed production strategies	DA-PhilRice, DA-RFOs, SUCs
2023	adlay	Development of adlay varieties for organic production system	organic adlay varieties	DA-PhilRice, DA-RFOs, SUCs
2024-25	adlay	Improvement of adlay production management protocol	production protocol	DA-PhilRice, DA-RFOs, SUCs
2024-25	adlay	Evaluation of adlay varieties for NSIC registration	list of adlay varieties for registration seed system strategy	DA-PhilRice, DA-RFOs, SUCs
2026-28	millet, wheat	Multi-location Adaptability Trial for Millet and wheat	Millet and wheat seeds tested	SUCs

PRODUCTION				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	wheat, other cereal crops	Improvement of new varieties against biotic and abiotic stresses; development of	Developed new varieties	SUCs

PRODUCTION				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		varieties adapted to tropical conditions		
2023	quinoa, grain sorghum	Adaptation to different growing environments	Identified varieties with good yielding abilities under different planting time, elevation and planting environments	DA-RFOs, UPLB, SUCs
2023	adlay	Improvement of adlay varieties against biotic and abiotic stresses	resistant/tolerant adlay varieties	DA-PhilRice, DA-RFOs, SUCs
2024-25	adlay	Evaluation of existing adlay best cultural management practices	best cultural management practices	DA-PhilRice, DA-RFOs, SUCs
2024-25	adlay	Evaluation of adlay varieties for GAP certification	GAP-certified adlay varieties	DA-BPI, DA-RFOs, SUCs
2026-28	quinoa, grain sorghum	Strategic deployment to end-user	Demonstration trials	DA-RFOs, UPLB, SUCs
2026-28	adlay	Evaluation and improvement of adlay ratooning practices	improved adlay ratooning practices	DA-RFOs, SUCs

POSTHARVEST AND PROCESSING				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	other cereal crops	Development of postharvest and processing related technologies	1. Conduct of R4D in new Mechanization technology 2. Utilization of renewable energy for postharvest and processing 3. Consolidation of available of Technology on prolonging shelf life of products	DA-PhilMech, SUCs
2024-25	adlay	Evaluation of performance of existing adlay postharvest machines	AMTEC-certified adlay machines	DA-RFOs, DA-PhilMech, AMTEC-UPLB
2024-25	adlay	Evaluation of aflatoxin content of stored milled adlay	aflatoxin content	DA-BPI, DA-PhilRice, DA-RFOs
2024-25	adlay	Evaluation of developed adlay	adlay food by-product	DA-RFOs

POSTHARVEST AND PROCESSING				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		food by-product for commercialization		

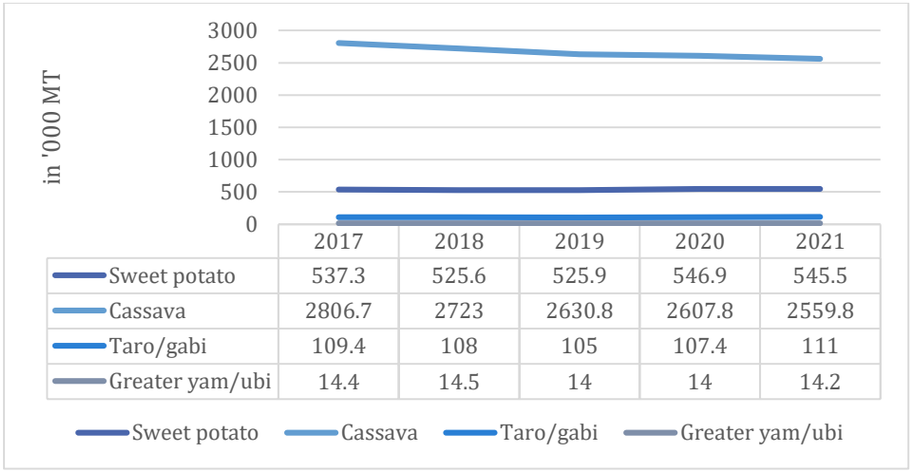
MARKETING				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	adlay	Value chain analysis of adlay	adlay value chain analyzed supply chain of adlay analyzed	DA-PhilRice, DA-RFOs
2024-25	adlay	Evaluation of consumer's acceptability of adlay as important staple food	evaluated acceptability of adlay as important staple food	DA-PhilRice, DA-RFOs
2026-28	quinoa, grain sorghum	Marketing	Identification of marketing strategies; profitability and income	DA-RFOs, UPLB, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	adlay	Value chain analysis of adlay	adlay value chain analyzed supply chain of adlay analyzed	DA-PhilRice, DA-RFOs

Root crops

Commodity industry situation, performance outlook, and economic importance

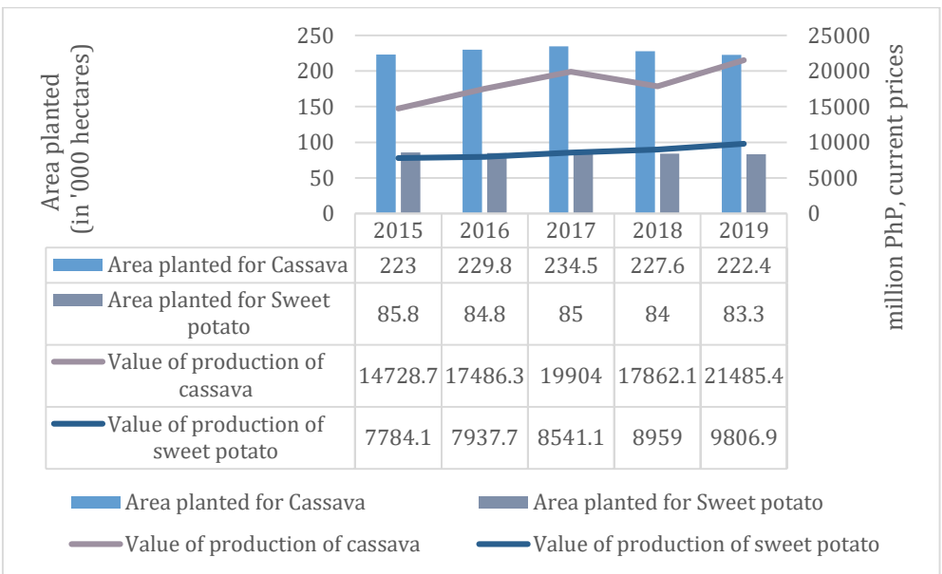
Root crops are important staple crops for Filipinos. They are well adapted to the soil of the country, and they are good sources of carbohydrates. Among the root crops in the country, the priorities are sweet potato/camote, cassava, taro/gabi, and greater yam/ubi. From 2016 to 2021, production for these crops seem to stay constant or decreased only slightly **(Figure 14)**. Among the priority root crops of the country, cassava consistently has the highest production followed by sweet potato. Cassava is one of the staple foods of Filipinos. Aside from consumption, cassava is utilized in the production of feeds and other industrial products. It provides livelihood to approximately hundreds of thousands of Filipino families.



	2017	2018	2019	2020	2021
Sweet potato	537.3	525.6	525.9	546.9	545.5
Cassava	2806.7	2723	2630.8	2607.8	2559.8
Taro/gabi	109.4	108	105	107.4	111
Greater yam/ubi	14.4	14.5	14	14	14.2

Figure 14. Volume of production of root crops, 2017-2021
(Source: PSA)

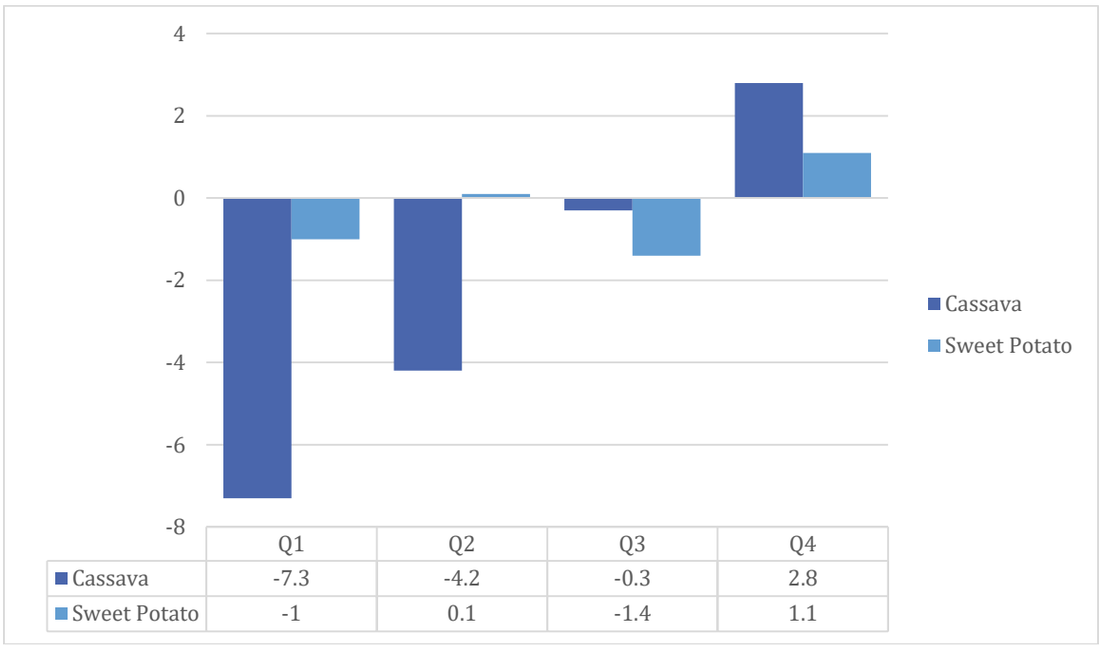
With regards to area planted/harvested and value of production, not much has been written about taro and ubi. As for cassava and sweet potato, a slight change can be observed in their area planted as well as value of production. The value of sweet potato continues to expand. Cassava, on the other hand, experienced an increase from 2015 to 2017, a decline in 2018, and an increase again in value in 2019.



	2015	2016	2017	2018	2019
Area planted for Cassava	223	229.8	234.5	227.6	222.4
Area planted for Sweet potato	85.8	84.8	85	84	83.3
Value of production of cassava	14728.7	17486.3	19904	17862.1	21485.4
Value of production of sweet potato	7784.1	7937.7	8541.1	8959	9806.9

Figure 15. Area planted and value of production, in current prices, 2015-2019
(Source: PSA)

An expansion can be seen in the value of cassava from Q1 to Q4 of 2020-2021. From -7.3 growth rate in Q1, its growth rate increased to 2.8 at the end of Q4. As for sweet potato, value of production has been fluctuating all year round **(Figure 16)**.



	Q1	Q2	Q3	Q4
Cassava	-7.3	-4.2	-0.3	2.8
Sweet Potato	-1	0.1	-1.4	1.1

Figure 16. Growth rates of value of cassava and sweet potato, Q1 to Q4, 2020-2021
(Source: PSA)

The growth in the value of cassava can be seen in **Figure 17**. Value of production, in constant 2018 prices, can be seen increasing from Q1 to Q4 of 2020 to 2021.

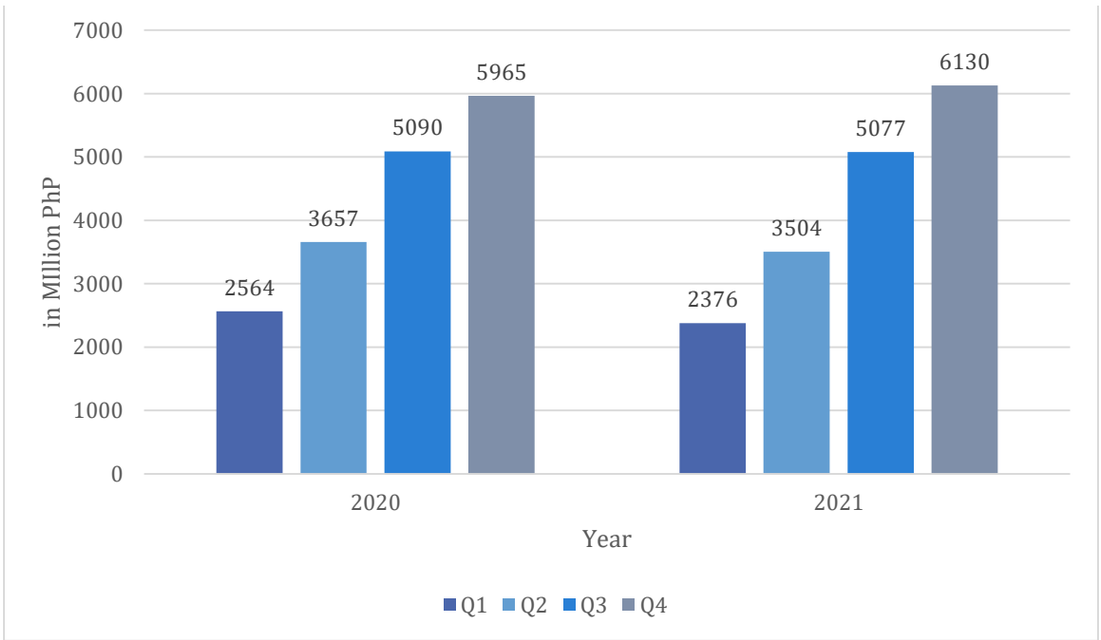


Figure 17. Value of production of cassava at constant 2018 prices, 2020-2021
(Source: PSA)

In contrast, value of production of sweet potato has been fluctuating from Q1 to Q4. Value of production, in constant prices, is highest in Q2 for both years. This can be linked to the time of planting of farmers.

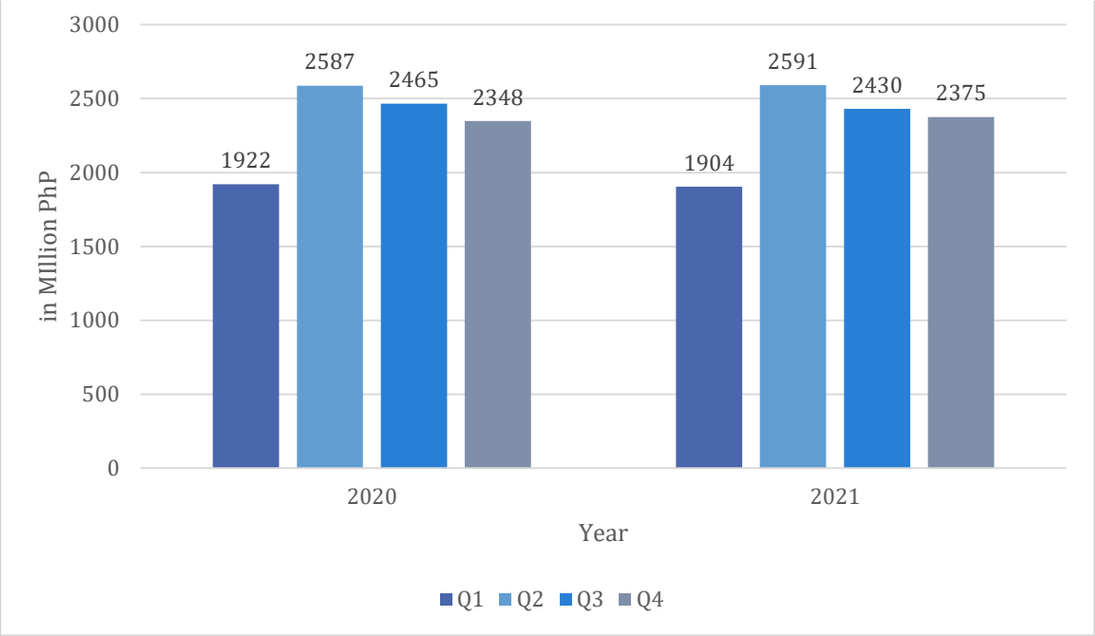


Figure 18. Value of production of sweet potato at constant 2018 prices, 2020-2021 (Source: PSA)

Priority Research Areas

Cassava

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development/improvement of varieties for desired traits	Varieties with high yield, high starch content, high nutraceuticals content, and/or resistance/ tolerance to biotic and abiotic stresses	DA-BPI, SUCs
2024-25	Development of quality planting materials	Protocol on propagation of quality planting materials	DA-RFOs, DA-ATI, VSU, TAU, SUCs
2024-25	Development of quality planting materials	Effective pre-planting treatments technologies	DA-BPI, SUCs
2024-25	Multi-location adaptability trials	Varieties for different agro-climatic conditions/ agro-ecosystems	DA-RFOs, DA-BPI, UPLB, VSU, SUCs
2024-25	Genetic resources conservation and management	Active germplasm collections	DA-RFOs, DA-BPI, SUCs

PRODUCTION			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Modernization of farm equipment, machineries, and facilities	Appropriate harvesting machineries (digger, harvester, etc.)	DA-RFOs, DA-PhilMech, SSC, SUCs
2023	Development/Improvement of pest and disease management protocol	IPM components/ protocols for cassava (insect pests, weeds, diseases, rodents)	DA-RFOs, SUCs
2023	Development of pest and disease detection/management protocol	Survey, forecasting models, and early warning systems on emerging pests and diseases	DA-RFOs, DA-BPI, SUCs
2024-25	Nutrient optimization and upscaling of appropriate fertilization management	Site-specific nutrient management, policy recommendation for scaling	DA-RFOs, DA-BSWM, SUCs
2024-25	Intensification of crop diversification and farming systems	Farming systems for sloping areas	DA-RFOs, DA-BPI, SUCs
2024-25	Intensification of crop diversification and farming systems	Information on cassava farming practices, production POT for different agroecosystems	DA-RFOs, DA-BPI, SUCs
2024-25	Development of pest and disease detection/management protocol	Rapid detection techniques for emerging diseases	DA-BPI, SUCs
2024-25	Development of pest and disease detection/management protocol	Cassava IPM	DA-RFOs, DA-BPI, SUCs
2024-25	Climate-resilient production systems and agroecosystems	Production POT for specific agro-climatic/ agroecosystem	DA-RFOs, DA-BSWM, SUCs
2024-25	Improvement of field cultural practices	Appropriate cultural practices for optimum root	DA-RFOs, SUCs

PRODUCTION			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
		production and leaf utilization for food and feeds	

POSTHARVEST AND PROCESSING			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Modernization of processing equipment, machineries, and facilities	Appropriate processing machineries (granulator, slicer, dryer, etc.)	DA-RFOs, DA-PhilMech, SUCs
2023	Development of proper postharvest treatment protocols and facilities	Processing technologies for removal/reduction in cyanide content of cassava roots and leaves	DA-RFOs, SUCs
2024-25	Development/Refinement of processing protocols and facilities for cassava-based products	Cassava-based biodiesel, bioethanol, etc.	DA-PhilMech, SUCs
2024-25	Development of proper postharvest treatment and processing protocols and facilities	Alternative drying technologies and materials for cassava chips	DA-RFOs, SUCs
2024-26	Development of proper postharvest treatment protocols and facilities	Information on cyanide and nutritional content of value-added products	DA-RFOs, SUCs
2024-25	Scaling processed products to expand market linkages and commercialization	Developed products from cassava leaves and roots for food and feeds	DA-RFOs, SUCs
2026-28	Development of proper postharvest treatment protocols and facilities	Postharvest techniques/ practices to prolong shelf life of fresh cassava roots	DA-RFOs, SUCs
2026-28	Development of proper postharvest treatment protocols and facilities	Information and recommendations on postharvest practices	DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development/Refinement of processing protocols and facilities	Technologies for the utilization of cassava by-products and wastes	DA-RFOs, DA-BSWM, SUCs

Other Root Crops

INPUT			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Development of quality planting materials	Protocol on propagation of quality planting materials such as taro, sweet potato, yam, etc.	DA RFOs, DA-BPI, DA-ATI, TAU, VSU
2023	Development/Improvement of varieties for desired traits	Varieties with reduced fiber and increased starch content	DA-RFOs, DA-BPI, SUCs
2024-25	Development/Improvement of varieties for desired traits	Pest and diseases resistant/tolerant varieties	DA RFOs, SUCs, LGUs, DA-BPI
2024-25	Genetic resources conservation and management	Active germplasm collections	DA-RFOs, DA-BPI
2024-25	Development of pest and disease management protocols	Developed technologies for biological control and upscaling of potential biological control agents through IEC materials and capability building	DA RFOs, DA-BPI, SUCS, DA-ATI, LGUs
2024-25	Development/Improvement of varieties for desired traits	High-yielding and early-maturing varieties	DA-RFOs, DA-BPI, SUCs
2024-25	Development/Improvement of varieties for desired traits	Varieties with enhanced postharvest qualities	DA-RFOs, DA-BPI, SUCs
2024-25	Promotion of enhanced cultural management practices towards organic agriculture	Green manuring technology and recommended crops and seeds for green manuring	DA RFOs, DA-FPA, DA-BSWM, DA-ATI, SUCs, LGUs
2024-25	Multi-location adaptability trials	Sweet potato varieties for different agro-climatic/ agro-ecosystems	DA-RFOs, DA-BPI, SUCs
2026-28	Development/Improvement of varieties for desired traits	Selection of high-yielding varieties in highland areas	DA-RFOs, LGUs

PRODUCTION			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Modernization of farm equipment, machineries, and facilities	Developed/Refined machineries and equipment (planter, harvester, postharvest processing, etc.), and machine demo centers	DA-PhilMech, DA RFOs, DA-ATI, SUCs, LGUs

MARKETING			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Modernization of farm equipment, machineries, and facilities	Developed/Refined machineries and equipment (planter, harvester, postharvest processing, etc.), and machine demo centers	DA-PhilMech, DA RFOs, DA-ATI, SUCs, LGUs
2024-25	Development of sustainable production system	POT for cost-effective production	DA-RFOs, SUCs, LGUs,
2024-25	Development of sustainable production system	Enhanced productivity of aeroponics-derived purple yam	DA-RFOs, DMMMSU, SUCs
2024-25	Development of sustainable production system	Sustainable production system for indigenous root crops	DA-RFOs, DA-ATI, NCIP, SUCs, LGUs

MARKETING			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of pest and disease management technologies and protocols	Survey, forecasting models, and early warning systems on emerging pests and diseases	DA-RFOs, SUCs
2024-25	Development of pest and disease management technologies and protocols	Standardized protocols for virus detection such as PCR-based ELISA technique	DA RFOs, DA-BPI, DA-ATI, DA-FPA, SUCs
2024-25	Promotion of enhanced cultural management practices towards organic agriculture	Appropriate cropping systems	DA-RFOs, SUCs, LGUs
2024-25	Development of pest and disease management protocols	Digital tools for updated information on pests and diseases and their management	DA-RFOs, SUCs
2024-25	Development/Improvement of varieties and cultural practices for specific food products	POT for maximizing starch production	DA-RFOs, SUCs, LGUs

POSTHARVEST AND PROCESSING			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Development of proper postharvest treatments/ protocols and facilities	Postharvest and storage technologies/systems (e.g. technologies to prolong shelf-life of *Dioscorea luzonensis* and other lesser yam species, product enhancement and refinement activities based on market assessment and compliance to health and safety standards)	DA-RFOs, SUCs
2024-25	Development of pest and disease management technologies and protocols	Developed postharvest disease control measures/protocols	DA-RFOs, DA-BPI, SUCs
2024-25	Development of proper post-harvest treatments/ protocols and facilities	Efficient and cost-effective postharvest and processing machineries	DA-RFOs, DA-PhilMech, DA-ATI, and SUCs, LGUs
2024-25	Scaling processed products to expand market linkaging and commercialization	Processing technologies and processed products (e.g. detoxification technique, arrowroot processing, processing of colored sweet potato, taro/root crop flour, yam-based food products, processed products from indigenous crops such as extruded puffed snacks from composite flours of Palawan indigenous crops)	DA-RFOs, SUCs, LGUs
2024-25	Development of proper postharvest treatment protocols and facilities	Postharvest and storage technologies/systems	SUCs
2024-25	Development of proper postharvest treatment protocols and facilities	Optimized rhizome handling, storage and extraction to maximize starch recovery	DA-RFOs, SUCs

OTHERS				
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
2023	GIS-Based site suitability assessment for sweet potato production	GIS-Based suitability assessment for sweet potato production	DA-RFOs, DA-BSWM	Thematic Area 1
2023	Adoption of conservation agriculture technology in root crop agroecosystems	Information on factors affecting technology adoption	DA-RFOs, SUCs	Thematic Area 2
2023	Development of food and non-food products from root crops and exploring its potentials as superfood	Superfood value chain	DA-RFOs, SUCs, LGUs	Thematic Area 3

Vegetables and Legumes

Commodity industry situation, performance outlook, and economic importance

Garlic

Garlic production in the country shows a decreasing trend from 2016 to 2021. After a one-year increase in production from 2016 to 2017, production started decreasing at an increasing rate up to 2012. Growth rates of -2.48, -4.01, -6.74, and -12.96 was recorded in successive from 2018 to 2021. From 2016 production of 7,469 MT, production for 2021 at 5,890 MT – down by 21 percent.

The area planted to garlic also showed a decreasing trend from 2,647 hectares in 2016 to 2,425 hectares in 2021. The area planted to garlic decreased by 8.41 in the said period. Considering production and area planted, yield also showed decreasing trend. Yield increased in 2017 after which it decreased at an increasing rate.

The country is highly dependent on imports to cater to the local demand. Import dependency ratio has been consistently increasing since 2016 from 89.1 percent to 2021 at 94.1 percent. This is 5.6 percent increase (or an average of 1.12 percent increase per year).

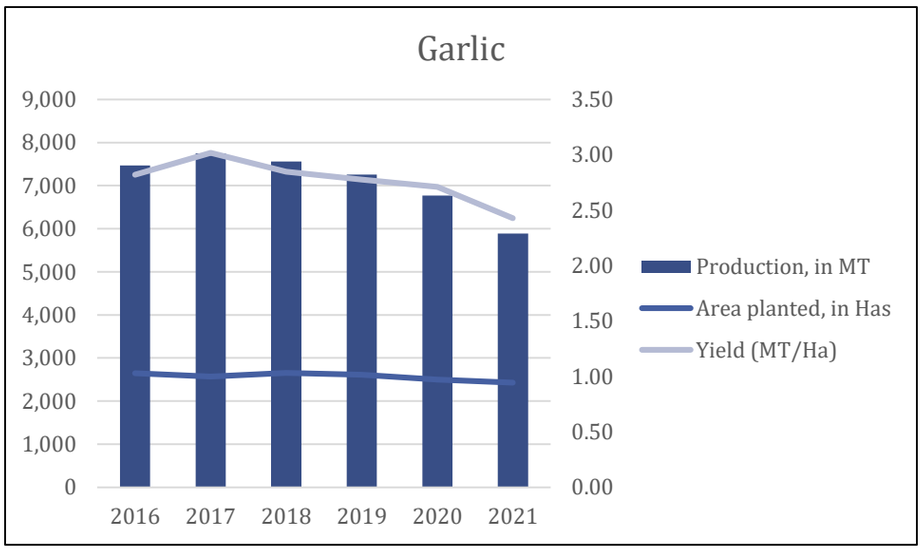


Figure 19. Production, area planted and yield of garlic in the Philippines, 2016 to 2021 (Source: PSA)

Onion

There are two types of onions produced locally—the bermuda onion and the native onion. Bermuda onion is by far the dominantly produced of two with a share of at least 71 percent in 2016 to as high as 83 percent 2019. From 2016 to 2017, onion production in the country is in a generally increasing trend. From 122,594 MT in 2016, production jumped to 218,047 MT in 2021 for a 78 percent increase (or an average of 15.6 percent per year). Most of the increase is due to the bermuda onion - the production of which more than doubled from 2016 to 2017. The year 2017 brought a massive increase in production with 50 percent increase.

This increase in onion production is complemented with the increase in area planted. From 12,988 hectares in 2016, area increased to 19,302 hectares in 2021—an increase of 66

percent or 13 percent annually. Yield also improved from 9.4 MT per hectare in 2016 to 11.3 MT per hectare in 2021.

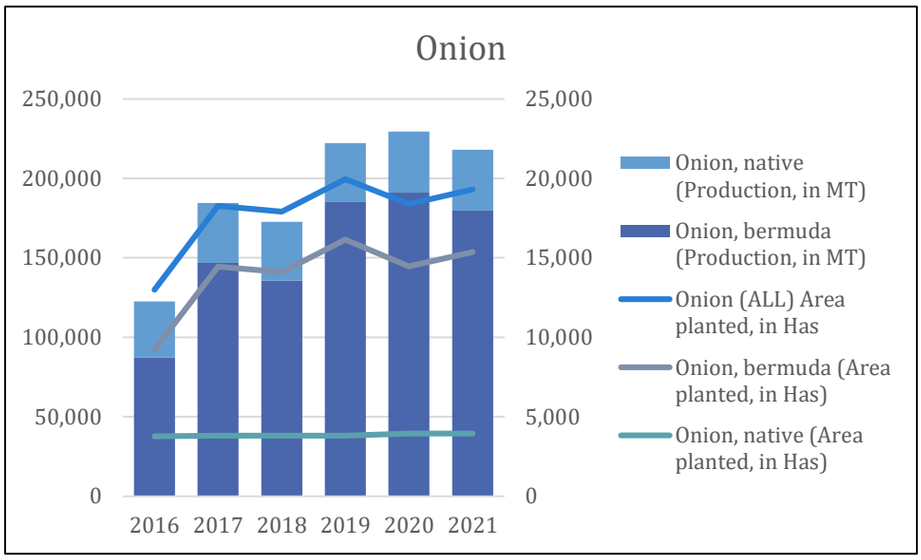


Figure 20. Production, area planted and yield of garlic in the Philippines, 2016 to 2021 (Source: PSA)

Vegetable and Legumes

The Philippines has one of the lowest vegetable consumption in the world at around 58 kg per year (FAOSTAT, 2019). Mean daily intake is 454g (15 percent of total) costing around PhP27.6 (10 percent of total) (FNRI, 2018). Despite this, the Philippines produces many types of vegetables and legumes. Generally, vegetables grown are classified as either highland or lowland.

Table 3. Different classifications of vegetables in the Philippines

Crop	PSA Major Vegetables Legume	Highland Vegetables	Low Land Vegetables	HVC (RA7900)
Asparagus				x
Bell Pepper				x
Broccoli				x
Cabbage Chinese		x		
Carrots		x		x
Cauliflower				
Celery				x
Habitchuelas		x		
Patola				x
Pole Sitao				x
Radish				x
Squash			x	
Stringbeans (Sitao)			x	
Ampalaya (Fruit)	x		x	
Cabbage	x	x		x
Cassava	x			
Eggplant	x		x	
Mung bean (Mongo)	x			

Crop	PSA Major Vegetables Legume	Highland Vegetables	Low Land Vegetables	HVC (RA7900)
Onion (Bermuda and Native)	x			
Potato	x	x		
Sweet Potato	x			
Tomato	x		x	x

Legumes

String beans (or *sitaw*) has the highest volume of production from 2016 to 2021, but production consistently decreased. Production ranged from 117,201 metric tons in 2016 down to 108,781 metric tons in 2021 (7.2 percent decrease in five years, 1.4 percent average yearly decrease). Mungbean (*mongo*) and snap beans (*Baguio beans*) are distant second and third in volume of production. Mung bean production increased by 4.2 percent (0.8 percent yearly) while snap beans decreased by 1.4 percent (0.3 percent yearly)

For area planted, mung bean has the largest in 2021 at 41,695 hectares distantly followed by area planted to string beans at 13,882 hectares and snap beans at 3,059 hectares. Area planted to mung bean and string beans has minimal increase of 0.8 percent and 0.9 percent from 2016 to 2021 while area for snap beans decreased by 2.3 percent.

Yield if consistent for Mungbean and Snap beans but decreasing for string beans. Yield for string beans dropped from 8.52 in 2016 to 7.74 in 2021.

Table 4. Volume of production (MT), area planted (Has) and yield (MT/has) of selected legumes of the Philippines, 2016 to 2021

CROP	2016	2017	2018	2019	2020	2021
Volume of production						
Mungbean/Mongo	34,039	35,341	36,664	36,248	37,036	35,482
Snap Beans/Habitchuelas / Baguio	14,389	14,151	13,950	14,029	13,421	14,183
Stringbeans	117,201	116,804	114,380	112,311	109,516	108,781
Area planted						
Mungbean/Mongo	41,349	41,933	41,581	41,728	41,853	41,695
Snap Beans/ Habitchuelas	3,131	3,150	3,103	3,093	2,974	3,059
String beans	13,754	13,939	13,907	13,915	13,912	13,882
Yield						
Mungbean/Mongo	0.82	0.84	0.88	0.87	0.88	0.85
Snap Beans/ Habitchuelas	4.60	4.49	4.50	4.54	4.51	4.64
String beans	8.52	8.38	8.22	8.07	7.87	7.84

Vegetables

Major vegetables in the country include tomato, eggplant, and squash (fruit) with production of at least 200,000 metric tons, each annually. Cabbage production around 120,000 metric tons. Except for squash, the production increased from 2016 to 2021 for the top four vegetable crops mentioned. In terms of area planted, eggplant has the largest at almost 22,000 hectares followed by tomato, squash, and bitter gourd. There was minimal change in

area planted in vegetables except for asparagus whose area decreased by 45.6 percent (9 percent per year). The yield is also consistent over the years for the major vegetables.

In terms of socio-economic of vegetable farming, Pangilinan et al. (2019) characterized two types of farmers—*pinakbet* and chopsuey. *Pinakbet* farmers grows okra, eggplant, bitter gourd (amplaya), tomatoes, pepper, and squash. These grow best in lowland areas. While chopsuey farmers plant vegetables adapted to cooler climate such as cabbage, cauliflower, beans, bell pepper, and broccoli.

Pinakbet farmers have an average age of 49 years. Average farm size is 1.04 hectares. The average household size of is five. They have a diversified income source, and the top contributor is farming. Other sources include a combination of farming and other jobs mostly classified as unskilled labor. Both parents of most farmers are farmers too. In terms of technology adoption, pinakbet farmers have difficulty in adopting specific technology and always rely on traditional methods.

Chopsuey farmer-respondents are mostly female with household size ranging from four to five members. While the farmers are female, farm labor are mostly male in addition to male and female family members of the household that participate in farming. Almost all of the surveyed chopsuey farmer-respondents have both parents engaged in farming. About technology adoption, some adopt new technology, but many are not open and unwilling to adopt innovations.

Table 5. Volume of production (MT), area planted (Has) and yield (MT/has) of selected legumes of the Philippines, 2016 to 2021

CROP	2016	2017	2018	2019	2020	2021
PRODUCTION						
Ampalaya Fruit	87,460	89,460	87,395	89,341	87,804	88,215
Asparagus	2,172	1,904	1,648	1,329	1,056	867
Broccoli	2,859	3,159	2,906	3,246	3,339	3,507
Cabbage	123,080	122,474	120,656	128,050	129,803	124,491
Carrots	65,987	65,219	64,896	65,070	63,527	64,035
Cauliflower	11,641	12,061	11,328	11,553	11,983	11,445
Celery	3,290	3,437	3,418	3,491	3,629	3,869
Eggplant	235,626	241,901	244,838	249,890	242,730	244,035
Patola	12,805	13,091	12,814	12,869	12,979	13,179
Pepper, bell	12,994	13,739	13,613	13,952	14,926	15,959
Radish	9,516	9,301	9,119	9,092	8,944	8,932
Squash Fruit	214,147	206,024	202,229	194,771	193,814	195,084
Tomato	210,720	218,793	220,825	223,294	222,002	225,451
AREA PLANTED						
Ampalaya Fruit	10,526	10,657	10,679	10,676	10,688	10,655
Asparagus	229	206	200	189	166	126
Broccoli	282	310	296	308	310	298
Cabbage	8,018	7,912	7,839	7,847	8,020	7,774
Carrots	4,607	4,606	4,531	4,551	4,430	4,393
Cauliflower	1,069	1,098	1,042	1,058	1,090	1,036
Celery	426	440	446	455	458	480
Eggplant	21,038	21,446	21,651	21,819	21,780	21,829
Patola	2,820.60	2,883.50	2,852.10	2,856.40	2,844.70	2,820.00

CROP	2016	2017	2018	2019	2020	2021
Pepper, bell	2,188	2,265	2,242	2,259	2,288	2,340
Radish	1,330	1,311	1,305	1,281	1,259	1,241
Squash Fruit	13,754	13,939	13,907	13,915	13,912	13,882
Tomato	16,197	16,491	16,494	16,360	16,448	16,404
YIELD (MT per Ha)						
Ampalaya Fruit	8.31	8.39	8.18	8.37	8.22	8.28
Asparagus	9.48	9.24	8.24	7.03	6.36	6.88
Broccoli	10.14	10.19	9.82	10.54	10.77	11.77
Cabbage	15.35	15.48	15.39	16.32	16.18	16.01
Carrots	14.32	14.16	14.32	14.30	14.34	14.58
Cauliflower	10.89	10.98	10.87	10.92	10.99	11.05
Celery	7.72	7.81	7.66	7.67	7.92	8.06
Eggplant	11.20	11.28	11.31	11.45	11.14	11.18
Patola	4.54	4.54	4.49	4.51	4.56	4.67
Pepper, bell	5.94	6.07	6.07	6.18	6.52	6.82
Radish	7.15	7.09	6.99	7.10	7.10	7.20
Squash Fruit	15.57	14.78	14.54	14.00	13.93	14.05
Tomato	13.01	13.27	13.39	13.65	13.50	13.74

Other concerns for Garlic, Onion, Vegetable, and Legumes

- High cost of labor and material inputs (i.e. seeds, fertilizers, and pesticides) in production (ADB 2022)
  - ➔ Labor cost: 52-62 percent for red onion, 48-49 percent for table tomato, 50 percent for processed tomato
  - ➔ Material inputs: 34-38 percent for red onion, 25 percent for table tomato, 30 percent for processed tomato

- High post-harvest losses (ADB 2022)
  - ➔ For freshly harvested red onion: 45 percent (48,891 tons, PHP1.96B) red onions (from Nueva Ecija to Divisoria)
  - ➔ For cold-stored red onions: 64 percent, 69,333 tons, PHP4 billion
  - ➔ For tomatoes (Nueva Ecija to Manila): 11 percent, 1,930 tons, PHP47M
  - ➔ For tomatoes Bukidnon to Manila): 24 percent, 9,928 tons, PHP180

Priority Research Areas

Garlic

INPUT			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Collection, characterization, germplasm conservation of garlic	accessible germplasm conservation of garlic	DA-BPI, DA-RFOs, SUCs
2023	Development of clean garlic planting material development of a controlled facility for propagation of planting materials	clean garlic planting material propagation technology	DA-BPI, DA-RFOs, SUCs
2023	Development/Improvement and promotion of biocontrol agents	biocontrol agents developed/improved and promoted	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Development of sustainable seed system Improvement on the bulb development of garlic using appropriate nutrient management	developed seed system for garlic improved bulb development	DA-BPI, DA-RFOs, SUCs
2023	Development/Improvement of soil amendment technologies (organic fertilizers, soil enhancers/ conditioners)	soil amendment technologies (organic fertilizers, soil enhancers/conditioners)	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Development/Improvement of recommended varieties for off season crops and protected cultivation	varieties for off-season crops and protected cultivation	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Potential expansion areas of garlic in the Philippines Assessment of yield performance and conduct of adaptability trials in new areas to expand production of garlic	GIS-based suitability mapping of garlic production in the Philippines	DA-BPI, DA-BSWM, DA-ICTS, DA-RFOs, SUCs
2023	Integrated crop management a) Survey and documentation of existing cultural management practices in the Philippines b) Development and pilot testing of good production practices and agricultural POT generated for garlic producers c) Technology upscaling of the developed package of technology d) Mechanization of labor-intensive activities e) Different spacing with improved fertilizer application for enhanced and increased productivity	documentation and analysis of cultural practices, recommendations on good production practices, upscaled POT, recommendations on plant spacing and fertilizer application	DA-BPI, DA-ATI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Development/Improvement of varieties with enhanced resistance to priority pest and diseases	pest-and-disease-resistant garlic varieties	DA-BPI, DA-RFOs, SUCs
2023	Mechanization in the production of garlic through low-cost system	developed/improved/ solar-powered irrigation, fertilizer, and pesticide application for garlic	DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement of low-cost protective structures	low cost protective structures for garlic	DA-BPI, DA-PhilMech, DA-RFOs, SUCs
2024-25	Rapid monitoring of emerging pests and diseases	results data, monitoring report of emerging pests and diseases	DA-BPI, DA-ATI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Areas**	**Expected Output**	**Possible Implementing Agency**
2023	Development/Improvement of appropriate postharvest and storage technologies and systems Postharvest treatment using non-hazardous methods; optimization of storage conditions	Developed/improved postharvest treatments; optimized storage conditions; postharvest treatment	DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement of appropriate postharvest and storage technologies and systems Development of village type post-harvest facilities	baseline information on postharvest handling; postharvest and storage technologies; postharvest and storage systems	DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement varieties and cultural practices for enhanced postharvest quality	documentation and analysis of cultural practices; improved varieties	DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement and technology upscaling of processing technologies and processed products on garlic Technology upscaling of the developed garlic-based products	processed products and upscaled technologies	DA-BAFS, DA-RFOs, SUCs
2024-25	Development/Improvement of varieties and cultural practices for specific food products	garlic food products; documentation and analysis of cultural practices; varieties	DA-BPI, DA-FDC, DA-RFOs, SUCs

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
2024-25	Risk assessment studies on heavy metals, pesticides, antibiotic, and other contaminants	food safety studies	DA-BAFS, DA-FDC, DA-RFOs, SUCs	Thematic Area 1

Onion

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development/Improvement and promotion of biocontrol agents Development and formulation of broad spectrum biopesticide through screening of microbial collections against OAW and FAW	biopesticide and biocontrol agents developed and formulated	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Development/Improvement of soil amendment technologies (organic fertilizers, soil enhancers/ conditioners)	soil amendment technologies (organic fertilizers, soil enhancers/conditioners)	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Development of sustainable seed system Development of Shallot seed system to eliminate virus diseases common in asexually propagated shallot	developed seed system	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Potential expansion areas of onion in the Philippines a) Adaptability of Onion Production; Onion Production Technology Promotion b) Suitability maps	Adaptability result (growth, survival and yield), Production Technology, GIS-based suitability maps	DA-BPI, DA-BSWM, DA-ICTS, SUCs
2023	Integrated crop management a) Yield performance assessment for increased onion production b) Development of technologies aligned to GAP standards	documentation and analysis of cultural practices; recommendation on good production practices;	DA-BPI, DA-ATI, DA-RFOs, SUCs
2023	Development/Improvement of varieties with enhanced resistance to priority pest and diseases Seasonal postharvest migration and ecology of *Spodoptera* species for possible onion armyworm management controls	developed new improve and resistant varieties of onion; pest management	DA-BPI, DA-ATI, DA-RFOs, SUCs
2023	Integrated crop management Mechanization of labor-intensive activities (Irrigation support and small machinery pool in major growing areas)	developed solar-powered irrigation, fertilizer, and pesticide application	DA-BPI, DA-ATI, DA-RFOs, SUCs
2024-25	Development/Improvement of low-cost protective structures	low cost protective structures and suitable structure design	DA-BPI, DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement of recommended varieties for off season crops and protected	developed off-season varieties	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	cultivation Development of White Onion varieties with long shelf life		
2024-25	Rapid monitoring of emerging pests and diseases including use of biosensors	documentation or information on emerging pest and diseases, monitoring report of emerging pests and diseases	DA-BPI, DA-ATI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development/Improvement of appropriate postharvest handling and storage techniques and systems for onion and shallot shelf-life prolongation	Developed/improved postharvest treatments; optimized storage conditions; postharvest treatment	DA-BPI, DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement varieties and cultural practices for enhanced postharvest quality	documentation and analysis of cultural practices; improved varieties	DA-PhilMech, DA-RFOs, SUCs
2024-25	Development/Improvement and technology upscaling of processing technologies and processed products on onion	POT on processing and processed products on onion; upscaled technologies on onion	DA-BAFS, DA-RFOs, SUCs
2024-25	Development/Improvement of varieties and cultural practices for specific food products	onion food products, varieties, documentation and analysis of cultural practices	DA-BPI, DA-FDC, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Risk assessment studies on heavy metals, pesticides, antibiotic, and other contaminants	Food safety studies	DA-BAFS, DA-FDC, DA-RFOs, SUCs

Vegetables and Legumes

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Upscaling of open-pollinated and inbred varieties of vegetables	upscaled open-pollinated varieties for vegetables	DA-BPI, DA-RFOs, SUCs
2023	Development/Improvement and promotion of biocontrol agents	biocontrol agents developed/improved and promoted	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Development of sustainable seed system and conservation of traditional varieties	developed seed system for vegetables and legumes	DA-BPI, DA-RFOs, SUCs
2023	Collection, characterization, and germplasm conservation of pinakbet and indigenous vegetables a) Enhance plant genetic	Germplasm collection from underrepresented provinces; available and viable pinakbet and indigenous vegetables ready for utilization; pinakbet and indigenous	DA-BPI, DA-RFOs, SUCs

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	resources (PGR) collection, characterization and evaluation (native and traditional) pinakbet and indigenous vegetables b) Agriculture technology for sustainable intensification legume production and conservation of traditional & heirloom varieties & species c) Collection, improvement, gene banking, and utilization transformation of underutilized crops and leguminous species	germplasm information for utilization; pinakbet and indigenous vegetables profile/database; tangible agritech for production and conservation of traditional/heirloom varieties and species	
2023	Development/Improvement and promotion of soil amendment technologies (organic fertilizers/concoctions, soil enhancers/ conditioners) a) Performance of selected vegetables (e.g., pechay) to different combinations of media *(volcanic ash, vermicompost, and sand)* b) Improvement of Black Soldier Fly rearing for increased compost and biomass production c) Development and utilization of biofertilizer and biopesticide for vegetable production	soil amendment technologies (organic fertilizers, soil enhancers/conditioners)	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Potential expansion areas of vegetables and legumes in the Philippines (benchmarking study, enhance availability of seeds) a) Upscaling of mungbean varieties for potential production areas b) Suitability maps (compare with DA's national color-coded agricultural guide map) c) Location specific varieties in the region	upscaled mungbean varieties, developed GIS-based suitability maps, developed location-specific varieties *(tie up with supply chain studies)*	DA-BPI, DA-BSWM, DA-ICTS, DA-RFOs, SUCs
2026-28	Identification of locally-adapted progenitors for seed production	documentation and information on locally adapted progenitors identified	DA-BPI, DA-RFOs, SUCs
2026-28	Improvement of local legume varieties *(ex. mutation breeding of red peanut)*	improved local legume varieties	DA-BPI, DA-RFOs, SUCs
2026-28	Genetic improvement of tomato varieties through targeted gene editing	improved tomato varieties through targeted gene editing	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Potential expansion areas of vegetables and legumes in the Philippines (benchmarking study, enhance availability of seeds) a) Upscaling of mungbean varieties for potential production areas b) Suitability maps (compare with DA's national color-coded agricultural guide map) c) Location specific varieties in the region	upscaled mungbean varieties, developed GIS-based suitability maps, developed location-specific varieties *(tie up with supply chain studies)*	DA-BPI, DA-BSWM, DA-ICTS, DA-RFOs, SUCs
2023	Upscaling of selected technologies for Integrated Crop Management and Integrated Pest Management a) POT for new varieties of vegetables and legumes b) Diversity and Severity of Solanaceous Crops in Selected Vegetable Areas in Bicol Region c) green manuring technology d) Conservation agriculture in vegetable agroecosystems e) Development of good agricultural practices for pest management for vegetables and legumes	upscaled technologies for integrated crop management and integrated pest management	DA-BPI, DA-ATI, DA-RFOs, SUCs
2023	Mechanization in the production of highland and lowland vegetables through low-cost system through SMART Agriculture Optimization of solar-powered irrigation, fertilizer, and pesticide application	developed solar-powered irrigation, fertilizer, and pesticide application	DA-BPI, DA-RFOs (some will collaborate with NIA), SUCs
2023	Upscaling of selected technologies for Integrated Pest Management Development of good agricultural practices for pest management for vegetables and legumes	upscaled pest and disease management technologies, Good Agricultural Practices for pest management	DA-BPI, DA-RFOs, SUCs
2024-25	Development/Improvement of low-cost protective structures	low cost protective structures and suitable structure design	DA-BPI, DA-PhilMech, DA-RFOs, SUCs
2024-25	Off-season production system (varieties, protected cultivation, and indoor farming)	developed/improved off-season varieties and POT on Cultural Management	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development/Improvement of recommended practices for off-season crops and protected cultivation including grafting technology	developed/improved recommended practices for off-season crops	DA-BPI, DA-RFOs, SUCs
2024-25	Expansion of plant-based protein sources (indigenous legume crops/varieties and processing, legume cropping system with other crops)	plant-based protein sources	DA-RFOs, SUCs
2024-25	Integrated crop management under different production systems (e.g. urban agriculture, organic farming) a) Utilization and upscaling of effective and efficient vegetable production technologies in highly urbanized places (i.e., Vertical farming, square foot gardening) b) Yield Performance of Different Varieties of Selected PINAKBET Vegetables Grown Organically c) Mechanization of labor-intensive activities d) Development and promotion of best practices for integrated cash crop backyard gardening e) Evaluation of cultural practices to enhance adaptive capability of crops	upscaling of vegetables production technologies in highly urbanized places, analysis of the yield performance on vegetables, developed best practices for integrated cash crops backyard gardening, cultural practices evaluated	DA-BPI, DA-NUPAP, DA-ATI, DA-RFOs, SUCs
2024-25	Integrated pest and disease management a) Development/Improvement of pest and disease-resistant varieties and disease control/elimination methods b) Development of mobile application for pest detection of pinakbet vegetables c) Monitoring of emerging pests and diseases	developed/improved pest and disease resistant varieties and disease control methods, mobile application for pest detection developed, monitoring of emerging pest and diseases developed/improved	DA-BPI, DA-RFOs, SUCs
2024-25	Development/Promotion of climate resilient varieties a) Development/Promotion of floating garden for all-season weather especially areas that are prone to flooding b) Development of climate-resilient eggplant varieties	climate-resilient varieties on vegetables and legumes developed/promoted	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	c) Climate resilient vegetable production in AMIA villages		

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Scaling processed products to expand market linkaging and commercialization of Rosselle	Improved process/value addition technology	DA-RFOs, SUCs
2024-25	Assessment and improvement of vegetable marketing systems and strategies Increasing vegetable consumption (consumption determinants, promotion strategies, packaging, preparation, processing)	documentation and analysis on vegetable market systems and strategies	DA-PhilMech, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Risk assessment studies of vegetables on heavy metals, pesticides, antibiotic, and other contaminants	Food safety studies	DA-BAFS, DA-FDC, DA-RFOs, SUCs

Fruits

Commodity industry situation

Banana

Philippines is a major producer of banana with an average annual production of 9,122 thousand MT from 2016 to 2021 **(Figure 21)**. There are four main varieties of banana that is being cultivated in the country: cavendish, saba, latundan, and lakatan. Among these varieties, the banana cavendish, which is mainly for export, accounts for about 51 percent of the banana production. It was followed by banana saba, which is mainly processed into banana chips for local and international markets, with 28 percent share; banana lakatan, which is mainly consumed as fresh fruit, with 10 percent share; and the remaining 11 percent for production of banana latundan, bungulan, and other varieties.

In terms of area planted, minimal expansion can be seen over the last five years. From 442.0 thousand hectares in 2016, the area planted with banana has slightly expanded to 450.4 thousand hectares in 2021.

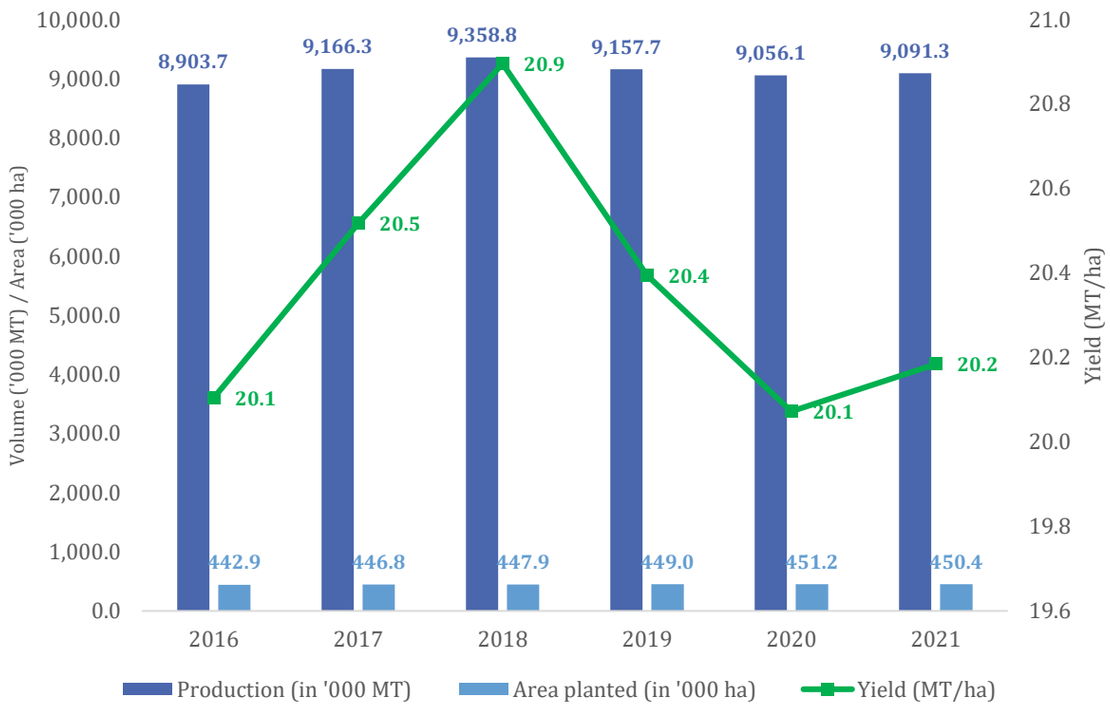


Figure 21. Volume of production, area planted, and yield of banana, 2016-2021
(Source: PSA)

Mango

Mango is widely cultivated in the Philippines with two main varieties—carabao mango and piko. Over the last five years, mango production showed a decreasing trend at a rate of 1.7 percent. **Figure 22** shows that from 814 thousand MT in 2016, mango production dropped to 742 thousand MT in 2021. Similar scenario can be observed in terms of area planted. Area devoted to mango has decreased from 187.8 thousand hectares in 2016 to 185.9 thousand hectares in 2021. As a result, yield of mango exhibited the same downward pattern.

Figure 22. Volume of production, area planted, and yield of mango, 2016-2021
(Source: PSA)

Pineapple

Philippines remains the second largest producer and exporter of pineapple in the world in 2021 (FAOSTAT). The country's pineapple industry is largely dominated by two multinational companies, i.e., the Del Monte Philippines, Inc. and Dole Philippines. As can be seen in **Figure 23**, pineapple production has been increasing since 2016 but at a slow pace. On the average, annual production of pineapple was recorded at 2.72 million MT with an annual increase of 1.9 percent. There has also been a minimal expansion in the area planted with pineapples from 65.2 thousand hectares in 2016 to 67.1 thousand hectares in 2021. Consequently, pineapple yield followed an uptrend with a 2.5 MT/ha increase from 2016 to 2021.

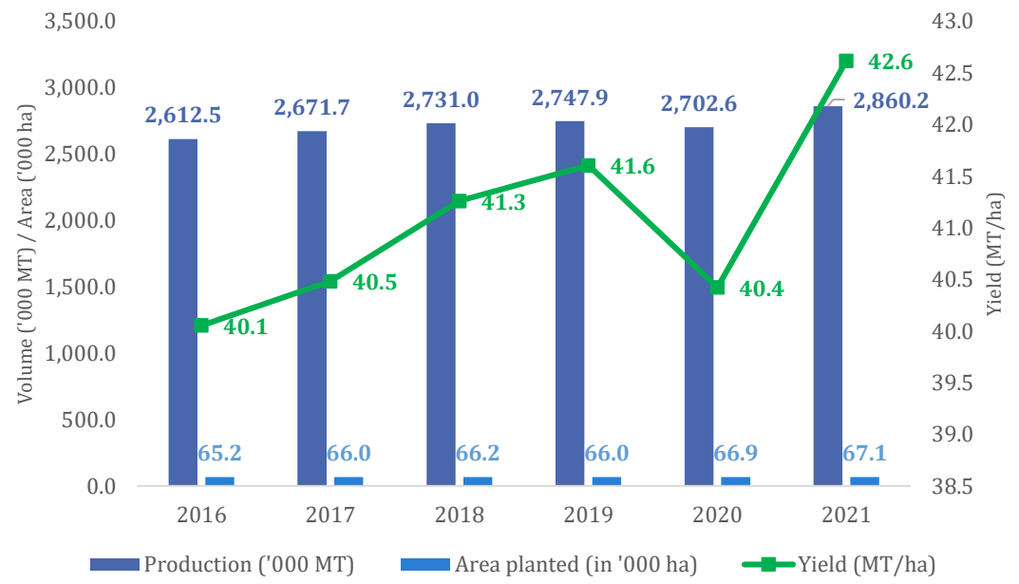


Figure 23. Volume of production, area planted, and yield of pineapple, 2016-2021
(Source: PSA)

Economic Importance

Contribution to Agriculture, Forestry and Fishing Sector's Gross Value-Added (AFF GVA) and Gross Domestic Product (GDP)

Among the three major fruit crops, banana has the highest gross value added (GVA) amounting to PhP 134,773 million in 2021 **(Table 6)**. It was followed by mango with GVA of PhP 34,513 million and pineapple with PhP 29,091 million during the same year. Meanwhile, it can be seen from Figure 24 that pineapple and banana followed the general uptrend of the AFF sector with an average GVA growth of 1.87 percent and 0.17 percent, respectively. On the other hand, GVA of mango has been declining at a rate of 1.52 percent from 2016 to 2021.

Table 6. Gross Value Added (at constant 2018 prices) of the major fruits, in million pesos, 2016-2021

Commodity	2016	2017	2018	2019	2020	2021
Banana	133,719	135,806	138,215	135,355	133,619	134,773
Mango	37,460	34,023	33,050	34,456	34,431	34,513
Pineapple	26,530	27,106	27,599	27,788	27,757	29,091
GVA in AFF	**1,672,085**	**1,743,134**	**1,762,616**	**1,783,855**	**1,780,391**	**1,775,358**
GDP	**16,062,676**	**17,175,978**	**18,265,190**	**19,382,751**	**17,537,843**	**18,538,054**

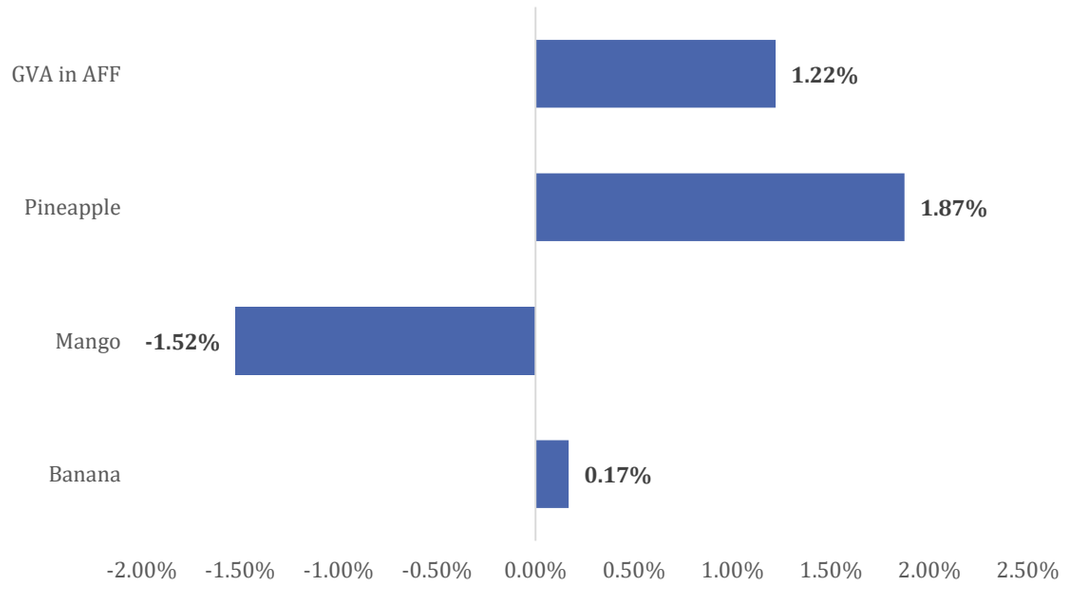


Figure 24. Average growth rates of GVA of major fruits from 2016-2021
(Source: PSA)

In terms of contribution to AFF GVA and Philippine GDP, banana recorded the highest average share to AFF GVA with 7.72 percent and highest average share to Philippine GDP with 0.76 percent among the three major fruit crops (**Figure 25**). Meanwhile, both mango and pineapple have very minimal contributions to AFF GVA and GDP as can be seen from the figure.

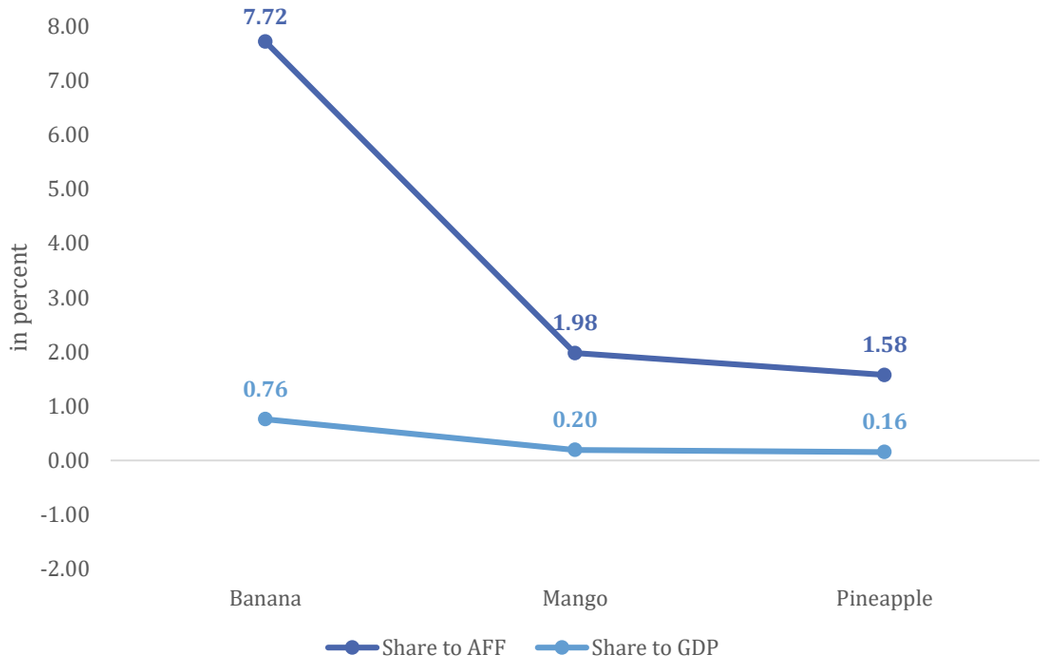


Figure 25. Average contributions of major fruits to AFF GVA and GDP, 2016-2021
(Source: PSA)

Export

Banana

According to FAOSTAT data, Philippines remains to be the second largest exporter of banana in 2021 although its export had significantly decreased since 2019 (**Figure 26**). The restrictions due to COVID-19 pandemic, occurrence of Panama disease, and weather damage were some of the culprits of the decreased banana exportation of the country (O'Callaghan, 2022). Nevertheless, fresh banana continued to be the leading export commodity of the country in 2021 with 16.8 percent share to the total value of agricultural exports.

The country's top five international markets for fresh banana in 2021 are Japan, China, South Korea, Saudi Arabia, and Hong Kong (DTI's Tradeline Philippines). A total of 93 percent of the country's banana export went to these five countries with Japan as the major destination with 43 percent share.

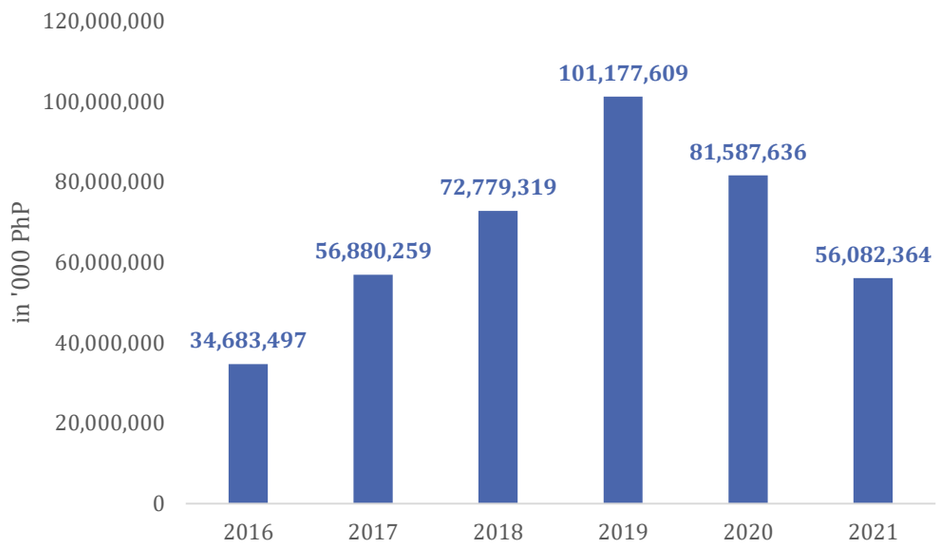


Figure 26. Export value of banana from 2016 to 2021
(Source: Agricultural Indicators System [AIS] Report from PSA)

Mango

Philippine carabao mango is the only mango variety that is being exported by the country. As can be seen in **Figure 27**, there was a sharp increase in mango exportation from 2016 to 2017 then a continuous decline afterwards. This decline in mango export can be attributed mainly to imposition of strict sanitary and phytosanitary (SPS) requirement by importing countries. However, with the recent mutual agreement between the DA-BPI and the US Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) to open additional ports of entry in the USA, mango export to USA resumed and is expected to increase in the coming years (DA Communications Group, 2021).

In 2021, export earnings from mango amounted to PhP 617.78 million which represents a minimal share (0.18%) to the total agricultural export earnings of the country. About 72 percent of the mango export was shipped to Hong Kong and about 24 percent to South Korea. Other export markets for mango include Japan, Qatar, and UK Great Britain.

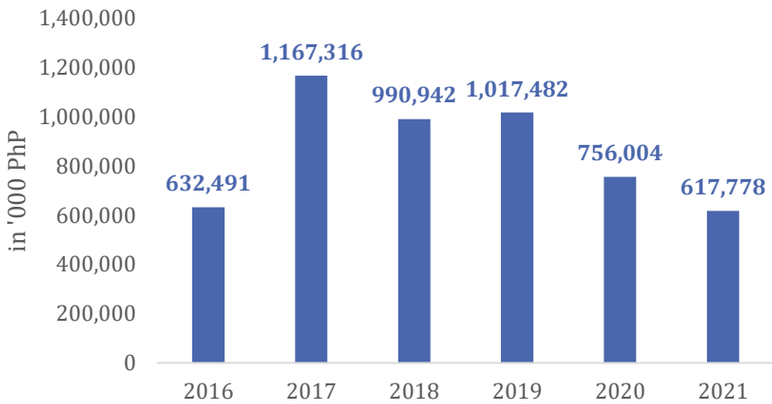


Figure 27. Export value of mango from 2016 to 2021
(Source: AIS Report from PSA)

Pineapple

According to FAOSTAT data (2021), the Philippines is the second largest exporter of pineapples, next to Costa Rica. Over the last five years, pineapple export went through ups and downs as can be seen in **Figure 28**. From 2016 to 2018, a downtrend can be observed followed by a sharp increase from 2018 to 2019. Thereafter, pineapple export followed a downtrend again landing at PhP 14.3 billion export earnings in 2021. Although the exportation of pineapple went through ups and several downs, pineapple remains the second leading export commodity of the country posting a 4.27 percent share in the total agricultural exports in 2021.

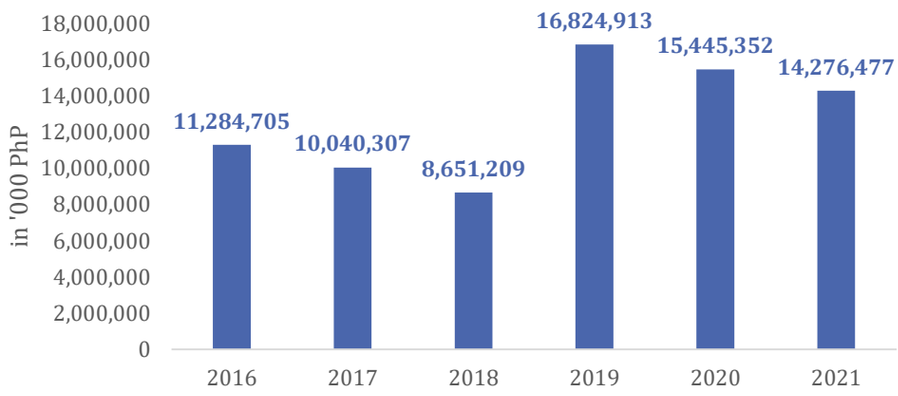


Figure 28. Export value of pineapple from 2016 to 2021
(Source: AIS Report from PSA)

Priority Research Areas

Banana

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement of varieties resistant to pests and diseases	Performance of different banana varieties planted in fusarium wilt as well as banana bunchy top virus infested areas Selected/Identified disease-resistant variety of banana Genebank for banana cultivars	DA-RFO 12, BARMM, DA-BPI USeP, UPLB
2023	Development of strategies for low-cost inputs (e.g. alternative cost-effective and efficient fertilizers, among others)	Procedure on the use of Trichoderma for in situ composting Procedure on the utilization of Mykovam in cardaba	DA-RDIs, SUCs
2024-25	Modernization of farm equipment, machineries, and facilities	Enhanced/promoted/utilized hole digger for planting banana Developed banana inflorescence protection through mechanization Established virus indexing laboratory	DA-PhilMech, USeP
2024-25	Micro and macro propagation of planting materials for various priority crops	Established tissue culture laboratory Optimized micropropagation techniques and protocols Performance and productivity assessment of banana through sucker management system	DA-RFO CAR, DA-RFO 5, PSAU, USeP, UPLB
2024-25	Intensification of crop diversification and farming systems	Developed/improved integrated farming system for cardaba banana	DA-RFO 8, DA-RDIs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Outscaling of banana production (Saba, Lakatan, and Cavendish) utilizing tissue culture planting materials	Analysis of value chain on various banana production	DA-RDIs, SUCs
2024-25	Development of pest and disease management protocols	Information on the molecular Identity and detection of microbial pathogens of banana Integrated management strategy for fusarium wilt of banana Information on the antifungal activity of different weed leachates against *Fusarium oxysporum* f. sp. cubense Tropical Race 4 (Foc TR4) causing fusarium wilt on Lakatan Banana Effective pest and disease management control and strategies	SKSU, USeP, UPLB

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		(e.g. use of bio-pesticides and BCAs) Information of factors affecting the development of emerging diseases Etiology of emerging diseases (prerequisite of epidemiology) Real time computer-generated model/sensors (IoT for early warning systems) Epidemiology on pest and diseases	
2024-25	Development of pest and disease management protocols	Real time computer-generated model/sensors (IoT for early warning systems)	SUCs
2024-25	Development and pest and disease management protocols	Information of factors affecting the development of emerging diseases	SUCs

POSTHARVESTING AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development and promotion of value-added products	Evaluation of different banana varieties for processing/postharvest Developed standardized production protocol of banana powder Developed processing technology for wine and vinegar production from Bungulan variety of banana	DA-PhilMech, SKSU, DA-RDIs, SUCs,

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development and promotion of value-added products	Developed value-added products from the leaves of different types of banana Developed packaging material from banana waste product that are biodegradable (e.g. leaves)	DA-BPI

Mango

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Nutrient optimization and upscaling of appropriate fertilization management	Site-specific fertilizer/nutrient recommendations for mango Developed location specific soil fertility rehabilitation guidelines	DA-RDIs, SUCs
2024-25	Development and authentication of new and marketable varieties	Developed new and marketable mango varieties DNA fingerprint of different mango varieties	DA-RFO 9, DA-RDIs, SUCs
2026-28	Development of quality planting materials	Policy recommendation for the improvement/enhancement of quality planting material standards	DA-RDIs, SUCs
2026-28	Adoption/utilization and promotion of new commercial varieties	Information on the yield and growth performance of commercial mango varieties from other countries Identified new commercial mango varieties suitable to Philippine conditions	DA-RDIs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Intensification of crop diversification and farming systems	POT on mango production system with apiculture Technology on the production and utilization of organic-based mango flower inducer	DA-RDIs, SUCs
2024-25	Development of pest and disease management protocols	Information on the pests and diseases Information on factors affecting the development of new and emerging diseases Protocol for pests and disease management Information on and management strategy against fruitfly population and other insect pests on mango in Guimaras Information on the efficacy and protocol on the application of biopesticides against leaf hoppers Information on the efficacy and protocol on the application of alternative control against Anthracnose (*Collectotrichum gloeosporoides*) disease of mango using botanical plant extracts Control strategies on the new and emerging pest and diseases	DA-BPI, MMSU, BPSU, UPLB, BSU, USeP

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of strategies for low-cost inputs (e.g., alternative cost-effective and efficient fertilizers, among others)	Information on the factors influencing the adoption of sustainable farming technology in mango farms (e.g. drip irrigation, etc.) Protocol for pruning, fertilization, and irrigation techniques for old and non-productive trees Information on the performance of different mango varieties in a constant planting distance Canopy management strategy for bearing mango trees Protocol for the development and production of mango trees with small canopy Organic production technologies of red-coloured mango varieties under Guimaras conditions Information on the flush intensity of Carabao mango leaves as affected by different flush Induction	DA-RFO 9, BPI, BPSU, ISCOF, PSAU, BASC
2024-25	Precision farming and digital agriculture	Protocol on sustainable mango production and improving productivity of Philippine Carabao Mango through introduction of SMART farming technologies Web-based decision-making tool for fertilizer management for mango orchard	DA-RDIs, SUCs
2024-25	Multi-location adaptability trials	Recommended mango varieties based on elevation and topography	DA-RFO 9, UPLB
2026-28	Development of organic-based mango flower inducer	Technology on the production and utilization of organic-based mango flower inducer	DA-RDIs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Information on the issues/ challenges on the adoption of postharvest disease management Policy recommendation Appropriate Modified Atmosphere Packaging (MAP) (individual and bulk packaging)	DA-RDIs, SUCs
2024-25	Development and promotion of value-added products	Information on the physico-chemical, sensory evaluation, and shelf-life assessment of green mango powder from selected varieties of mango	MMSU, PSAU, MSC, UPLB

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		Processing technologies and standards for green mango powder and mango chips Information on the nutritional composition and consumer acceptability of mango (*Mangifera indica* l.cv "carabao") chips	
2024-25	Scaling processed products to expand market linkaging and commercialization	Business model for the developed mango products	MMSU, PSAU, MSC

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development and promotion of value-added products	Protocols and standards on traceability Information on the marketability of various mango-based products	BPSU

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development and promotion of value-added products	Formulated and developed mango pectin-based food products Developed and evaluated food products blended with Carabao mango pulp flour	DA-BPI, DA-PhilMech, BPSU

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Impact assessment of adopted standards for the specific commodity	Policy recommendation from impact assessment of adopted standards for the specific commodity Enhanced regulatory policy on agritrade of mango e.g., Philippine National Standards, quarantine	DA-RDIs, SUCs
2024-25	Modernization of farm equipment, machineries, and facilities	Policy recommendation on socio-economic research on the establishment of postharvest facilities	DA-RDIs, SUCs

Pineapple

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Micro and macro propagation of planting materials	Comparative field performance of tissue culture-derived plantlets and suckers of Queen Pineapple Improved tissue culture protocol using modified nutrient media for Queen Pineapple and MD2 Pineapple	DA-RFO 5, DA-RFO 8, VSU
2024-25	Nutrient optimization and upscaling of appropriate fertilization management	Recommended location-specific fertilizer management strategy for Queen pineapple production Developed location specific soil fertility rehabilitation guidelines Soil fertility guide specific to production of pineapple for fiber Suitability maps of pineapple production for fiber	DA-RFO 5, ASU, VSU
2024-25	Crop germination, collection, conservation, characterization, and profiling	Information on the morphological, biochemical characteristics, and population profile of Queen Pineapple populations	VSU

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development and assessment of sustainable production management	Optimized POT to enhance fruit size and quality of Spanish Red Pineapple	DA-RFO 5, ASU
2026-28	Development of pest and disease management protocols	Alternative pest control technologies for queen pineapple	DA-RFO 5, DA-RFO 8, VSU, UPLB

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development and promotion of value-added products	Refined processing protocol for Spanish Red Pineapple fibers and dyes	DA-PhilFIDA, DA-RFO 5, VSU

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Identification and assessment of supply, market demand, market potential, and consumer preferences	Web-based monitoring system for small and medium crafts (for industry, MSME) Supply and demand analysis of Queen Pineapple Recommendations (e.g., policy, programming of production, etc.) Policy recommendations on supply chain structure and constraints of	DA-RDIs, SUCs DA-RFO 8

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		Pineapple queen community enterprise in Region 8 (Ormoc)	

Other Fruits

INPUT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Strawberry	Development and promotion of quality planting materials	Micro-macro-/mass propagation techniques and protocols for tissue culture Established protocols for quality planting materials	DA-BPI, DA-RFO CAR, BSU
2023	Mangosteen, Lanzones, Rambutan	Crop germination, collection, conservation, characterization, and profiling	Collected, characterized, improved and NSIC-registered fruit trees	DA-RDIs, SUCs
2023	Mangosteen, Lanzones, Durian	Nutrient optimization and upscaling of appropriate fertilization management	Developed location specific soil fertility rehabilitation guidelines	DA-RDIs, SUCs
2023	Guyabano	Nutrient optimization and upscaling of appropriate fertilization management	Enhanced location specific soil fertility rehabilitation guidelines	SUCs
2023	Jackfruit	Nutrient optimization and upscaling of appropriate fertilization management	Enhanced location specific soil fertility rehabilitation guidelines Recommended location specific variety Information on the total soluble solids of jackfruit at different climatic conditions	DA and SUCs
2023	Jackfruit	Development and authentication of new and marketable varieties	Validated site-specific package of technology for EVIARC Sweet Variety	DA and SUCs
2023	Jackfruit	Development of quality planting materials	Standard production guidelines on quality planting materials for jackfruit Policy recommendation for accreditation of nurseries and scion groves in key production areas Established clonal gardens and scion groves in strategic areas	DA and SUCs
2023	Pear, Persimmon, Fig, Raspberry, Blackberry, Blueberry, Pomegranate, Cherry, Plum,	Multi-location adaptability trials	Recommended varieties suitable under local growing conditions Adaptability and feasibility of non-traditional/temperate fruit crops	DA and SUCs

INPUT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	Mulberry, Avocado, Grape			
2023	Grape, Pear	Micro and macro propagation of planting materials for various priority crops	Established mass propagation protocols	DA and SUCs
2023	Grape	Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming	POT for organic grape production	SUCs
2023	Pear	Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming	Utilized conservation agriculture to ensure sustainable intensification	DA and SUCs
2024-25	Strawberry	Development/ adoption of new/improved variety (Crop improvement for disease resistance or tolerance and adaptation to climate change)	Recommended new/improved variety of strawberry for different production system Germplasm collection, collection and characterization of strawberry varieties	DA-RFO CAR, DA-BPI, BSU
2024-25	Cashew	Nutrient optimization and upscaling of appropriate fertilization management	Developed location specific soil fertility rehabilitation guidelines	DA and SUCs
2024-25	Cashew	Crop germination, collection, conservation, characterization, and profiling	Updating on the morphological and biochemical characteristics of cashew	UPLB
2026-28	Jujube	Multi-location adaptability trials	Recommended varieties suitable under local growing conditions Adaptability and feasibility of non-traditional/temperate fruit crops	DA and SUCs
2026-28	Persimmon, Fig, Raspberry, Blackberry, Blueberry, Pomegranate, Cherry, Plum, Jujube, Mulberry	Micro and macro propagation of planting materials for various priority crops	Established mass propagation protocols	DA and SUCs
2026-28	Jujube	Development, enhancement, and promotion of cultural practices such as organic agriculture	Utilized conservation agriculture to ensure sustainable intensification	DA and SUCs

INPUT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		and indigenous farming		

PRODUCTION				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Jackfruit	Development of pest and disease management protocols	Integrated pest and disease management of jackfruit	DA and SUCs
2023	Jackfruit	Intensification of crop diversification and farming systems	Multi-storey cropping system Hilly lands fruit-based farming system Native chicken production under jackfruit-based cropping system Jackfruit production under coco-based cropping system	DA and SUCs
2023	Jackfruit	Development of production management	Enhanced technologies for off-season production	DA and SUCs
2023	Breadfruit	Development and promotion of quality planting materials	Scaling of good quality planting materials and/or processed products Information on breadfruit production distribution in Western Visayas	DA and SUCs
2023	Avocado	Crop germination, collection, conservation, characterization, and profiling	Genebank/geotagging of avocado varieties	IPB-UPLB
2023	Avocado	Identification and assessment of supply, market demand, market potential, and consumer preferences	Feasibility of value-added products from avocado by-products (e.g. essential oils)	SUCs
2023	Durian	Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming	Recommendations on sustainable and/or organic production management	SUCs
2023	Lanzones	Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming	Recommendations on sustainable and/or organic production management	DA and SUCs

PRODUCTION				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Citrus (e.g. pomelo)	Development, enhancement, and promotion of cultural practices such as organic agriculture and indigenous farming	Protocols for flower induction	SUCs
2023	Lanzones	Development of sustainable production management	Protocols for flower induction e.g. off-season production technology	DA and SUCs
2023	Pear, Persimmon, Fig, Raspberry, Blackberry, Blueberry, Pomegranate, Cherry, Plum, Jujube, Mulberry	Socio-economic research	Adaptability and feasibility of non-traditional/temperate fruit crops	DA-CAR and SUCs
2023	Fig	Standards/protocols for grading, sorting, and classification	Established PNS	DA-CAR and SUCs

POSTHARVEST AND PROCESSING				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Jackfruit	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Improved postharvest handling practices and transport packaging	DA and SUCs
2023	Jackfruit	Scaling processed products to expand market linkaging and commercialization	POT addressing short shelf life of fresh and minimally processed produce, poor manufacturing practices, poor packaging	DA and SUCs
2023	Jackfruit	Development and promotion of value-added products	Market-driven and novel products from unripe jackfruit	DA and SUCs
2023	Dragon fruit	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Appropriate Modified Atmosphere Packaging (MAP) for Different Fruits (individual and bulk packaging)	SUCs (MMSU and CvSU)
2023	Fresh fruits	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Nano-enhanced or nanomaterial- based fruit coatings for prolonging shelf life and for bacterial and fungal disease management	DA and SUCs

POSTHARVEST AND PROCESSING				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Citrus (e.g., pomelo), Marang	Development and authentication of new and marketable varieties	Cultivar with long shelf-life cultivar through biotechnology	DA-BPO and SUCs
2023	Citrus (e.g., pomelo)	Development of pest and disease management protocols	Pest monitoring, surveillance, and forecasting Pest and disease management Farm machinery production related to sorting and grading, washing and labelling	DA-RFO 2, DA-RFO 4A, DA-RFO 9, USeP
2024-25	Bignay	Scaling processed products to expand market linkaging and commercialization	Established agri-enterprise	DA and SUCs
2024-25	Strawberry	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Developed/improved of appropriate packaging material for transport and marketing Development of alternative retail packaging material	DA-BPI, DA-RFO CAR, BSU
2024-25	Avocado	Development of proper postharvest treatment protocols and facilities for efficient and cost-effective handling, storage system, and extension of shelf life	Developed packaging material prolonging shelf life of avocado	DA and SUCs
2026-28	Grape	Development and promotion of value-added products	Processing technologies of grapes for functional foods, nutraceutical products, and industrial products	SUCs

OTHERS				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Strawberry	Development and assessment of sustainable production management	Value chain analysis for the gaps in the strawberry key commodity production system Established quality standards required by the target market	DA-BPI, DA-RFO CAR, BSU
2023	Dragon fruit	Impact assessment of adopted standards for the specific commodity	Enhanced PNS for Dragon fruit	DA and SUCs

Plantation and Biofuel Crops

Commodity industry situation

Abaca

Philippine abaca fiber, internationally known as Manila hemp, is characterized by its superior strength. In fact, it is considered as the "strongest natural fiber in the world" by the DOST and the DA-PhilFiDA. Abaca fiber is being processed into pulp, cordage, and various fiber craft products by local processors. Although the country has various plants that produce fibers such as banana, abaca, piña, among others, abaca is the most important among them in terms of production, area planted, and contribution to the Philippine economy (The Philippine Abaca Industry Roadmap 2018-2022).

According to PSA, the average production of abaca fiber from 2016 to 2021 is 69.6 thousand MT, decreasing each year by 2.6 percent (**Figure 29**). The performance of the abaca industry over the last five years was opposite of what was targeted by the industry. More specifically, the production in 2021 amounting to 62.4 thousand MT is quite far from the target fiber production in 2021 of about 176.7 thousand MT (The Philippine Abaca Industry Roadmap 2018-2022). In terms of area planted, there has been no expansion of area devoted to abaca since 2016 as can be seen from the same figure. The area planted to abaca has even declined from 134.4 hectares in 2016 to 131.5 hectares in 2021.

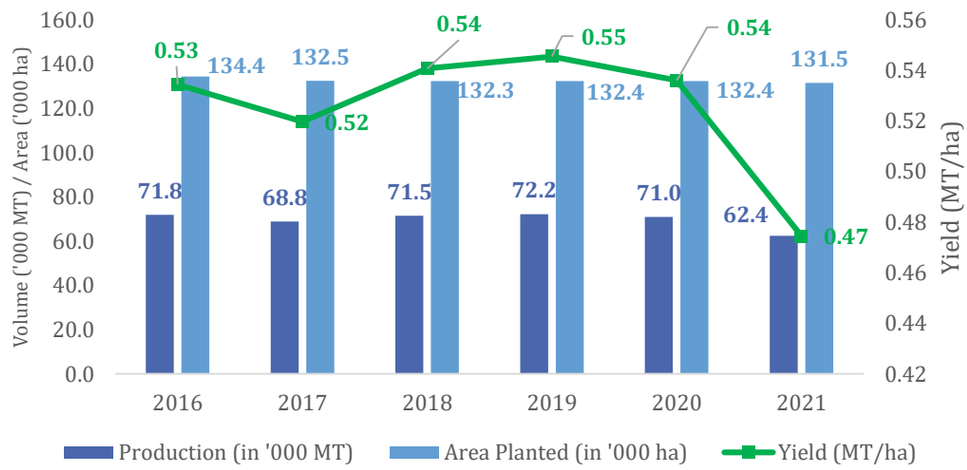


Figure 29. Volume of production, area planted, and yield of abaca (dried raw fiber), 2016-2021
(Source: PSA)

Cacao

Over the last five years, the cacao industry showed a positive growth in terms of production and area planted. From 2016 to 2021, the average production of cacao (dried beans with pulp) was recorded at 8,181 MT with an annual average growth of 9.85 percent. Moreover, cacao production in 2021 (10,000 MT) is 60 percent higher than production in 2016 which is 6,263 MT. Although the industry performed well, its production still falls short of the local demand which is around 50,000 MT annually (Philippine Cacao Industry Roadmap 2021-2025).

In terms of area, there has been a wide expansion of area planted to cacao from 2016 to 2021. In fact, the area planted in 2021 is double than the area planted in 2016 as shown in **Figure 30**. However, despite the increase in both area and production, cacao yield decreased from 0.42 MT/ha in 2016 to 0.32 MT/ha in 2021. The low cacao yield can be attributed to the

insufficient supply of quality planting materials and lack of trainings on good agricultural practice among cacao farmers.

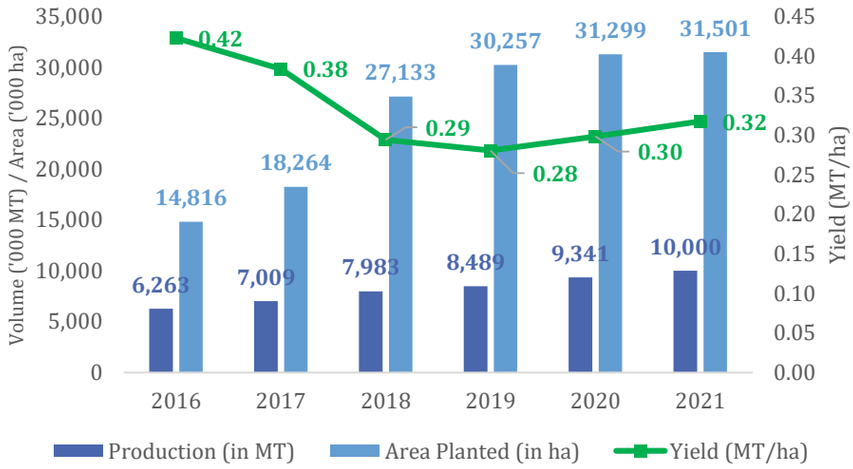


Figure 30. Volume of production, area planted, and yield of abaca (dried raw fiber), 2016-2021
(Source: PSA)

Coconut

Despite a slow growth of about 1.28 percent annually, the country's coconut production has managed to increase from 13.8 million MT in 2016 to 14.7 million MT in 2021 with an average production of 14.4 million MT during the last five years (**Figure 31**). With this performance of the coconut industry, the Philippines contributed an average share of 24 percent (from 2016-2020) in the global coconut production, making the country the second largest producer of coconut, next to Indonesia with 28 percent share (**Table 6**).

According to PSA, about 29 percent of the coconut production is utilized for domestic consumption with manufactured oil as the main product, accounting for 62 percent of domestic consumption. It was followed by consumption of food nuts and processing to homemade oil which accounts for 22 percent and 15 percent of domestic consumption, respectively. With the enactment of Biofuels Act of 2006 (RA 9367) which seeks to reduce the country's dependence on imported fuels by promoting the development and mandating the use of locally-sourced biofuels, i.e., biodiesel from coconut oil blended with petroleum diesel, and bioethanol from sugarcane molasses blended with gasoline, the demand for coconut specifically coconut oil (as well as sugarcane molasses) will increase in the next few years.

Similar with volume of production, the area planted with coconut also exhibited a slight growth from 2016 to 2021. From 3.57 million hectares in 2016, area for coconut slightly expanded to 3.65 million hectares in 2021. Coconut yield followed the same trend with minimal increase from 3.9 MT/ha in 2016 to 4.0 MT/ha in 2021.

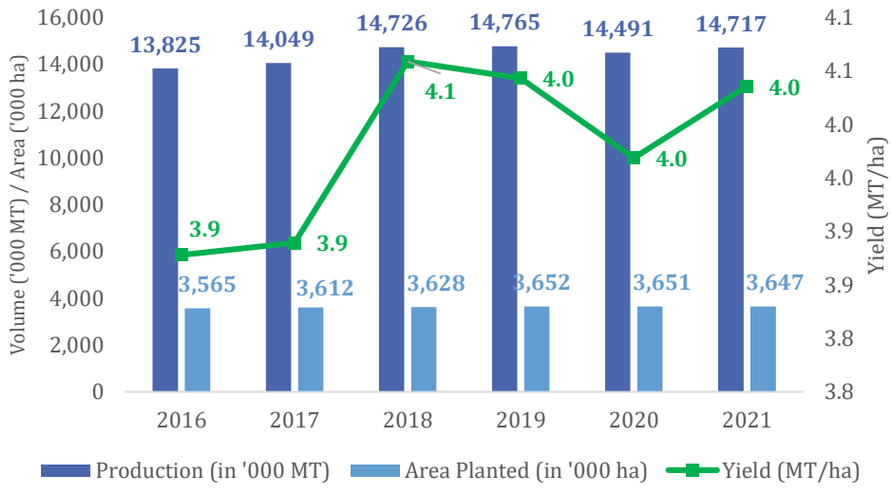


Figure 31. Volume of production, area planted, and yield of coconut (with husk), 2016-2021
(Source: PSA)

Table 7. World coconut production by major producing countries, 2016-2020

Production (in '000 MT)	2016	2017	2018	2019	2020	Average
World	58,090	57,015	63,373	62,160	61,520	60,432
Philippines	13,825	14,049	14,726	14,765	14,491	14,371
Indonesia	17,400	17,200	17,100	17,075	16,825	17,120
India	11,344	11,167	16,413	14,682	14,695	13,660
Share in the World Production (%)	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
Philippines	23.80	24.64	23.24	23.75	23.55	23.80
Indonesia	29.95	30.17	26.98	27.47	27.35	28.38
India	19.53	19.59	25.90	23.62	23.89	22.50

Coffee

Coffee production in the country declined from 68.8 thousand MT in 2016 to 60.6 thousand MT in 2021 with an average reduction rate of 2.43 percent each year (**Figure 32**). Similar trend can be observed with the area planted to coffee. Over the last five years, coffee production area has declined from 114.8 thousand hectares in 2016 to 112.6 thousand hectares in 2021. Following the decline in both production and area planted is the decreasing yield as shown in the same figure. This trend in coffee yield can be attributed to aging coffee trees, limited rejuvenation, and poor farm management, in addition to the decline in both the production and area planted (Philippine Coffee Industry Roadmap 2021-2025).

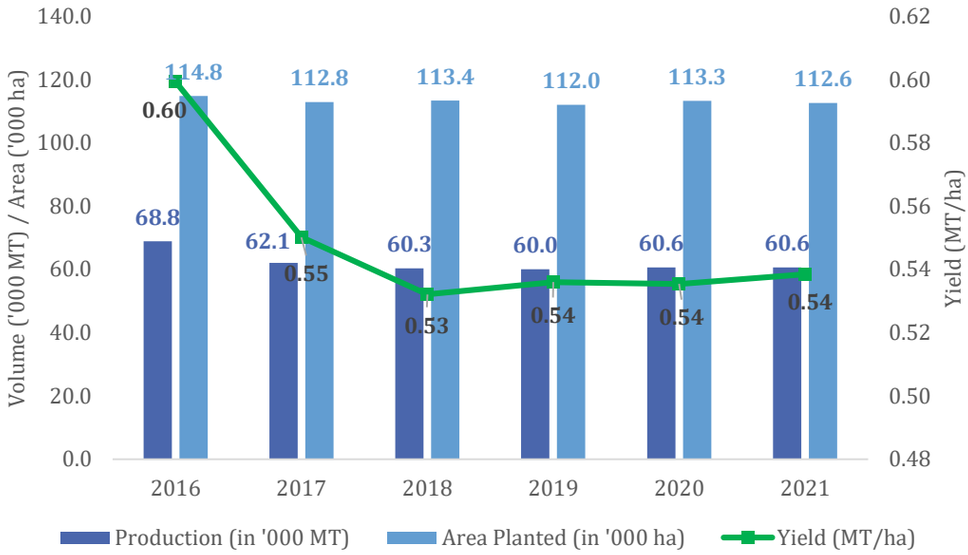


Figure 32. Volume of production, area planted, and yield of coffee (dried berries with pulp), 2016-2021
(Source: PSA)

Pili

Production of pili nut in the country slightly increased from 2016 to 2018 then continuously decreased from 2018 to 2021 (**Figure 33**). On the average, the country produced pili nut amounting to 6,953 MT from 2016 to 2021 which decreased annually by 4.11 percent. Similarly, the area devoted to pili production has been declining since 2016—from 2,281 hectares in 2016 down to 1,998 hectares in 2021.

Although the pili industry did not perform well over the last five years, the Philippines still has its edge in the global market as it is the only country that has the capability to process pili into both food and non-food products (Pham and Dumandan, 2015). In fact, the DA considered pili as a crop that should be given more intensive R&D activities (Catelo and Jimenez, 2016).

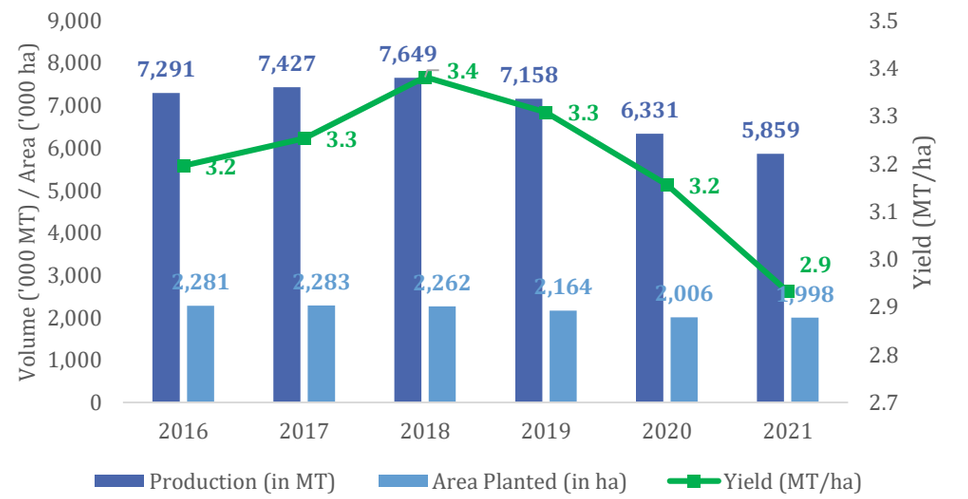


Figure 33. Volume of production, area planted, and yield of pili nut (dried nut with shell), 2016-2021
(Source: PSA)

Sugarcane

Sugarcane registered an average production of 24.6 million MT of canes from 2016 to 2021 (**Figure 34**). In the Philippines, about 98 percent of sugarcane produce is mainly used to produce centrifugal sugar while the remaining 2 percent is used for other products such as ethanol, panocha/muscovado, chewing, and basi/vinegar (PSA). In terms of area, there has been a minimal expansion of area devoted for sugarcane. During the same period, the average growth of area planted with sugarcane is only at 0.78 percent. The average yield of sugarcane in the country is 59 MT/ha. Using the FAOSTAT data for sugarcane, **Figure 35** shows that the sugarcane yield of the country is much lower as compared to major sugar producing countries.

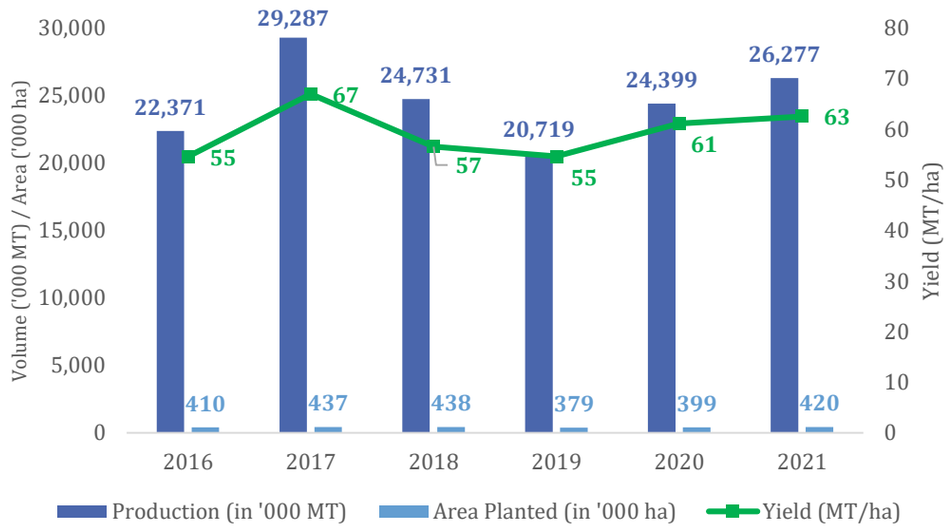


Figure 34. Volume of production, area planted, and yield of sugarcane, 2016-2021 (Source: PSA)

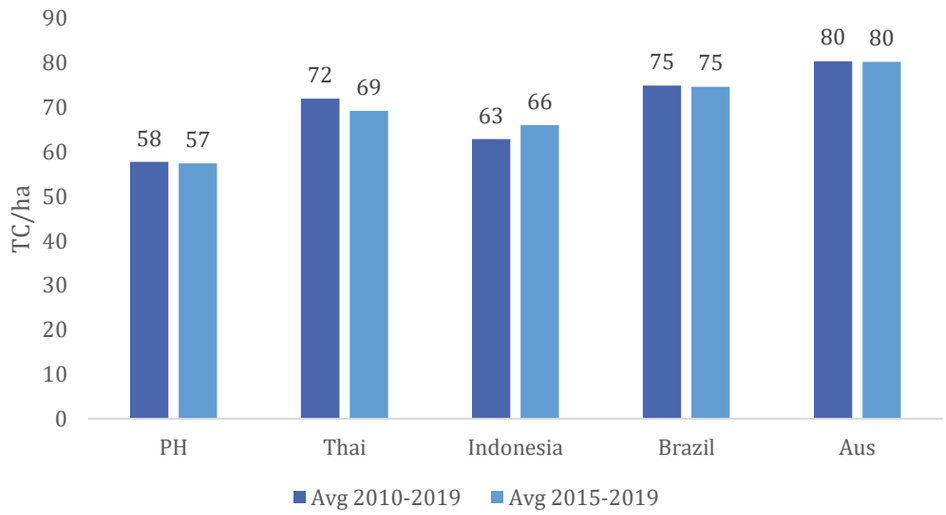


Figure 35. Average sugar yields of major sugar producing countries

Sweet Sorghum

Sweet sorghum, a variety of sorghum that is suited for ethanol production, is not widely known in the Philippines. According to Reddy et al. (2011), the juice of sweet sorghum has

greater potential for ethanol production due to its higher content of reducing sugars compared to other sugar sources. In addition, sweet sorghum has other uses, i.e., its grains are used for human consumptions, and its stalks and leaves are used for animal fodder.

Sweet sorghum was first introduced in the Philippines by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) through the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development of the Department of Science and Technology (DOST-PCARRD, now PCAARRD) in 2004 by providing 17 cultivars which were planted for preliminary evaluation trials at MMSU. Multi-location trials followed the first evaluation trials alongside the conduct of technology fora, seminars, and workshops to discuss the potentials of sweet sorghum. In 2007, the DA-BAR and the MMSU signed a tripartite agreement with ICRISAT aiming to further explore the appropriate cultivars for different agro-climatic conditions, strengthen hybrids development research, and commercialize sweet sorghum stalks as feedstock for ethanol production in the Philippines (Reddy et al., 2011). Since the sweet sorghum industry has not yet developed, there is no available data particular to sweet sorghum.

Rubber

Figure 36 shows that there has been a slow growth in the rubber industry of the country. On the average, the rubber planters, which are predominantly small farmers, has able to produce an average of 413,000 MT of cup lumps from 2016 to 2021 with an annual growth rate of only 3.6 percent. Similar trend can be observed in terms of area planted to rubber and yield. The area planted to rubber barely expanded by 1.4 percent annually from 2016 to 2021. Meanwhile, improvement in rubber yield from 1.62 MT/ha in 2016 to 1.80 MT/ha in 2021 can be attributed to the distribution of quality planting materials by the Department of Agriculture through its regional offices and Philippine Rubber Research Institute from 2013 to 2015 (Philippine Rubber Industry Roadmap 2017-2022).

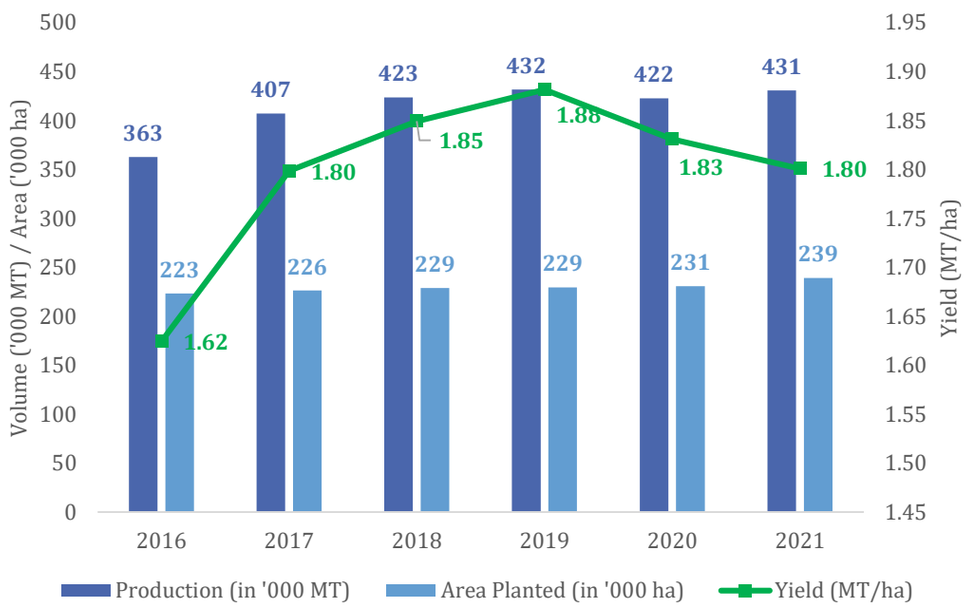


Figure 36. Volume of production, area planted, and yield of rubber (coagulated cup lump), 2016-2021
(Source: PSA)

Economic Importance

Contribution to Agriculture, Forestry and Fishing Sector's Gross Value-Added (AFF GVA) and Gross Domestic Product (GDP)

Among the biofuel and plantation crops, coconut has the highest gross value added (GVA) amounting to PhP 82,889 million in 2021 (**Table 8**). It was followed by sugarcane with GVA of PhP 33,386 million and rubber with PhP10,096 million during the same year. On the other hand, abaca has the lowest share amounting to PhP1,624 million. Meanwhile, it can be seen from **Figure 37** that there has been an improvement in the GVA of the AFF sector, in general, with an average growth rate of 1.22 percent from 2016 to 2021. However, despite the general uptrend in the AFF sector, opposite trend can be observed for abaca and coffee with average decline in GVA of -2.35 percent and -2.61 percent, respectively, during the same period.

Table 8. Gross Value Added (at constant 2018 prices) of selected biofuels and plantation crops, in million pesos, 2016-2021

Commodity	2016	2017	2018	2019	2020	2021
Coconut	78,361	79,151	83,528	84,403	81,986	82,889
Sugarcane	26,336	33,557	27,988	25,484	30,910	33,386
Coffee	6,864	6,175	5,956	5,855	5,904	5,986
Rubber	8,213	9,160	9,499	9,740	10,047	10,096
Cacao	1,605	1,577	1,581	1,646	1,809	1,960
Abaca	1,841	1,795	1,784	1,858	1,826	1,624
GVA in AFF	**1,672,085**	**1,743,134**	**1,762,616**	**1,783,855**	**1,780,391**	**1,775,358**
GDP	**16,062,676**	**17,175,978**	**18,265,190**	**19,382,751**	**17,537,843**	**18,538,054**

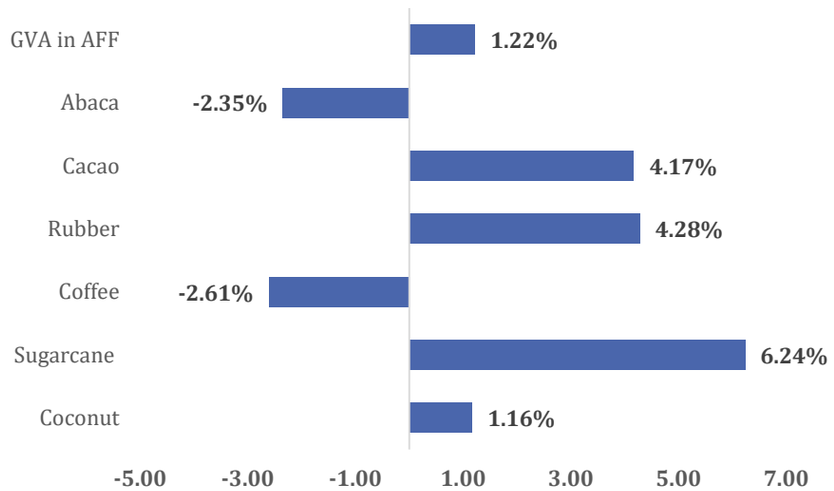


Figure 37. Average growth rates of GVA of selected biofuel and plantation crops from 2016-2021
(Source: PSA)

In terms of contribution to AFF GVA, coconut recorded the highest average share to AFF GVA with 4.89 percent while cacao has the lowest average share of 0.10 percent (**Figure 38**). In terms of contribution to GDP, all the biofuel and plantation crops have very minimal contribution to the Philippine GDP. **Figure 38** shows that from 2016 to 2021, their average contribution to GDP ranges only from 0.51 percent (from coconut) to 0.01 percent (from abaca and cacao crops).

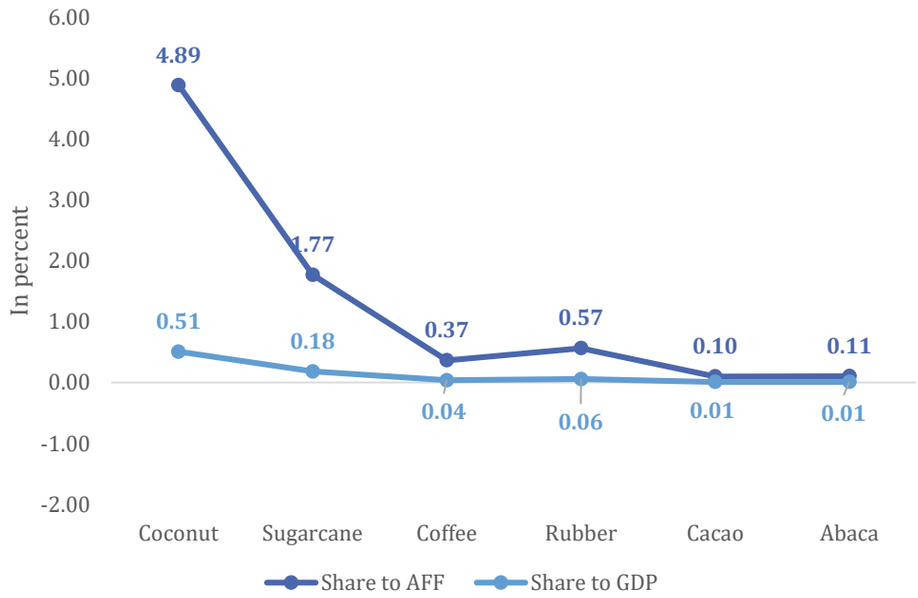


Figure 38. Average contributions of selected biofuel and plantation crops to AFF GVA and GDP, 2016-2021
(Source: PSA)

Export

Abaca

The Philippines remains to be the world's top exporter of raw abaca fiber in 2021 with a total export earning amounting to PhP1,565,164 thousand, which is only 0.47 percent of the total value of agricultural exports (**Figure 39**). Over the last five years, the country generated an average of PhP1,476,848 thousand from abaca fiber supplying largely to UK Great Britain. In fact, in 2021, more than 50 percent of the country's export was supplied to UK followed by Japan with about 24 percent share (**Figure 40**).

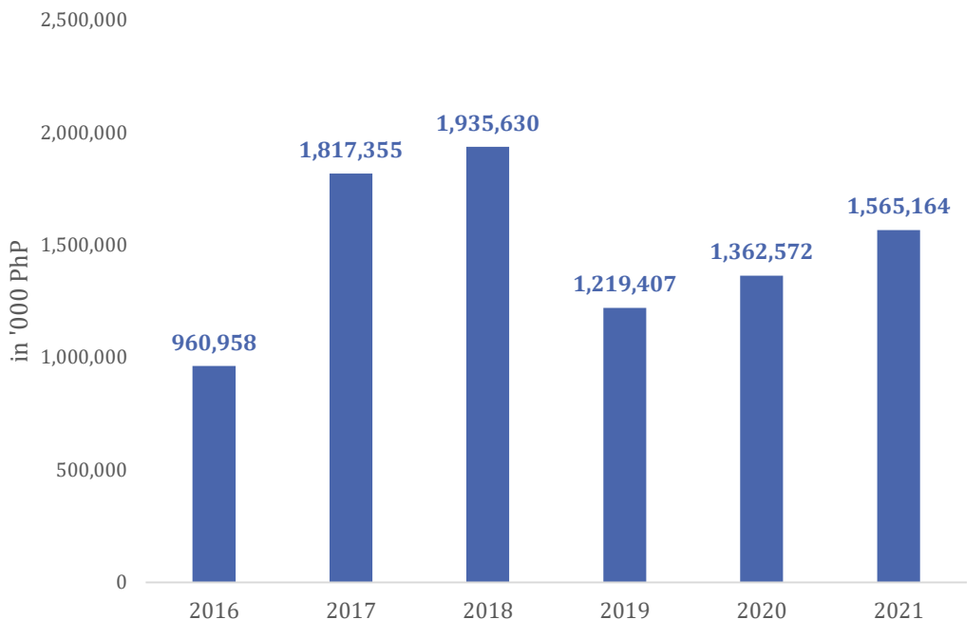


Figure 39. Export value of abaca fiber (raw) from 2016 to 2021
(Source: Agricultural Indicators System (AIS) Report from PSA)

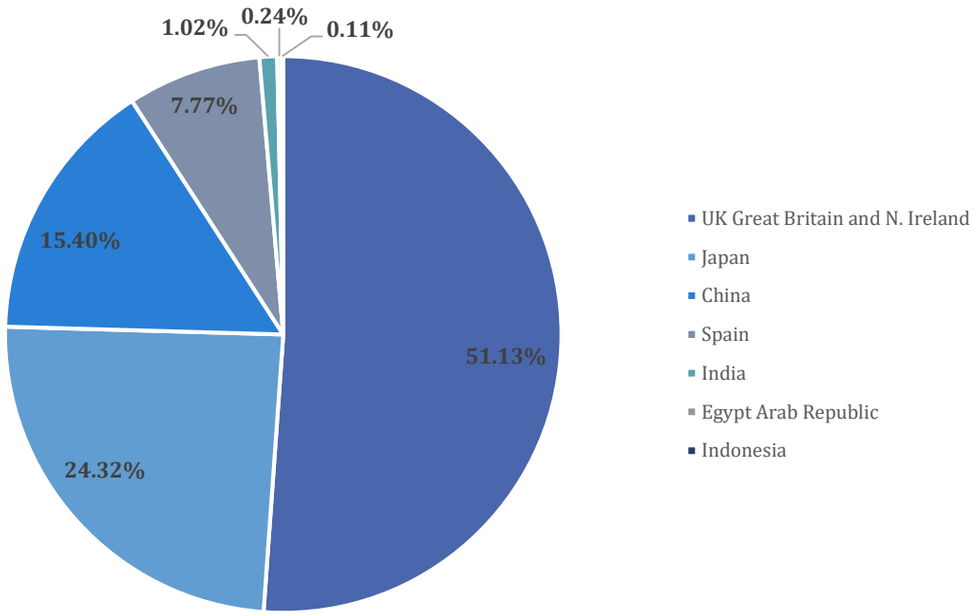


Figure 40. Export markets of abaca fiber, 2021
(Source: Tradeline Philippines)

Cacao

According to some literatures, the Philippines is the first Asian country to plant cacao. However, the country imports more cocoa products than exports as local manufacturers use imported cocoa products such as cocoa powder and cocoa butter in manufacturing chocolate. These manufactured chocolates are then being exported to other countries (Philippine Cacao Roadmap 2016-2022). **Figure 47** shows that export earnings of the country from cocoa products had increased from PhP 345.6 million in 2016 to PhP 572 million in 2021. However, the export earnings in 2021 represents only 0.17 percent of the total value of agricultural exports of the country.

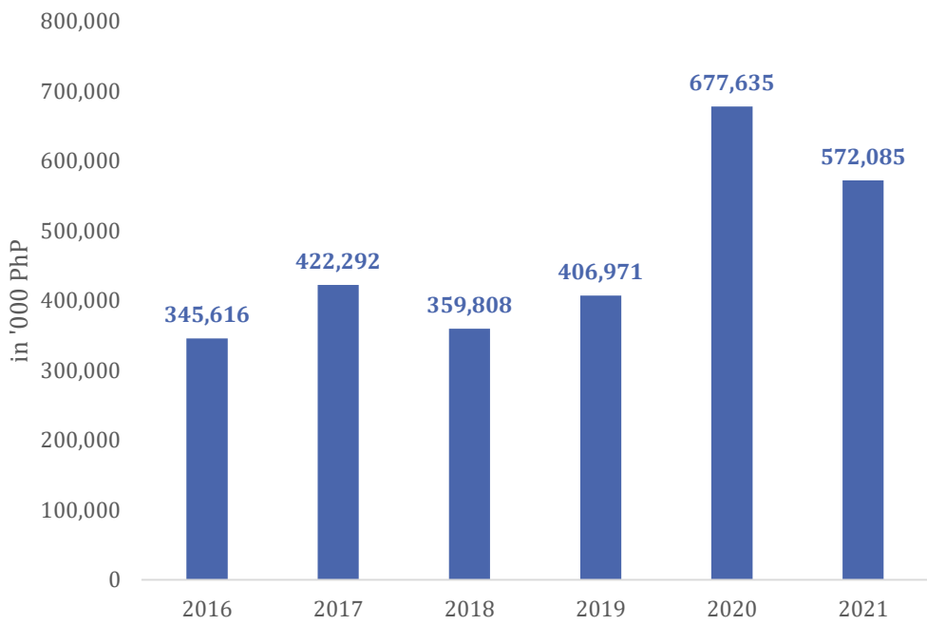


Figure 41. Export value of cacao from 2016 to 2021
(Source: AIS Report from PSA)

Coconut

The Philippines is also the top exporter of coconut products, specifically for coconut oil (copra, crude) (FAOSTAT). Export earnings of the country from coconut generally came from coconut (copra) oil and desiccated coconuts (fresh or dried). It can be observed from **Figure 41** that there has been a significant decrease in the export of coconut from PhP 120,795 thousand in 2016 to PhP 29,479 thousand in 2021. This export earnings in 2021 got only 0.01 percent share of the total value of agricultural exports. Meanwhile, the country's two major markets for coconut oil are Netherlands and USA that bought about 44 percent and 20 percent of coconut oil export, respectively (**Figure 42**).

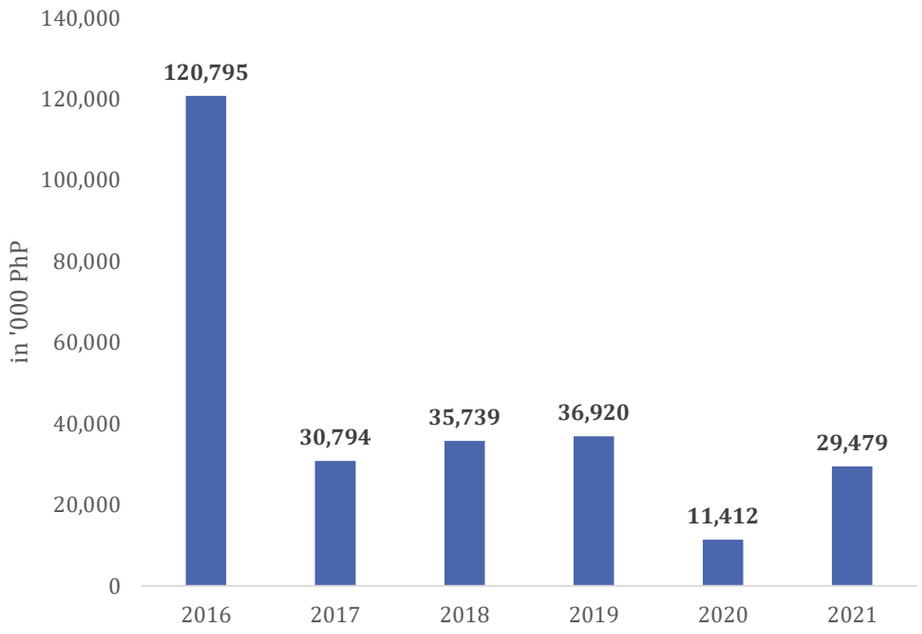


Figure 42. Export value of coconut from 2016 to 2021
(Source: AIS Report from PSA)

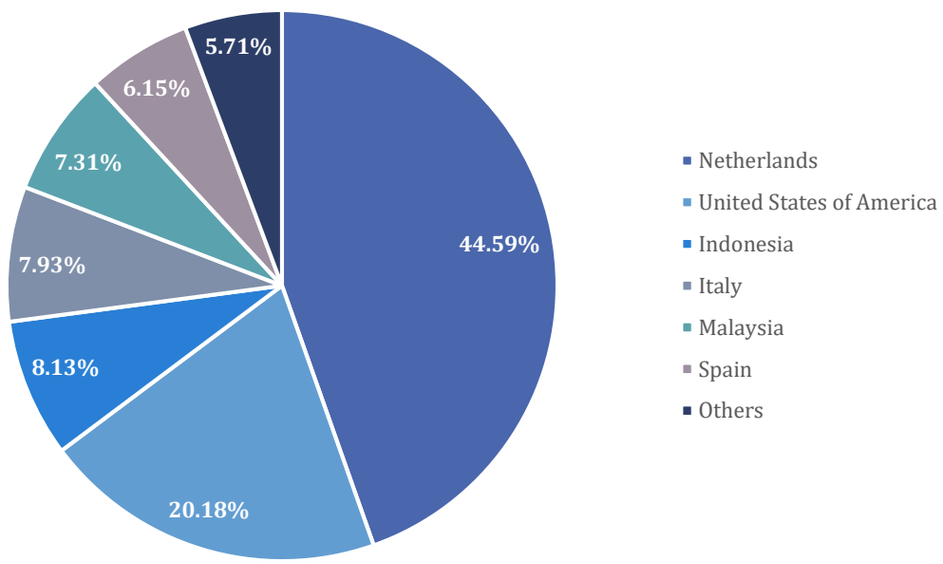


Figure 43. Export markets of coconut oil (crude), 2021
(Source: Tradeline Philippines)

Coffee

According to FAOSTAT data, the Philippines ranked 108th among the exporting countries of coffee in 2021. In fact, coffee exports in 2021 amounting to PhP 12,943 thousand represents a very minimal share (0.004%) of the total value of agricultural exports of the country. Meanwhile, based on the DTI trade data, USA got the lion share of the country's coffee export in 2021 (**Figure 44**).

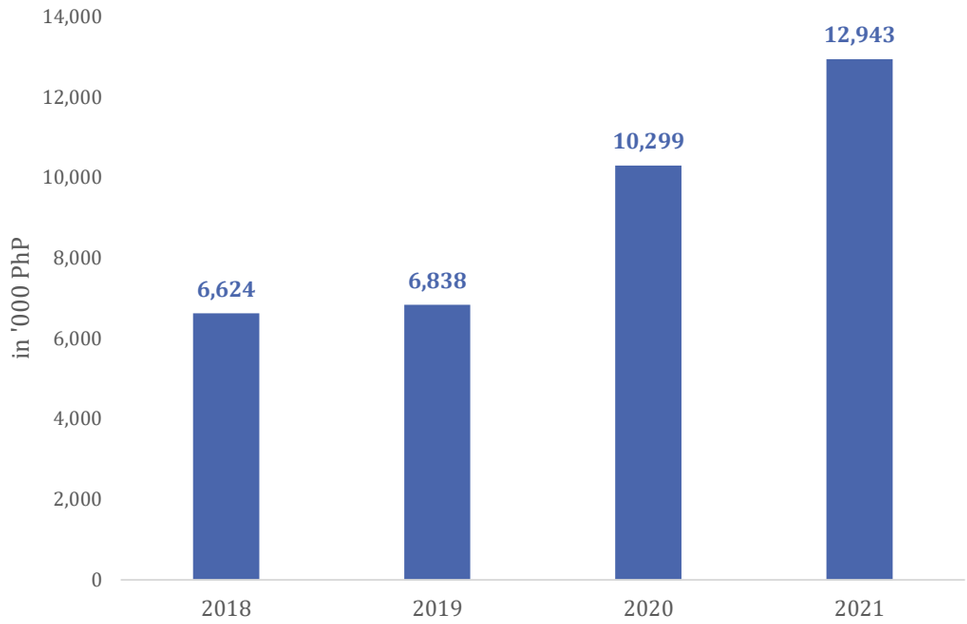


Figure 44. Export value of coffee from 2018 to 2021
(Source: AIS Report from PSA)

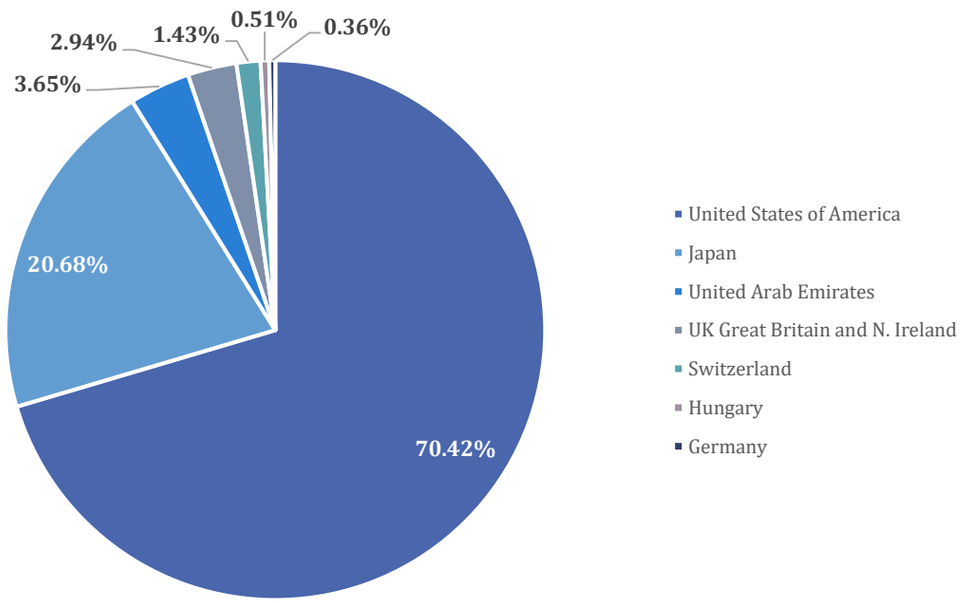


Figure 45. Export markets of roasted coffee, 2021
(Source: Tradeline Philippines)

Sugarcane

Historically, the Philippines was self-sufficient when it comes to sugar and was even exporting its surplus to the world market. However, for various reasons, the country became an importer of sugar to augment its local supply. Today, the Philippines is both an importer and exporter of sugar. Under the quedan system, raw sugar with "A" classification may be exported to the USA. **Figure 45** shows the export earnings of the country from sugar from 2016 to 2021.

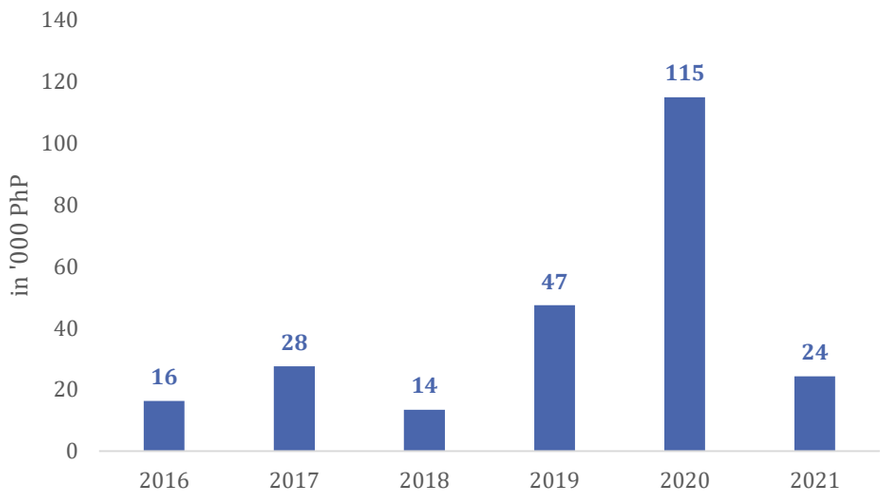


Figure 46. Export value of sugarcane from 2016 to 2021
(Source: AIS Report from PSA)

Rubber

The country's export earnings from natural rubber significantly increased from PhP 1,777 million in 2016 to PhP 8,161 million in 2021 (**Figure 46**). Local market for Philippine natural rubber are the Philippine Rubber Manufacturers and Yokohama Tire Philippines, Inc. (YTPI) (Philippine Rubber Industry Roadmap 2017-2022). On the other hand, export markets include Malaysia, Vietnam and China in 2021 with Malaysia as the largest market with about 97 percent share.

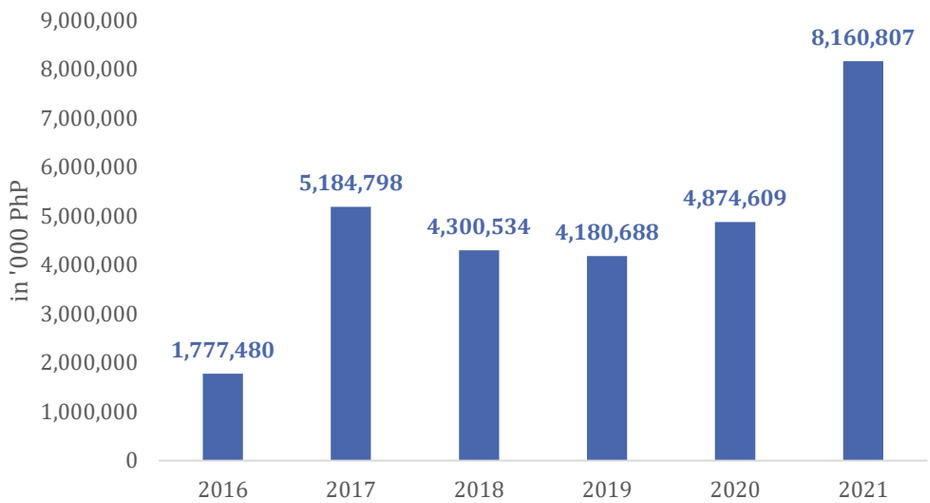


Figure 47. Export value of Philippine natural rubber from 2016 to 2021
(Source: AIS Report from PSA)

Priority Research Areas

Abaca

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement of abaca varieties through modern technologies	Updated physical, chemical, and morphological properties of different abaca commercial varieties Developed high-yielding and disease resistant abaca varieties thru DNA marker assisted selection breeding and genetic engineering Disease free quality planting materials of abaca through micropropagation	DA-PhilFiDA, DA-RFOs, SUCs
2023	Multi-location adaptability trials of recommended varieties	Recommended varieties of abaca including hybrids	DA-PhilFiDA, DA-RFOs, SUCs
2024-25	Enrichment, collection, characterization, and evaluation of abaca germplasm	Abaca germplasm	DA-PhilFiDA, DA-RFOs, SUCs
2024-25	Molecular characterization of abaca germplasm	Abaca germplasm	DA-PhilFiDA, DA-RFOs, SUCs
2024-25	Improvement of the production of abaca planting materials	Abaca regeneration system Methods of propagation Abaca genotypes with resistance major insect pest and diseases	DA-PhilFiDA, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Enhancement and improvement of soil and plant health of abaca	Information on nutrient deficiency, soil degradation of abaca Detection kit for nutrient deficiency and soil degradation of abaca Site-specific fertilizer recommendations/adaptive balanced fertilizer strategy for abaca Emerging and re-emerging diseases of abaca Upscaled/Pilot production/Commercialized Virus detection Upscaled production of polyclonal antibodies/ antiserum Effective management strategies for major diseases	DA-PhilFiDA, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment study for the expansion of abaca plantation	Identified production areas to supply raw materials for the embroidery industry	DA-PhilFiDA, DA-RFOs, SUCs
2023	Needs and design assessment (NADA) on fiber production, focusing on abaca, 'Red Spanish' pineapple, and bamboo, post-production (fiber extraction, material characterization), and waste management Needs assessment study for abaca stakeholders and acceptability on developed technologies for abaca	NADA study	DA-PhilFiDA, DA-RFOs, SUCs
2024-25	Development of appropriate location-specific production system for abaca	Developed appropriate and cost-effective, and climate resilient production technologies (e.g. SALT, IK, CSA, harvesting techniques) Water and nutrient management Integrated pest management Good agricultural practices Cropping systems [e.g. agroforestry, intercropping)	DA-PhilFiDA, DA-RFOs, LGUs, SUCs
2026-28	BAFS: Parameters on stripping and grading classification of fibers from improved varieties	Information on stripping and grading classification of fibers from improved varieties	DA-PhilFiDA, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of postharvest and processing system for abaca	Renewable energy for abaca postharvest processing Mechanization and automation of abaca decorticator Developed new designs of machines, tools and equipment for safe and efficient extraction of standard grades of fiber Developed drying and storage methods adaptable to abaca growing areas	DA-PhilFiDA, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Value chain analysis of abaca	Value chain analysis study	DA-PhilFIDA, SUCs, NGOs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of exclusive platform for abaca information system	Dissemination of market information to farmers	DA-PhilFiDA, DA-RFOs, SUCs
2026-28	GI/traceability of abaca	Information on the traceability of abaca	DA-PhilFiDA, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development/value-addition of abaca co-product/by-product	Antimicrobial application of Abaca Extracts Adsorbent of organic pollutants in waste water from fiber processing using abaca extraction wastes Developed other uses of abaca fiber Production of biofuels and power from abaca residues Extraction of oil from abaca seeds Abaca product transformation	DA-PhilFiDA, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Ecological impact study of abaca production	Impact assessment report Policy recommendations	SUCs, NGOs

Cacao

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Updating of quality standards and certification process for cacao	Cacao accredited nurseries producing quality cacao planting materials Certification of cacao process/products	DA-BPI, DA-RFOs, SUCs
2023	Varietal selection and improvement of cacao	Developed high yielding cacao varieties	DA-BPI, DA-RFOs, SUCs
2023	Assessment of seed dispersal program	Recommendations for the best practices on seedling dispersal	DA-BPI, DA-RFOs, SUCs
2023	Germplasm collection for cacao	Established and well-characterized germplasm collection for cacao	DA-BPI, DA-RFOs, SUCs
2023	Improvement of cacao planting materials propagation and management	Production of high-quality planting materials Protocol for the use of root trainers for cacao production; Improved vigor of cacao seedlings and efficiency of seedling production	DA-BPI, DA-RFOs, SUCs
2024-25	Location-specific morphological and genetic characterization of different cacao varieties (e.g. Criollo cacao)	Developed cacao information system Identified characteristics of location-specific cacao varieties (disseminated to stakeholders)	DA-BPI, DA-RFOs, SUCs
2024-25	Multi-location trials of cacao varieties under different ecological conditions	Site-specific cacao varieties	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of nutrient, water and soil management decision support tools	Nutrient, water, and soil diagnostic protocol for cacao trees: tree or clone-specific nutrient requirement and needs (location-specific)	DA-BPI, DA-BSWM, DA-RFOs, SUCs
2023	Improvement of appropriate production management system for cacao	Effect of rejuvenation on old unproductive cacao tree focused on dissemination (Abra, Ifugao, Apayao, Kalinga, Mt. Province, and Benguet)	DA-BPI, DA-RFOs, SUCs
2023	Improvement of cacao pest and disease management	Climate-related cacao production Pest and disease management Integrated pest management Integrated crop management Cropping and farming systems (e.g., agroforestry, intercropping) Utilized endophytic fungi for bio-fungicide	DA-BPI, DA-RFOs, SUCs
2024-25	Improvement of cacao production technologies	POT for organic cacao production GAP	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		pollination on cacao production	
2026-28	Utilization of endophytic fungi for bio-fungicide development	Bio-fungicide	DA-BPI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement of processing and postharvest technologies for cacao	Improved roasting techniques to enhance chocolate flavor and nutritional value of cacao beans Machine for separating cacao nibs and cacao kernels Protocol for fermentation and storage of cacao beans Detection of cacao bean quality through spectroscopy Materials for cacao beans fermentation (i.e. specific type of wood, rattan/wicker baskets, banana leaves, etc.)	DA-BPI, DA-PhilMech, DA-RFOs, SUCs
2024-25	Development, improvement, and value-addition of cacao products and by-products	Cacao-based beverages Cacao pod husk products	DA-BPI, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of products from cacao waste	Marketable products from utilized wastes (e.g., cacao beans skins into special paper or packaging materials)	DA-BPI, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment of current farmers practices, productivity, and bean quality	Assessment/analysis of farmer's practices from production to processing	DA-RFOs, SUCs, NGOs
2023	Assessment on cacao food safety of cacao beans i.e., heavy metals	Information on the heavy metal level of cacao beans	DA-RFOs, SUCs, NGOs
2023	Geo-mapping of cacao farms	Maps	DA-RFOs, SUCs, NGOs
2026-28	Assessment of production practices for cacao plantation and cacao-based farming systems in the Philippines	Assessment/analysis of farmer's practices and farming systems	DA-RFOs, SUCs, NGOs
2026-28	Genomics/phenotypic characterization of heirloom varieties	Heirloom varieties	DA-RFOs, SUCs, NGOs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Ecological impact study of cacao production	Impact assessment study	DA-RFOs, SUCs, NGOs
2026-28	Supply chain analysis on cacao	Supply chain analysis	DA-RFOs, SUCs, NGOs

Coconut

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Identification and development of high-yielding and disease-resistant varieties through molecular marker technology and genetic breeding	Optimized protocol for mass propagation of coconuts Gene discovery for coconut somatic embryogenesis Development/breeding of high-quality planting materials	DA-PCA, DA-RFOs, SUCs
2024-25	Formulation of low-cost appropriate fertilizer for coconut	Low-cost appropriate coconut fertilizer	DA-PCA, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of appropriate farming system	Protocol for coconut toddy production for sugar, ethanol, and other sugar-based products Nanotechnology/nanofertilizers Enhancement of existing but antiquated CME technologies using reusable catalysts (green catalysts) Documentation of successful intercropping systems—ecological and economic benefits, in-depth studies on the interrelationships of coconut with intercrops (on the rhizoshere and crop levels) Market-driven diversified farm plan and budget for smallholder coconut farmers	DA-PCA, DA-RFOs, SUCs
2023	Enhancement of production management practices for coconut	Soil/nutrient, water, pest and disease management New diagnostic protocol for pest and diseases	DA-PCA, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment on the storage shredded buko and/or other semi processed products	POT on the packaging material/semi processed products for shredded buko for export	DA-PCA, DA-RFOs, SUCs
2024-25	Development of new coconut food products and processing technologies	Spray drying protocols for coconut biomass (inflorescence sap, cocowater, coco milk) Ethanol production from coconut inflorescence sap and other biomass (ligno-cellulosic ethanol)	DA-PCA, DA-PhilMech, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		Sap and mineral contents (sweetness) of cocowater of different coconut cultivars at different stages of maturity Improved machineries Post-drying facility for copra Improved existing copra practices geared towards producing white copra Harvest and postharvest protocols for fresh young coconuts (trimmed FYC) Integrated technology processing model for coco-based food products Biotechnological enhanced coconut based food production (e.g. VCO, coconut-based food ingredients and additives) Developed products from *macapuno* (*Macapuno* product development and processing and packaging technologies)	

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of 'buko' waste husk shredder	Buko waste husk shredder	DA-PCA, DA-PhilMech, DA-RFOs, SUCs
2023	Optimization of processing system for efficient production and utilization of coconut by-products as ingredients or organic inputs in organic farming	Coconut value-added by-products as organic inputs	DA-PCA, DA-RFOs, SUCs
2023	Utilization of coconut wastes to develop marketable products	Plastic alternatives from palm biomass Developed VCO by-products, copra by-products (e.g., coconut water, coconut meat residues, coco skim milk, coco proteins)	DA-PCA, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Feasibility of commercial production of PCA recommended coconut varieties through coconut somatic embryogenesis using plumule tissues (CSet)	Feasibility study, quality coconut varieties	DA-PCA, DA-RFOs, SUCs
2023	Feasibility of commercial production of embryo cultured *macapuno*	Feasibility study, quality *macapuno* and soft-endosperm coconut varieties	DA-PCA, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	seedlings and other soft-endosperm coconuts		
2023	Vulnerability assessment of coconut agroecosystem in relation to climatic conditions	Assessment study, policy briefs	DA-PCA, DA-RFOs, SUCs
2023	Profiling of unmanaged or unmaintained coconut plantations for possible interventions and policy formulations to maximize productivity	Profiling study, policy briefs	DA-PCA, DA-RFOs, SUCs
2023	Value chain analysis of coconut production system in the Samar Island	Value chain analysis	DA-PCA, DA-RFOs, SUCs
2024-25	Conservation of Bicol germplasm	Coconut germplasm	DA-PCA, DA-RFOs, SUCs
2026-28	Possible amendments in the biofuel act covering technical, financial, and economic consideration	Policy analysis, policy brief	DA-PCA, SUCs, NGOs
2026-28	Use of cheaper oils for biofuel blending	Protocols	DA-PCA, DA-RFOs, SUCs
2023	Food safety related research on copra	Food safety study	DA-PCA, DA-RFOs, SUCs

Coffee

INPUTS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Updating of quality standards and certification process for coffee planting materials	Certification/accreditation of nurseries, planting materials, etc. Determination of the authenticity of quality seedlings sold in the market GAP Characterization and certification of locally planted barako coffee Assessment of the performance of heirloom coffee (e.g., *arabica* or *liberica var liberica*) Information on farmers practices, productivity, and bean quality vis a vis market standards/demand both for conventional and organic production	DA-BPI, DA-BAFS, DA-RFOs, SUCs
2023	Improvement of coffee planting materials propagation and management	Protocol in using root trainer for planting materials production for coffee	DA-BPI, DA-RFOs, SUCs
2023	Assessment study of the seedling dispersal program	Recommendations for the best practices on seedling dispersal	DA-BPI, DA-RFOs, SUCs
2023	Varietal selection and improvement of coffee	Screening of germplasm for accessions that are drought-tolerant varieties and tolerant to other abiotic stresses (e.g., ash fall from volcanic eruption, flashfloods, etc.)	DA-BPI, DA-RFOs, SUCs
2024-25	Multi-location testing and quality assessment of different NSIC approved varieties/cultivars	Trial/pilot testing of new coffee varieties/cultivars	DA-BPI, DA-RFOs, SUCs, LGUs
2024-25	Development, improvement, and breeding of coffee planting materials using biotechnology	Developed/improved varieties of coffee	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of metabolomics protocol for coffee	Protocol development	DA-BPI, DA-RFOs, SUCs
2023	Improvement of appropriate production management system for coffee	Water and nutrient management Climate-resilient coffee Coffee organic production Effect of rejuvenation on old unproductive coffee plants focused on dissemination (Ifugao, Apayao, Kalinga, Benguet)	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		Integrated pest management Cropping and farming systems (e.g., agroforestry, intercropping) Developed appropriate, cost-effective, and climate-resilient production technologies (e.g., SALT, IK, CSA, harvesting techniques) Appropriate practices for organic coffee production	

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of processing and postharvest technologies for coffee	Developed and commercialized machines and mechanization of facilities Detection of coffee bean quality through spectroscopy Quality improvement of green coffee beans (GCB) Identification of chemical and toxin contamination of coffee beans	DA-BPI, DA-PhilMech, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Market study for coffee products	Competitive packaging and promotional strategies for coffee products Addressing the challenges related to catering the demand through increased local coffee production and making local coffee products more competitive in terms of quality and price	DA-BPI, DA-RFOs, SUCs
2023	Updating quality standards and certification process for coffee products	Traceability using QR codes (with carbon printing locality name of famer for us to protect the consumer and farmer producer) Establishment of quality standards and certification process for Civet coffee and organic coffee Proving the uniqueness of coffee in a particular origin of the Philippines Good manufacturing practices	DA-BPI, DA-BAFS, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of coffee by-products	Utilization of coffee wastes Bioenergy research	DA-BPI, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of exclusive platform for coffee information system	Mobile apps for the real-time monitoring (e.g., pest identification/detection and management)	DA-BPI, DA-ICTS, DA-RFOs, SUCs
2024-25	Development of exclusive platform for coffee information system	Mobile apps for product selling	DA-BPI, DA-ICTS, DA-RFOs, SUCs
2024-25	Feasibility study of community-based expansion of coffee production areas	Feasibility study	DA-BPI, DA-RFOs, SUCs
2024-25	Value chain analysis including the documentation of successful coffee projects where farmers participate in the higher level of the value chain to identify gaps or interventions in existing systems	Value chain analysis	DA-BPI, DA-RFOs, SUCs
2026-28	Ecological impact study of coffee production	Carbon footprint, water footprint, and energetics of pulp	DA-BPI, DA-RFOs, SUCs

Pili

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Multi-location testing and quality assessment of different NSIC approved varieties/cultivars	Early bearing pili varieties	DA-BPI, DA-RFOs, SUCs, LGUs
2023	Physiological studies on pili Development of technology for early detection of male or female plants	Protocol for early detection of male and female plants	DA-BPI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of production management practices for pili	Growth and yield forecast for different pili varieties Reduction/elimination of tayangawon in pili nuts which causes unpleasant or bland taste during processing	DA-BPI, DA-RFOs, SUCs
2023	Characterization, evaluation, and conservation of pili trees	Profiles of pili varieties orchard Identification of areas with source of resin	DA-BPI, DA-RFOs, SUCs
2023	Development of new harvesting technologies on pili farming	Sustainable pili sap tapping	DA-BPI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Improvement of postharvest handling and processing for pili kernel, oil, and elemi	Evaluation of different processes of storing pili products	DA-BPI, DA-RFOs, SUCs
2023	Development and value-addition of pili sap for essential oil production	Elemi production	DA-BPI, DA-RFOs, SUCs
2023	Characterization of pili nuts in terms of nutritional and confectionary value	Sensory evaluation and nutritional profile of pili nuts	DA-BPI, DA-RFOs, SUCs
2024-25	Improvement of appropriate tools and machinery for postharvest	Improved various tools and machineries e.g., roaster, nutcracker, grinder, extractor, pili nut deshelling machine	DA-BPI, DA-PhilMech, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Market study of new pili products	Consumer acceptance of new pili products Consumer behavior patterns on pili products	DA-BPI, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Utilization of pili waste to develop new and marketable value-added by-products	Pili value-added by-products (e.g., pili nut shells, seedcoat, and pulp in fuel and craft industry)	DA-BPI, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Application of conservation agriculture for sustainable intensification in pili farms	Protocol on sustainable conservation/intensification	DA-BPI, DA-RFOs, SUCs
2024-25	Updating of information and mapping through geotagging	Maps	DA-BSWM, DA-RFOs, SUCs

Sugarcane

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of site-specific sugarcane varieties and technologies	Site-specific sugarcane varieties and package of technology	DA-SRA, DA-RFOs, SUCs, LGUs
2026-28	Development of flower inducer	Flower inducer for sugarcane	DA-SRA, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of mechanized cultural management practices for sugarcane	Mechanized cultural management practices for sugarcane	DA-SRA, DA-PhilMech, DA-RFOs, SUCs
2024-25	Development of pest and disease surveillance protocol	Survey of emerging and re-emerging diseases Use of markers for diseases in sugarcane	DA-SRA, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of locally-produced and affordable farm machineries through open systems agricultural machinery manufacturing	Farm machineries	DA-SRA, DA-PhilMech, DA-RFOs, SUCs
2023	Feasibility study of community-based sugar processing plant	Feasibility study	DA-SRA, DA-RFOs, SUCs
2023	Development of cost-efficient processing technology for muscovado	Cost-efficient processing technology for muscovado	DA-SRA, DA-PhilMech, DA-RFOs, SUCs
2024-25	Development of portable NIR spectrometers with calibration models for predicting sugarcane quality (brix, fiber, moisture)	Test kit	DA-SRA, DA-RFOs, SUCs
2026-28	Ecological impact studies on sugarcane production	Carbon footprint Water footprint estimates Environmental impact assessment	DA-SRA, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development, improvement, and value-addition of sugarcane products/by-products	Sugarcane co-products and by-products	DA-SRA, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Adoption of conservation agriculture technology for sustainable sugarcane production	Protocol on sustainable conservation/intensification of sugarcane	DA-SRA, DA-RFOs, SUCs

Sweet Sorghum

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Multi-location testing of sweet sorghum hybrids	Site-suitable sweet sorghum hybrids	DA-RFOs, SUCs, LGUs
2024-25	Low-cost production of hybrid seeds	Low-cost hybrid seeds	DA-RFOs, SUCs
2024-25	Development of production management practices for sweet sorghum (seed and ratoon)	Protocols on fertilizer application, irrigation schedule, water management, pest and disease management	DA-RFOs, SUCs
2026-28	Development of production management practices for local hybrids of sweet sorghum	Protocols on fertilizer application, irrigation schedule, water management, pest and disease management for local hybrids	DA-RFOs, SUCs
2026-28	Varietal development and improvement of local hybrids	Local hybrids	DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of sustainable agricultural production technology	Agricultural production technology	DA-RFOs, SUCs
2023	Socioeconomic and cultural acceptability of sorghum production among farmers	Sorghum production areas	DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development of locally-produced affordable and appropriate farm machineries through open systems agricultural machinery manufacturing	Farm machineries	DA-PhilMech, DA-RFOs, SUCs
2024-25	Product development for diversified uses of sweet sorghum	Diversified sweet sorghum products	DA-RFOs, SUCs
2026-28	Development and improvement of postharvest management local hybrids of sweet sorghum	Protocols on postharvest management	DA-RFOs, SUCs
2026-28	Assessment of engine performance using hydrous ethanol	Percentage use of hydrous ethanol in biofuels	SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Utilization of sweet sorghum waste to develop new and marketable value-added products	Value-added products from sweet sorghum wastes	DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Updating of feasibility study on production of sweet sorghum	Feasibility study	DA-RFOs, SUCs, NGOs

Rubber

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment study on the establishment of new and rehabilitation of existing rubber nursery	Identified areas for rubber nursery New methodologies in rubber nursery management	DA-PRRI, DA-RFOs, SUCs
2023	Collection, characterization, evaluation, and conservation of Rubber germplasm	Identified rubber germplasms	DA-PRRI, DA-RFOs, SUCs
2023	Development and promotion of quality planting materials	Cloning rubber through somatic embryogenesis	DA-PRRI, DA-RFOs, SUCs
2023	Prototype development of locally fabricated root trainer cups	Locally fabricated root trainer cups	DA-PRRI, DA-RFOs, SUCs
2023	Development and enhancement of protocols for the production of quality planting materials for rubber	Enhanced micropropagation techniques, including rapid multiplication of sufficient quality planting materials through traditional method Developed protocols for tissue culture production of planting materials Developed packaging technique for rubber bud stock Techniques in propagation of planting materials and extending viability of seeds	DA-PRRI, DA-RFOs, SUCs
2024-25	Varietal development and improvement of rubber clones/lines	Improved rubber clones/lines molecular markers	DA-PRRI, DA-RFOs, SUCs
2024-25	Feasibility study of producing quality and vigorous rubber planting materials	Feasibility study Identified quality planting materials	DA-PRRI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Adaptation trials of rubber	Identified and rehabilitated rubber plantation with obsolete clones in traditional and non-traditional area Field trials of young budded rubber	DA-PRRI, DA-RFOs, SUCs
2024-25	Development of appropriate production system for rubber	Protocols, databases and platforms in disease management of rubber, including integrated pest management Water and nutrient management GAP Integrated crop management (agroforestry, intercropping) Tapping Panel Dryness (TPD) management	DA-PRRI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		Appropriate and cost-effective, and climate resilient production technologies (e.g. SALT, IK, CSA, harvesting techniques) Utilized cover cropping technologies Balanced fertilization for rubber production Root training technique for efficient production system of rubber	
2024-25	Development of efficient tools and technologies for rubber tapping	Tools for rubber tapping	DA-PRRI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development, improvement, and value-addition of rubber products/by-products	Recycled rubber products and other rubber products Biogas using rubber lumps waste water	DA-PRRI, DA-RFOs, SUCs
2023	Assessment of rubber cuplumps qualities	Identified qualities of rubber cuplumps (storage, aging, coagulation process)	DA-PRRI, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Value chain analysis of rubber	Value chain analysis	DA-PRRI, DA-RFOs, SUCs
2024-25	Socioeconomic and cultural acceptability in non-rubber producing regions	Additional rubber production areas in non-rubber production regions	DA-PRRI, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of appropriate waste management	Protocol on waste management	DA-PRRI, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Establishment of rubber R4D laboratories and processing plants	R4D facilities for rubber (e.g. laboratories, processing centers)	DA-PRRI, DA-RFOs, SUCs
2024-25	Assessment of factors affecting the adoption of rubber technologies	Information on adoption practices	DA-PRRI, DA-RFOs, SUCs
2024-25	Ecological impact study of rubber production	Impact assessment	DA-PRRI, DA-RFOs, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Policy research e.g., market prices	Policy research Policy brief	DA-PRRI, DA-RFOs, SUCs

Other Plantation and Biofuel Crops

INPUT				
Period	**Commodity**	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Bamboo	Bamboo industry characterization	Industry study	DA-BPI, DA-RFOs, SUCs
2023	Nipa	Varietal development of site-specific nipa varieties	Site-specific nipa varieties	DA-BPI, SUCs, LGUs
2024-25	Cut flower	Development of micro and macro mass propagation techniques and procedures for some cut flowers and ornamentals	Protocols for propagation technique	DA-BPI, SUCs, LGUs
2024-25	Cut flower	Economic assessment of indigenous and endemic ornamentals and cut flowers	Documentation of indigenous and endemic ornamentals and cut flowers with potential market for medicinal and cosmetic uses	DA-BPI, SUCs, LGUs
2024-25	Cut flower	Varietal improvement through breeding and selection of cut flowers	Improved varieties	DA-BPI, SUCs, LGUs
2024-25	Cut flower	Adaptability trials of cut flowers	Site-specific varieties	DA-BPI, SUCs, LGUs
2024-25	Cut flower	Development of production technologies for cut flowers	Effective and alternative methods for pest and disease management control/strategies Soil amendments technologies (soil enhancers)	DA-BPI, SUCs, LGUs

Livestock

Commodity industry situation, performance outlook, and economic importance

The demand for animal-derived products continue to grow, and it is projected to continue having the same upward trend with meat and other animal-derived products being staples in most Filipino households. The increase in the demand for dairy products alone can be observed in the growing dairy imports of the country **(see Figure 48)**. Main drivers considered for increased demand are increasing urbanization, increasing income, and population growth (Philippine Dairy Industry Roadmap 2020-2025).

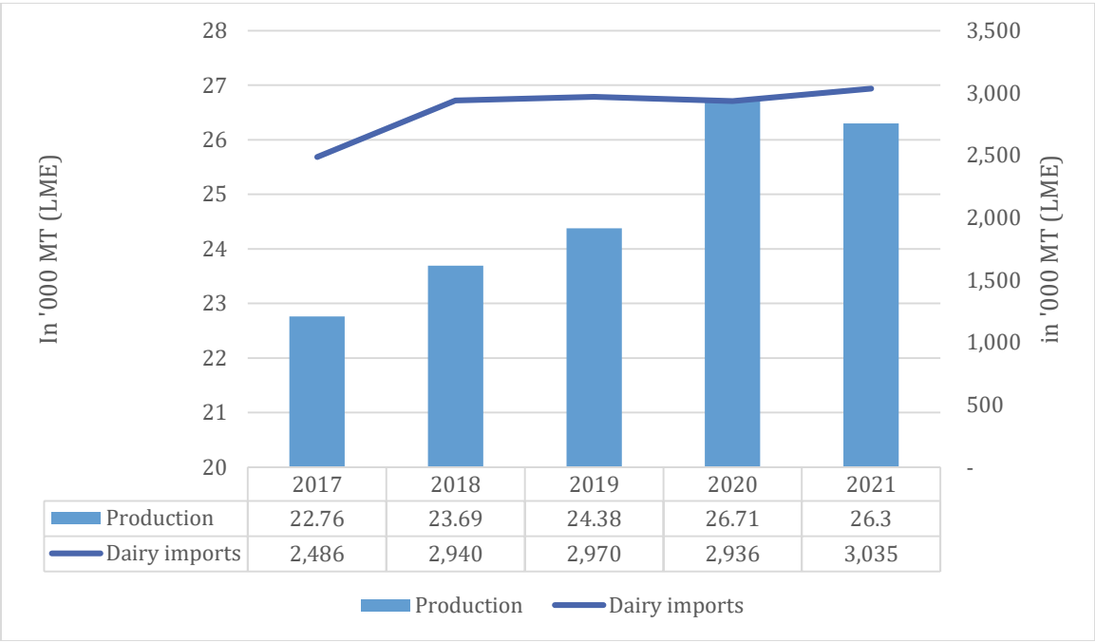


Figure 48. Philippine dairy production and annual imports, in LME, 2017-2021
(Source: PSA and NDA)

As of 2022, the Philippines imports 99 percent of its dairy requirement. To date, only 1 percent of the total domestic demand is catered by domestic production. Production growth has been minimal due to the decline in herd size and its production efficiency. The inability to increase the dairy herd is attributed to the slaughter of cows for meat and insufficient funding from the private sector (Mojica-Sevilla, 2022). Low production efficiency as well as poor reproduction, on the other hand, was linked to issues on feed base and inadequacy in nutritional management (Philippine Dairy Industry Roadmap 2020-2025).

Similar to cattle, draft carabaos (water buffaloes) in the country have been declining too. The decline in draft carabaos, or those that are utilized for farming, was linked to the introduction of farm mechanization. Due to the work needed to maintain carabaos, many farmers have shifted to mechanization. As mentioned by Orcino (1974) and Alviar (1983) in the Philippine Carabao Roadmap, farmers have declared that hand tractors cultivate land better and are cheaper to use in the long run. This trend was observed not only in the Philippines but in most of SEA countries.

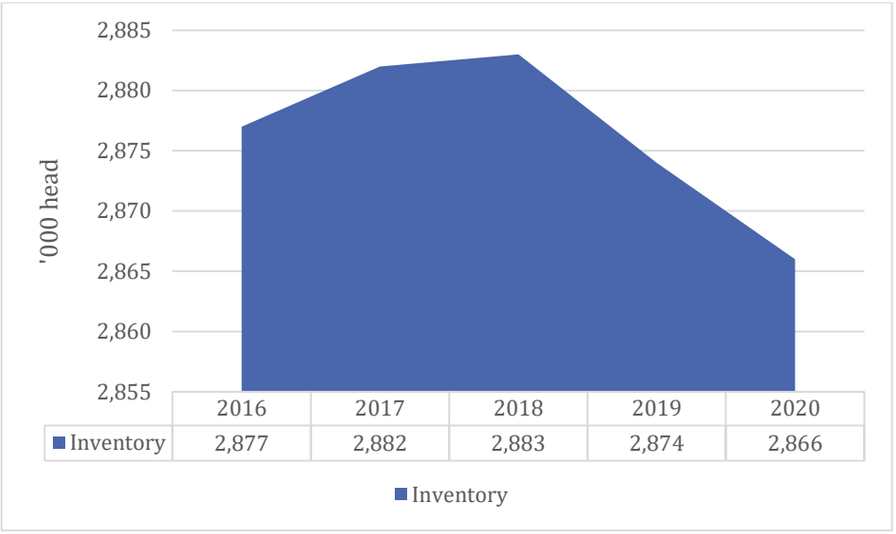


Figure 49. Carabao inventory, 2016-2020
Source: PSA

For the past few decades, there has been no significant change in carabao population. While a positive growth was observed from 2000 to 2007 in the data published by PSA, a decline in carabao population occurred from then on until 2015 when numbers has relatively been stabilized at an annual growth rate of 0.43 percent **(Table 9)**.

Table 9. Average annual change in carabao inventory, in percent, 2000-2020.

Period	Average Annual Percent Change (in %)	Average Annual Production (in MT)	Average Annual Import of Carabao meat (Carabeef in MT)
2000-2007	1.61	131.605	40.68
2008-2014	-2.41	143.44	30.93
2015-2020	0.43	139.27	34.67

Despite the absence of a remarkable increase in carabao population, separate reports from the National Dairy Authority (NDA) and the Philippine Carabao Center (PCC) show that there has been a growing interest in buffalo dairying due to the high market demand for buffalo milk products **(Figure 50)**. From 2014 to 2018, the inventory of dairy carabao has continuously been increasing. A slight decline in the number of dairy carabao occurred in 2019 but nevertheless, the amount of milk produced has a consistent upward trend from 2014 to 2019 **(Figure 51)**.

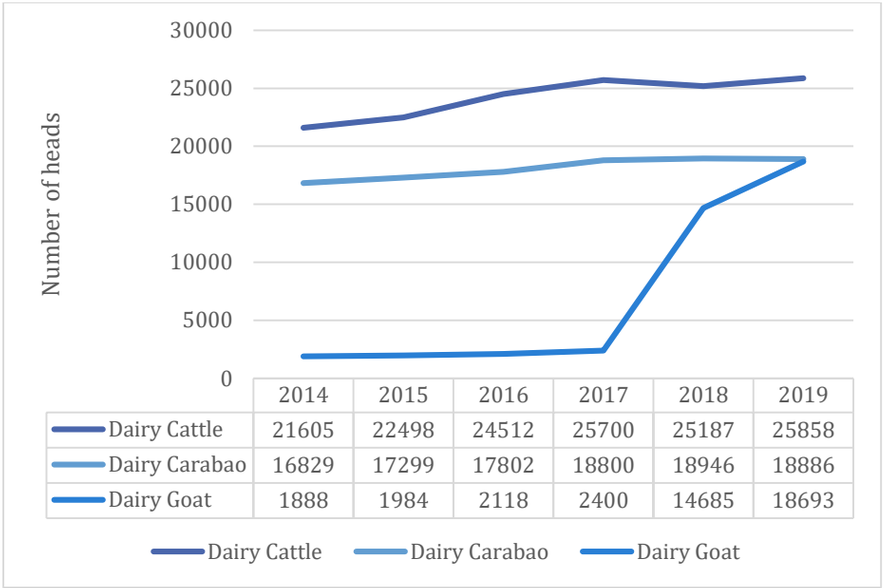


Figure 50. Inventory of dairy animals
(Source: Philippine Dairy Industry Roadmap 2020-2025 and Philippine Carabao Industry Roadmap 2022-2026)

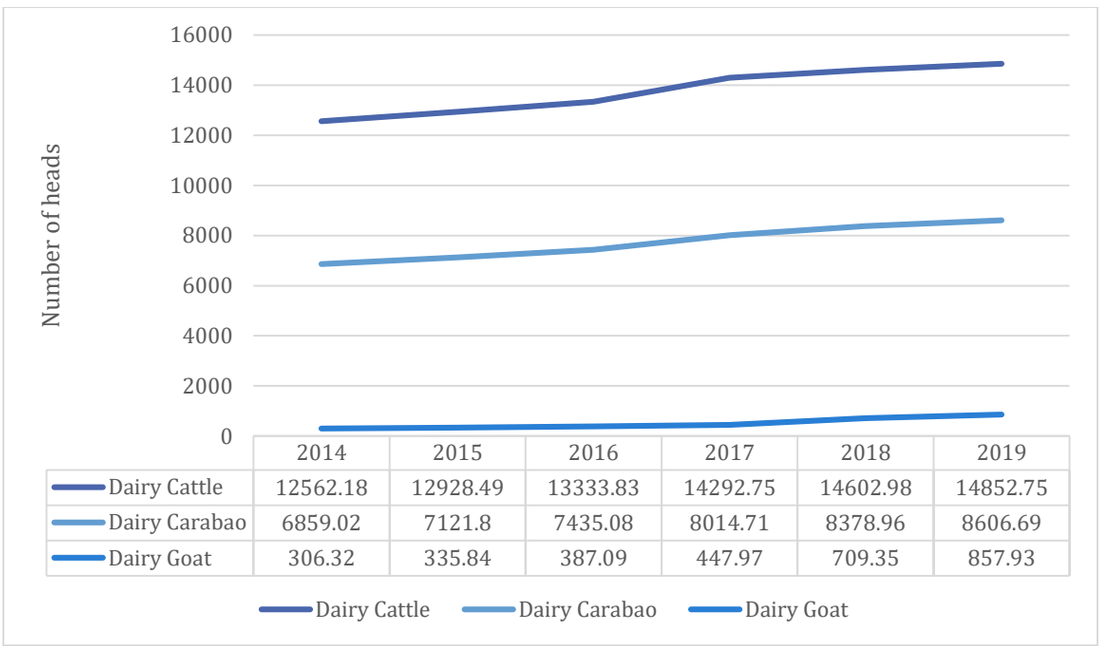
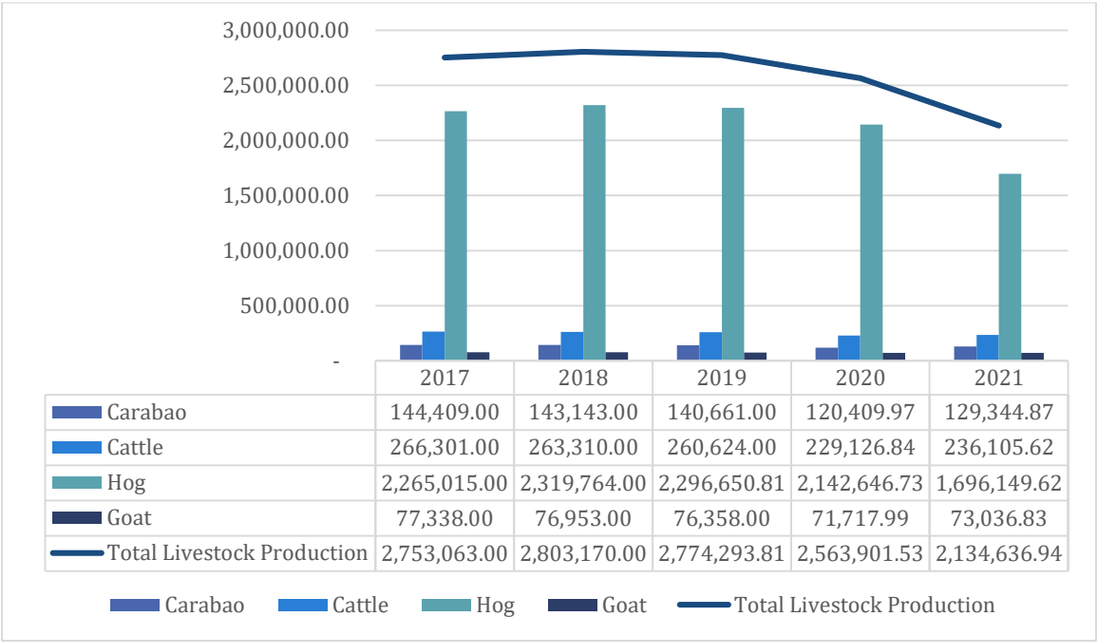


Figure 51. Milk production by animal type, in '000 liters, 2014-2019
Source: Philippine Carabao Industry Roadmap 2022-2026

Similarly, a growing interest in goat raising for dairy was observed **(Figure 50)**. A significant increase in dairy goats has been recorded in 2018 and has since then gone up. In the Philippine Small Ruminants Industry Roadmap 2022-2040, goat production in the country was described as a "sunrise industry". While goat population declined from 2018 to 2020, the numbers have started going up again in 2021 **(see Figure 52)**. The demand for goat meat is expected to rise with the need to find alternative sources of meat and the declaration of Philippines by the World Organization for Animal Health (OIE) as Peste des Petits Ruminants (PPR)-free and Foot-and-Mouth Disease (FMD)-free without vaccination with all the country's zone equally recognized. With regards to milk production, the production of milk by all dairy animals has been increasing consistently and this can be seen in the upward trend of milk production for all dairy animals.

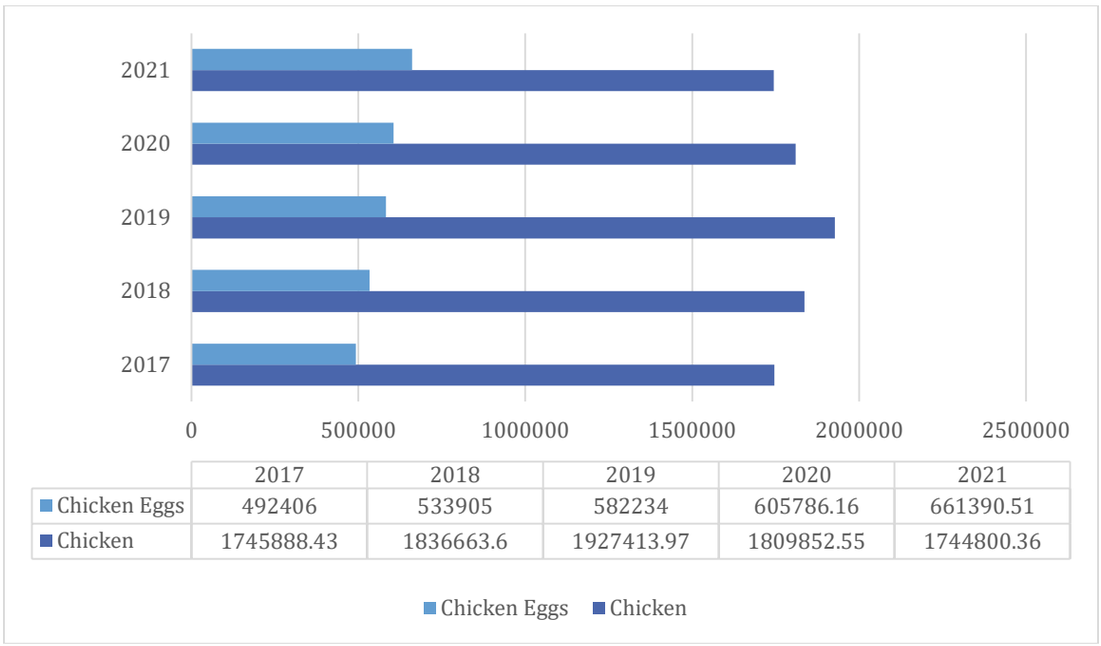


	2017	2018	2019	2020	2021
Carabao	144,409.00	143,143.00	140,661.00	120,409.97	129,344.87
Cattle	266,301.00	263,310.00	260,624.00	229,126.84	236,105.62
Hog	2,265,015.00	2,319,764.00	2,296,650.81	2,142,646.73	1,696,149.62
Goat	77,338.00	76,953.00	76,358.00	71,717.99	73,036.83
Total Livestock Production	2,753,063.00	2,803,170.00	2,774,293.81	2,563,901.53	2,134,636.94

Figure 52. Volume of production by animal type, 2017-2021
(Source: PSA)

Among the livestock sector, the hog industry is the major contributor in the agriculture sector of the country. Over the years, its output is consistent in being the highest in the livestock sector. While the industry is still dominated by backyard farmers, the industry is slowly being commercialized. With pork as a staple in some Filipino households, the hog industry is as strong as it could ever be. In 2019, however, the African Swine Fever (ASF) disease devastated the country and has remarkably affected the inventory of hogs. Numerous farms closed, some farmers lost confidence in the industry, and prices of pork continued to go up. Because of the numerous challenges in the hog industry, the volume of production of hogs has not gone up yet as of 2021. To help the industry recuperate, the government and the private sector has been working hand in hand. The private sector has invested billions for the industry. The government, on the other hand, has offered loans for hog producers (The Philippine Hog Industry Roadmap 2022-2026).

Next to pork, chicken meat is one of the most consumed meats by Filipino households. Consumption of meat has increased over the years, and this has been mostly driven by the increasing population, urbanization, and rising income. Due to its relatively cheaper price than other meat options and its availability in the market, it has become the go-to source of protein of many Filipinos. Demand for chicken continue to rise, the growth of the industry, however, is hindered by a number of challenges. Chicken production has been increasing until 2019. From 1,745.8 MT in 2017, the volume of production went up to 1,927.4 MT in 2019 before declining to 1,809.9 MT in 2020 and 1,744.8 MT in 2021. Based on the latest SWOT Analysis for Broiler Value Chain by the DA-BAI, threats for the industry are more on the high cost of Day-old Chicks (DOCs), supply of inputs, and existence of diseases such as the avian influenza (Philippine Broiler Industry Roadmap 2022-2040). In 2020, chicken production was also affected by the pandemic, and this can be seen in the decline in the volume of production shown in **Figure 53**. Nevertheless, the poultry sector is very proactive in addressing issues related to chicken production. Aside from chicken meat, chickens are also good sources of eggs. From 2017 to 2021, chicken egg production has posted continuous growth. Sustaining this growth is among the interests of the poultry sector. The private sector, in particular, actively supports the industry towards its advancement.



	2017	2018	2019	2020	2021
Chicken Eggs	492406	533905	582234	605786.16	661390.51
Chicken	1745888.43	1836663.6	1927413.97	1809852.55	1744800.36

Figure 53. Volume of production of poultry and eggs, 2017-2021
(Source: PSA)

Rabbit as a source of meat, while still controversial, is gaining attention slowly in the country. Due to the spread of ASF in the country, a portion of livestock raisers were reported to gain an interest in rabbit production. Growing rabbits do not require much space and inputs needed to grow them are readily available. Observing the graph in **Figure 54**, indeed, production in 2022 is higher than in 2021. It is assumed that in the long run, more people will consider rabbits as an acceptable source of meat.

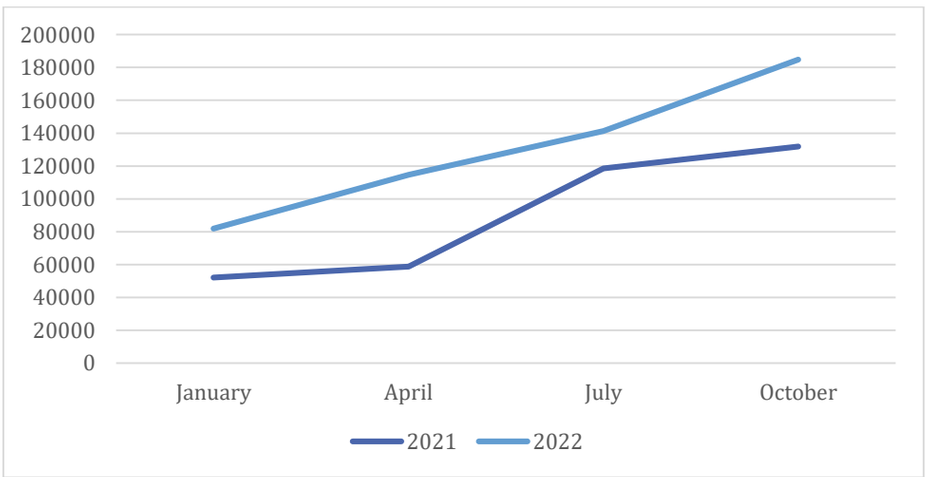


Figure 54. Rabbit inventory, in heads
(Source: PSA)

Similar to rabbit, apiculture is among the relatively new and emerging industries in the Philippines. Not much has been written about the bee industry in the country yet but over the past couple of years, a growth in the number of publications on Bee R&D can be observed. From the report released by BEENET Philippines and UPLB Bee Program, the annual honey production in the Philippines ranges from 50 to 110 mt. Of this production, majority is from *Apis mellifera,* a European honeybee. *Apis mellifera* is preferred by locals due to its high productivity. Despite its productivity, however, the supply of honey in the

country is still lower than the local demand due to the low number of people venturing into beekeeping. In a consumer study conducted, it was identified that people have developed a preference for honey that is of high quality and with that, it is hoped that many people would be encouraged to enter the industry.

Economic importance

The livestock and poultry industry are both major contributors to the agriculture sector of the Philippines. While there has been a decline in the percent share of both starting from 2019 due to the challenges experienced by the industries, Gordoncillo et al. (2020) reported that the livestock and poultry industry remain significant to Philippine agriculture, contributing approximately one-fourth of the total output of the country in terms of agriculture and fisheries.

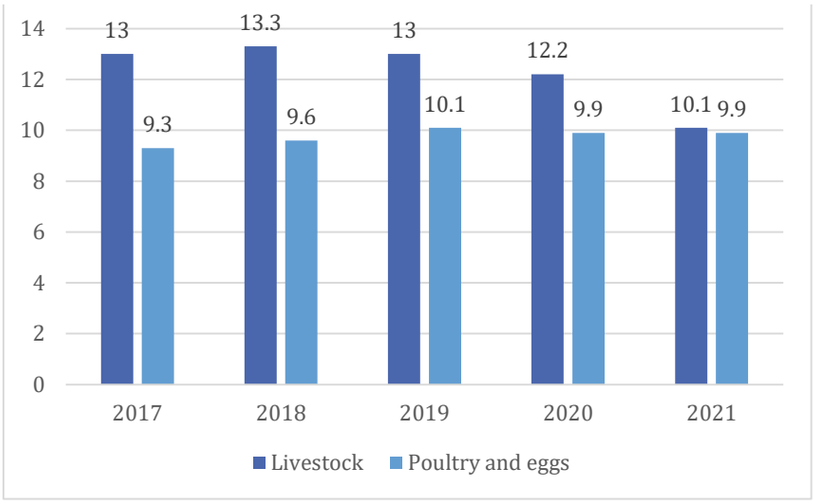


Figure 55. percent share of livestock and poultry and egg production in the GVA in agriculture, in 2018 constant prices
(Source: PSA)

In 2021, livestock, which contributed 10.1 percent to the total value of production in agriculture and fisheries, contracted by 2.1 percent. Poultry and eggs, on the other hand, recorded no change in the percent share to the total value of production at current prices and constant 2018 prices.

At current prices, the value of livestock production recorded improvements from 2017 to 2021. At constant prices, however, the value of livestock production started to decline from 2019.

The value of poultry production declined in 2018 and expanded from 2019 up to 2021 using current prices. In contrast, value of poultry production continued to expand from 2017 to 2019 and declined from 2020 to 2021 at constant 2018 prices.

To sum it up, the value of production of livestock and poultry at constant 2018 prices in million PhP in 2021 was lower than their value of production in 2020.

Table 10. Contribution to GVA in agriculture of livestock production, 2017- 2021

Item	2017	2018	2019	2020	2021
At Current Prices (in million PhP)	205,081	234,504	238,899	239,393	267,860
Percent (%) share to total GVA in Agriculture	12.2	13.3	13.9	13.1	13.7
At Constant 2018 Prices (in million PhP)	226,226	234,504	232,534	216,495	179,029
Percent (%) share to total GVA in Agriculture	13.0	13.3	13.0	12.2	10.1

Source: PSA

Table 11. Contribution to GVA in agriculture of poultry and eggs, 2017-2021

Item	2017	2018	2019	2020	2021
At Current Prices (in million PhP)	172,435	169,999	179,589	188,148	201,451
Percent (%) share to total GVA in Agriculture	10.2	9.6	10.4	10.3	10.3
At Constant 2018 Prices (in million PhP)	161,433	169,999	179,875	175,507	174,978
Percent (%) share to total GVA in Agriculture	9.3	9.6	10.1	9.9	9.9

Source: PSA

Priority Research Areas

Ruminants (Dairy and Meat)

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Feeds and Feeding System			
2023	Identification and evaluation of alternative and locally-available feed ingredients (organic and non-organic feed production)	information/data on nutritional valuation of alternative feeds	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2023	Scaling and standardization of alternative and locally-available feed ingredient production (organic and non-organic feed production)	POT/protocol for mass production of feed ingredient	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2023	Scaling and optimization of feed production through processing of alternative and locally-available feed ingredients (organic and non-organic feed production)	optimized protocols for feed processing (e.g., silage, dry rolling to increase feed value, etc.) feed formulation using alternative and locally-available feed ingredient	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2023	Improvement and utilization of feeding management system	automated and precise feeding system protocols efficient and effective equipment/machine and designs for feeding systems	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2024-25	Field validation and utilization of natural alternative feed additives and supplements	viable and natural alternative feed additives and supplements	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
Breeds and Breeding stock			
2024-25	Intensification of genetic profiling and conservation of native breeds	native breeds profile POT/protocol for the conservation of native breeds available and accessible breeding stock	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2024-25	Field validation and utilization of effective and efficient reproductive techniques	protocols for reproductive technique/method	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
Health and Nutrition			
2024-25	Assessment and field validation of POT for available alternative veterinary medicines/practices	production and application guide	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
Housing and Cooling Systems			

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development and utilization of climate-resilient housing systems for smallhold production	climate-resilient housing system design/prototype	DA-BAI, DA-BAFE, DA-PCC, DA-NDA, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development and utilization of rapid and cost-effective diagnostic methods	rapid and portable disease diagnostic kit/tool	DA-BAI, DA-PCC, DA-NDA, DA-RFOs, SUCs
2026-28	Development/improvement and utilization of POTs for ruminant management systems to advance productivity and efficiency	POT/protocols for ruminant management system	SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Market study of dairy and meat products	recommendation for the refinement of dairy and meat products and marketing strategies products compliant to organic and halal certification	DA-BAI, DA-PCC, DA-NDA, DA-NMIS, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development/refinement and utilization/scaling of postharvest and processing POTs	POT/Protocol	DA-BAI, DA-PCC, DA-NDA, DA-NMIS, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Refinement and scaling of POT on waste utilization from smallhold ruminant production	waste management technologies	DA-BAI, DA-PCC, DA-NDA, DA-NMIS, SUCs

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
Food security				

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
2023	Improving epidemiological surveillance and biosecurity measures	improved surveillance and biosecurity protocols policy recommendations	DA-BAI, DA-RFOs	Thematic Area 4
Food safety				
2024-25	Development of traceability systems for ruminant farms	traceability systems	DA-BAI, DA-NMIS, SUCs	Thematic Area 4
2024-25	Development and utilization of rapid and cost-effective detection of microbiological and chemical hazards Study on the prevalence and control of AMR on mastitis cases in the Philippines	diagnostic kits/equipment	DA-BAI, DA-NMIS, DA-RFOs, SUCs	Thematic Area 4
Environmental and economic impact				
2024-25	Impact and economic assessment of different ruminant diseases	environment and economic impact study policy recommendation	DA-BAI, SUCs	Thematic Area 1, Thematic Area 5
Supply Chain				
2024-25	National and integrated supply chain analysis of dairy and meat products	data/information on swine product supply chain policy recommendation	DA-BAI, SUCs	Thematic Area 2, Thematic Area 3

Swine

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Feeds and Feeding System			
2023	Identification and evaluation of alternative and locally-available feed ingredients (organic and non-organic feed production)	Information/data on nutritional valuation of alternative feeds	DA-BAI, DA-RFOs, SUCs
2023	Scaling and standardization of alternative and locally-available feed ingredient production (organic and non-organic feed production)	POT/protocol for mass production of feed ingredient	DA-BAI, DA-BAFS, DA-RFOs, SUCs
2023	Scaling and optimization of feed production through processing of alternative and locally-available feed ingredients (organic and non-organic feed production)	optimized protocols for feed processing (e.g., fermentation technologies, pelletized feed to increase feed value, etc.) feed formulation using alternative and locally-available feed ingredient	DA-BAI, DA-RFOs, SUCs
2024-25	Improvement and utilization of feeding management system	automated and precise feeding system protocols efficient and effective equipment/machine and designs for feeding systems	DA-BAI, DA-RFOs, SUCs
2024-25	Field validation and utilization of natural alternative feed additives and supplements	viable and natural alternative feed additives and supplements	DA-BAI, DA-RFOs, SUCs
Breeds and Breeding stock			
2024-25	Intensification of genetic profiling and conservation of native breeds	native breeds profile POT/protocol for the conservation of native breeds available and accessible breeding stock	DA-BAI, DA-RFOs, SUCs
2024-25	Field validation and utilization of effective and efficient reproductive techniques	protocols for reproductive technique/method	DA-BAI, DA-RFOs, SUCs
Health and Nutrition			
2024-25	Assessment and field validation of POT for available alternative veterinary medicines/practices Development of natural alternatives to improve meat quality (organic agriculture)	production and application guide	DA-BAI, DA-RFOs, SUCs

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Housing and Cooling Systems			
2024-25	Development and utilization of climate-resilient housing systems for small scale swine production	climate-resilient housing system design/prototype	DA-BAI, DA-BAFE, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development and utilization of rapid and cost-effective disease diagnostic tool/kit	Rapid and portable disease diagnostic kit/tool	DA-BAI, DA-RFOs, SUCs
2026-28	Development/improvement and utilization of POTs for swine management systems to advance productivity and efficiency	POT/protocols for swine management system	DA-BAFS, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Market study of swine products	recommendation for the refinement of swine products and marketing strategies	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development/refinement and utilization/scaling of postharvest and processing POTs	POT/Protocol	DA-BAI, DA-NMIS, DA-RFOs, SUCs

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Refinement and scaling of POT on waste utilization from smallhold swine production	waste management technologies	DA-BAI, DA-RFOs, SUCs
2024-25	Environmental study on swine waste	data/information on the effect of swine waste	DA-BAI, DA-RFOs, SUCs

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
Food security				

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
2023	Improving epidemiological surveillance and biosecurity measures	improved surveillance and biosecurity protocols policy recommendation	DA-BAI, DA RFOs	Thematic Area 4
Food safety				
2024-25	Development of traceability systems for swine farms	traceability systems	DA-BAI, DA-NMIS, SUCs	Thematic Area 4
2024-25	Development and utilization of rapid and cost-effective detection of microbiological and chemical hazards	diagnostic kits/equipment	DA-BAI, DA-NMIS, DA-RFOs, SUCs	Thematic Area 4
Environmental and economic impact				
2024-25	Impact and economic assessment of different swine diseases and antimicrobial resistance	environment and economic impact study policy recommendations	DA-BAI, SUCs	Thematic Area 1, Thematic Area 5
Supply Chain				
2024-25	National and integrated supply chain analysis of swine products	data/information on swine product supply chain policy recommendations	DA-BAI, SUCs	Thematic Area 2, Thematic Area 3

Poultry

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Feeds and Feeding System			
2023	Identification, evaluation, and field validation of alternative and locally-available feed ingredients (organic, non-organic and halal feed production)	information/data on nutritional valuation of alternative feeds	DA-BAI, DA-RFOs, SUCs
2023	Scaling and standardization of alternative and locally-available feed ingredient production (organic and non-organic feed production)	POT/protocol for mass production of feed ingredient	DA-BAI, DA-RFOs, SUCs
2023	Scaling and optimization of feed production through processing of alternative and locally-available feed ingredients (organic and non-organic feed production)	optimized protocols for feed processing (e.g. fermentation technologies, pelletized feed to increase feed value, etc.) feed formulation using alternative and locally-available feed ingredient	DA-BAI, DA-RFOs, SUCs
2024-25	Improvement and utilization of feeding management system	automated and precise feeding system protocols efficient and effective equipment/machine and designs for feeding systems	DA-BAI, DA-RFOs, SUCs
2024-25	Field validation and utilization of natural alternative feed additives and supplements Development of natural alternative to antibiotic/growth promotants Development and evaluation/field validation of Phytogenics heavy metals and contaminants (under crosscutting)	viable and natural alternative feed additives and supplements information/data on nutritional valuation of phytogenics	DA-BAI, DA-RFOs, SUCs
Breeds and Breeding stock			
2024-25	Intensification of genetic profiling and conservation of native breeds	native breeds profile POT/protocol for the conservation of native breeds	DA-BAI, DA-RFOs, SUCs

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		available and accessible breeding stock	
2024-25	Field validation and utilization of effective and efficient reproductive techniques	protocols for reproductive technique/method	DA-BAI, DA-RFOs, SUCs
Health and Nutrition			
2024-25	Assessment and field validation of POT for available alternative veterinary medicines/indigenous practices Socio-cultural and indigenous practices ,especially among small holders Surveillance and disease reporting (cross-cutting-indicate for poultry)	production and application guide	DA-BAI, DA-RFOs, SUCs
Housing and Cooling Systems			
2024-25	Development and utilization of climate-resilient housing systems for small scale poultry production	climate-resilient housing system design/prototype	DA-BAI, DA-BAFE, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Development and utilization of rapid and cost-effective disease diagnostic tool/kit	rapid and portable disease diagnostic kit/tool	DA-BAI, DA-RFOs, SUCs
2026-28	Development/improvement and utilization of POTs for poultry management systems to advance productivity and efficiency	POT/protocols for poultry management system	DA-BAI, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Market study of poultry products	recommendation for the refinement of poultry products and marketing strategies	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development/refinement and utilization/scaling of	POT/protocols	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	postharvest and processing POTs		

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Refinement and scaling of POT on waste utilization from smallhold poultry production Integrated approach involving proper waste management and chemical and non-chemical means (e.g. biological agents and natural products)	waste management technologies	DA-BAI, DA-RFOs, SUCs
2024-25	Environmental study on poultry waste	data/information on the effect of poultry waste	DA-BAI, DA-RFOs, SUCs

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
Food security				
2023	Improving epidemiological surveillance and biosecurity measures	improved surveillance and biosecurity protocols policy recommendations	DA-BAI, DA-RFOs	Thematic Area 4
Food safety				
2024-25	Development of traceability systems for poultry farms	traceability systems	DA-BAI, DA-NMIS, SUCs	Thematic Area 4
2024-25	Development and utilization of rapid and cost-effective detection of microbiological and chemical hazards	diagnostic kits/equipment	DA-BAI, DA-NMIS, DA-RFOs, SUCs	Thematic Area 4
Environmental and economic impact				
2024-25	Impact and economic assessment of different poultry diseases and antimicrobial resistance	environment and economic impact study policy recommendations	DA-BAI, SUCs	Thematic Area 1, Thematic Area 5
Supply Chain				
2024-25	National and integrated supply chain analysis of poultry products	data/information on poultry product supply chain	DA-BAI, SUCs	Thematic Area 2, Thematic Area 3

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
		policy recommendations		

Rabbit

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Feeds and Feeding System			
2024-25	Identification and evaluation/field validation of alternative and locally-available feed ingredients Appropriate feed formulation for rabbit meat-type	information/data on nutritional valuation of alternative feeds	DA-BAI, DA-RFOs, SUCs
Breeds and Breeding stock			
2024-25	Phenotypic characterization of existing locally adapted stocks	profile of available rabbit breeds	DA-BAI, DA-RFOs, SUCs
2024-25	Genetic improvement and utilization of rabbit breeds for increase meat production and feeding efficiency	improved breeds	DA-BAI, DA-RFOs, SUCs
Health and Nutrition			
2024-25	Documentation and validation of selected ethno-vet practices	production and application guide	DA-BAI, DA-RFOs, SUCs
Housing			
2024-25	Development of housing systems for smallholder production	housing system design/prototype	DA-BAI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Health management and epidemiological profile of rabbit diseases in the Philippines Development of database	profile of rabbit diseases	DA-BAI, DA-RFOs, SUCs
2024-25	Development of POT on production practices	POT on zero waste rabbit production	DA-BAI, DA-RFOs, SUCs
2024-25	Development of traceability systems for rabbit farms	traceability systems	DA-BAI, DA-RFOs, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Market and acceptability studies on rabbit products	recommendation for the refinement of rabbit products and marketing strategies	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Feasibility studies on postharvest and processing	feasibility studies	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
		postharvest and processing protocols	

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Utilization of skin/hair and other wastes Development of POT on waste utilization from smallhold rabbit production	POT on zero waste rabbit production	DA-BAI, DA-RFOs, SUCs

OTHERS-FOOD SAFETY				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
2024-25	Development of traceability systems for rabbit farms	traceability systems	DA-BAI, DA-RFOs, SUCs	Thematic Area 4

Bee

INPUT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
Feeds and Feeding System			
2023	Development of bee pasture and POT for alternative feedstuff production	feed supplement for bees (e.g. soya, vitamins, brewer's yeast, dry milk, vitamin c) compendium of bee plants nutritive value of pollen from selected bee plants	DA-BAI, DA-RFOs, SUCs
2024-25	Pollen characterization Identification and profiling of local melliferous plants	pollen profile of locally available melliferous plants	DA-BAI, DA-RFOs, SUCs
2026-28	Genetic profiling and conservation of alternative feed ingredients for higher production efficiency and good quality bee pasture	genetic profile of alternative feed ingredients that can increase production efficiency and bee pasture	DA-BAI, DA-RFOs, SUCs
Breeds and Breeding stock			
2023	Taxonomic genetic profiling and genetic conservation of native bee species	profile and characterization of native bees	DA-BAI, DA-RFOs, SUCs
2026-28	Development and utilization of POT for native queen production	POT on native queen production	DA-BAI, DA-RFOs, SUCs
Health and Nutrition			
2023	Profiling and conservation of alternative veterinary medicines for European and native bees	list of alternative and conventional veterinary medicines	DA-BAI, DA-RFOs, SUCs
2023	Evaluation of miticides (chemical and alternative medicines) against *Varroa spp.* and *Tropilaelaps spp.*	preventive and treatment protocol	DA-BAI, DA-RFOs, SUCs
2024-25	Development of cost-effective rapid test kits for certain bee diseases	rapid and portable disease diagnostic kit/tool	DA-BAI, DA-RFOs, SUCs
Housing			
2024-25	Development of standardized parameters for hive designs for stingless bees (e.g. pollen and honey pots, size of brood)	prototype for hive designs	DA-BAI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development/improvement and utilization of POTs for bee production systems to	cost-effective production systems/technologies	DA-BAI, DA-RFOs, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	advance productivity and efficiency		
2024-25	Native pollinators as local standard for pollinator safety	information on quality pollinators	DA-BAI, DA-RFOs, SUCs
2024-25	Economic valuation of pollinator services	information on quality pollinators	DA-BAI, DA-RFOs, SUCs
2024-25	Utilization and economic valuation of native pollinators	information on quality pollinators	DA-BAI, DA-RFOs, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development and monitoring of processing and handling technologies for bee products and by-products Studies on pesticide residues, drug residues in honey, pollen, and other products	defined characteristics of Philippine honey Philippine Honey Standard	DA-BAI, DA-BAFS, DA-FDA, DA-RFOs, SUCs

OTHERS				
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**	**Cross-referencing with the Cross-cutting Thematic Areas**
Health and wellness				
2023	Assessment of therapeutic properties of bee-derived products for the development of health and wellness products	Data on the nutritional and medicinal valuation of bee-derived products	DA-BAI, DA-RFOs, SUCs	Thematic Area 4
2023	Development/improvement of processing technologies for non-food bee products	POT/protocols	DA-BAI, DA-RFOs, SUCs	Thematic Area 4
Environmental and economic impact				
2024-25	Assessment of impact of pollinators on crop yield and biodiversity maintenance	information on the effect of pollinators to crop yield and environment policy recommendations	DA-BAI, DA-RFOs, SUCs	Thematic Area 1

Aquaculture and Capture Fisheries

Commodity industry situation

Status and trend of Fisheries Production

The annual performance of Philippines fisheries industry was attributed to the production of the aquaculture, municipal capture fisheries, and commercial capture fisheries. **Figure 56** showed the annual volume of fisheries production from 2016-2021. The total fisheries production declined in 2017 (4.31 million MT) compared from the previous year (4.36 million MT). It slightly recovered the following year 2018 (4.36 million MT) with almost same level of volume of production in 2016. The increase in volume of production was sustained until 2019 (4.42 million MT); however, it started to decline in 2020 to 2021. In 2021, the total volume of fisheries production in the Philippines reached 4.04 million MT which showed a decrease of 3.4 percent from the 2020 production of 4.4 million MT.

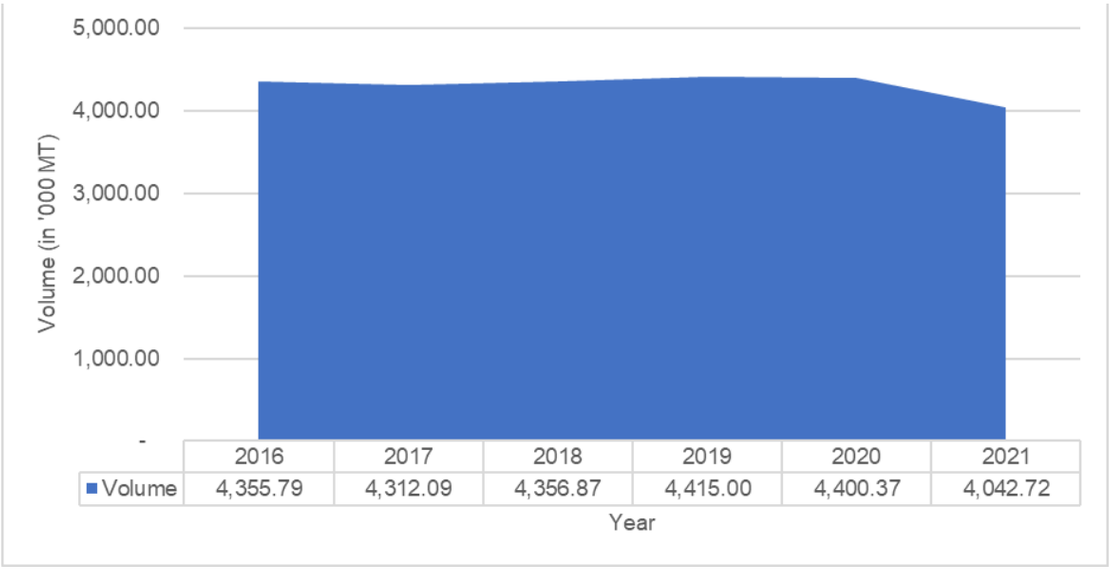


Figure 56. Volume of fisheries production (2016-2021)
Source: (PSA, 2022)

Over the past six years from 2016-2021, the average growth rate of fisheries production is -1.55 percent with negative growth rate recorded in 2016, 2017, 2020 and 2021. Year 2018 and 2019 experienced positive growth rate in the volume of production with 1.03 percent and 1.32 percent, respectively.

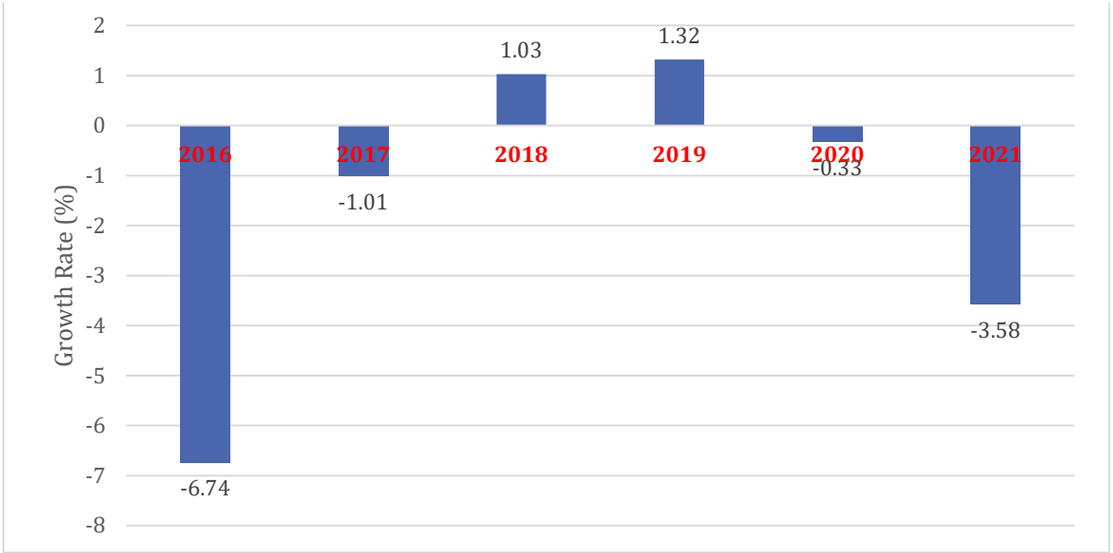
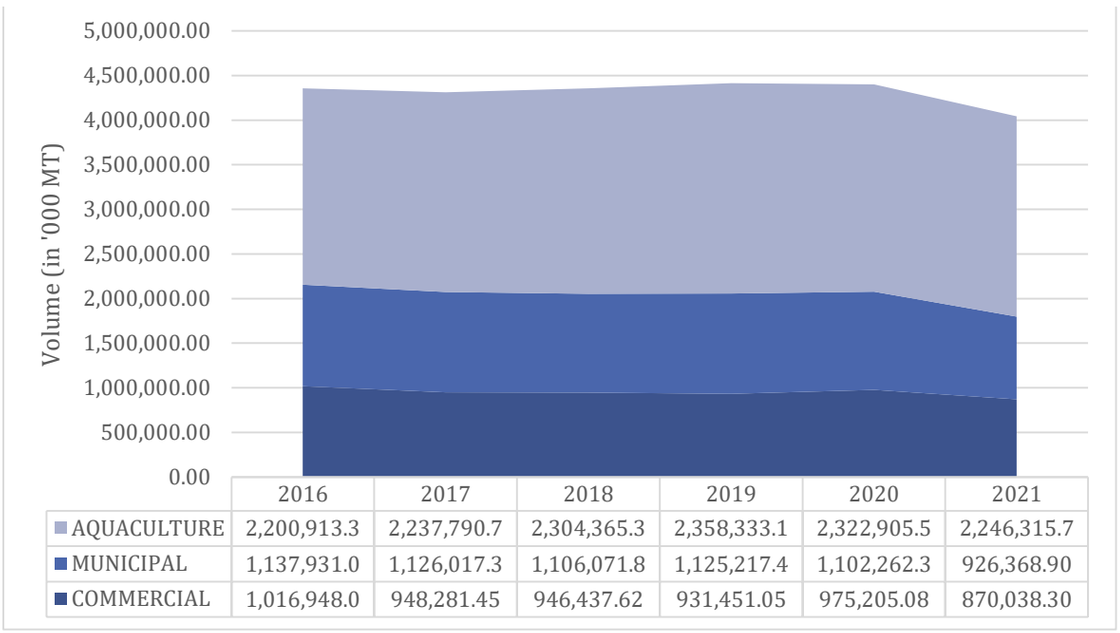


Figure 57. Annual growth rate of fisheries production (2016-2021)
Source: (PSA, 2022)

Volume of Fisheries Production (in MT) by Sub-sector

Among the fisheries sub-sector, aquaculture recorded the highest share in fisheries production for the last six years with an average production of 2.28 million MT. Municipal capture fisheries followed it with 1.09 million MT while commercial capture fisheries had 948,060 MT.

The increasing trend in aquaculture production was halted in 2020 and continued to decline in 2021 mainly due to declining aquaculture production. Municipal and commercial sub-sector showed downward trend attributed to almost stagnant capture fisheries.



	2016	2017	2018	2019	2020	2021
AQUACULTURE	2,200,913.3	2,237,790.7	2,304,365.3	2,358,333.1	2,322,905.5	2,246,315.7
MUNICIPAL	1,137,931.0	1,126,017.3	1,106,071.8	1,125,217.4	1,102,262.3	926,368.90
COMMERCIAL	1,016,948.0	948,281.45	946,437.62	931,451.05	975,205.08	870,038.30

Figure 58. Volume of fisheries production, by sub-sector, from 2016-2021
Source: (PSA, 2022)

Table 12 shows the volume of aquaculture production by species. The increasing production of tilapia and seaweed from 2016-2019 was halted in 2020 with 5.9 percent and 2.1 percent decrease in production, respectively. While shellfish and milkfish, increase production in 2020. Shrimp/prawn continued to decrease.

Table 12. Volume of aquaculture production (in MT), by species, 2016-2020

	2016	2017	2018	2019	2020
Milkfish	398,088.17	411,103.46	395,130.32	409,906.57	414,476.99
Tilapia	259,045.55	267,734.80	277,005.69	279,385.86	263,871.28
Seaweed	1,404,519.23	1,415,320.79	1,478,300.85	1,499,961.25	1,468,653.26
Shrimp/Prawn	51,450.60	48,457.33	47,060.95	47,407.49	43,520.96
Shellfish	38,286.91	42,152.99	55,010.92	61,615.22	72,261.02
Others	49,522.88	53,021.39	51,856.58	60,056.77	60,122.06
TOTAL	2,200,913.34	2,237,790.76	2,304,365.31	2,358,333.16	2,322,905.57

Source: (PSA, 2017, 2020, 2022)

Out of the total aquaculture production from 2016-2020, seaweeds contributed the most at 63.61 percent, while milkfish provided 17.76 percent, followed by tilapia at 11.79 percent, shrimp/prawn at 2.75 percent, shellfish at 2.36 percent and other species at 1.73 percent.

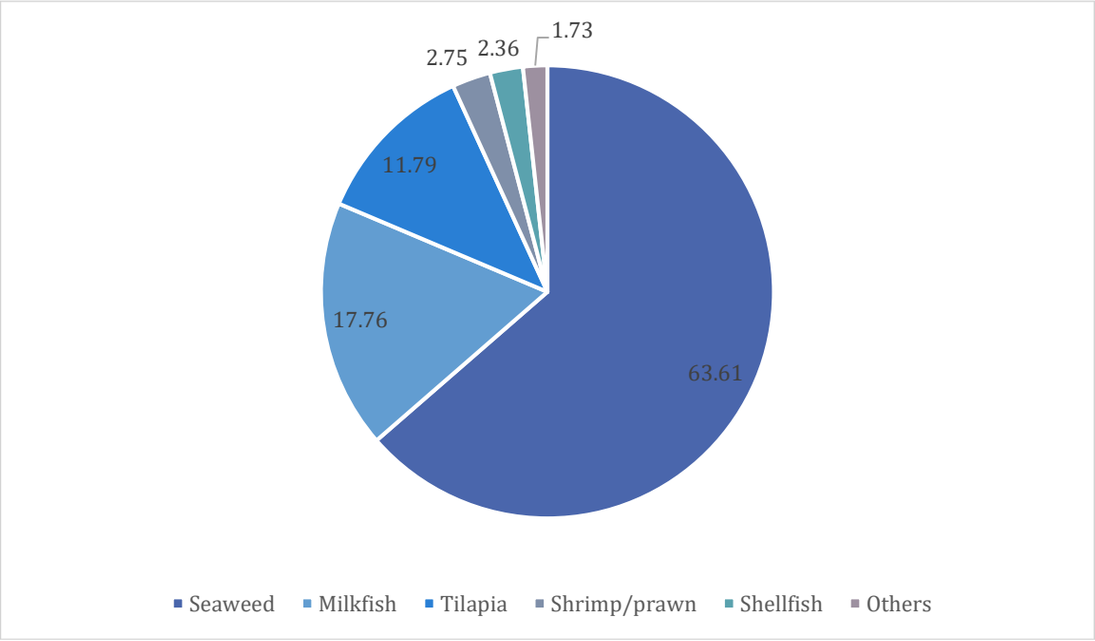
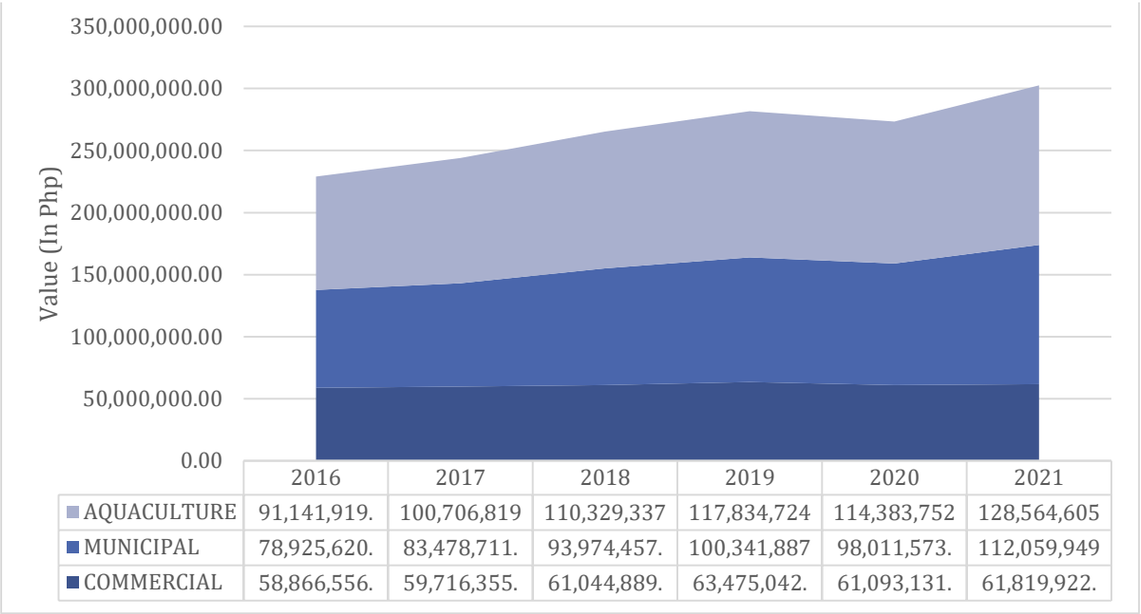


Figure 59. Proportion of major species from aquaculture production
Source: (PSA, 2017, 2020, 2022)

Value of Fisheries Production (2016-2021)

Despite the decrease in volume of fisheries production in 2021 compared with the previous year, the fish value increased by 11 percent. The value of fisheries production for the three-fishery subsector exhibited increasing trend except in 2020 where the value of production decreased. In 2021, all the fishery subsectors bounced back. Aquaculture had the highest percentage share in the value of fish production followed by municipal and commercial.



	2016	2017	2018	2019	2020	2021
AQUACULTURE	91,141,919.	100,706,819	110,329,337	117,834,724	114,383,752	128,564,605
MUNICIPAL	78,925,620.	83,478,711.	93,974,457.	100,341,887	98,011,573.	112,059,949
COMMERCIAL	58,866,556.	59,716,355.	61,044,889.	63,475,042.	61,093,131.	61,819,922.

Figure 60. Value of fisheries production (in MT) by sub-sector
Source: (PSA, 2017, 2020, 2022)

Milkfish, tilapia and shellfish increased value of production from 2016 to 2020. Although the value of production of seaweed, shrimp/prawn exhibited increase in production, it decreased in 2020.

Table 13. Value of aquaculture production (in PhP), by species, 2016-2020

	2016	2017	2018	2019	2020
Milkfish	35,042,257.39	37,623,623.34	40,767,835.02	42,879,624.07	43,379,111.83
Tilapia	18,329,363.12	20,466,305.22	21,541,667.93	22,493,472.27	22,834,180.27
Seaweed	6,104,737.53	8,301,351.18	10,919,695.79	11,845,017.17	10,614,121.68
Shrimp/ Prawn	23,776,011.76	25,298,759.07	25,530,709.26	28,325,318.18	26,043,342.90
Shellfish	477,113.20	571,463.73	825,927.63	1,267,214.81	1,503,338.54
Others	7,412,436.73	8,445,316.86	10,743,502.21	11,024,078.12	10,009,657.77
Total	91,141,919.73	100,706,819.40	110,329,337.84	117,834,724.62	114,383,752.99

Source: (PSA, 2017, 2020, 2022)

The value of milkfish production got the highest percentage at 37.37 percent in terms of the average contribution to the total aquaculture production followed by shrimp/ prawn at 24.13 percent, tilapia at 19.77 percent, seaweed at 8.94 percent, other species at 8.91 percent and shellfish at 0.87 percent.

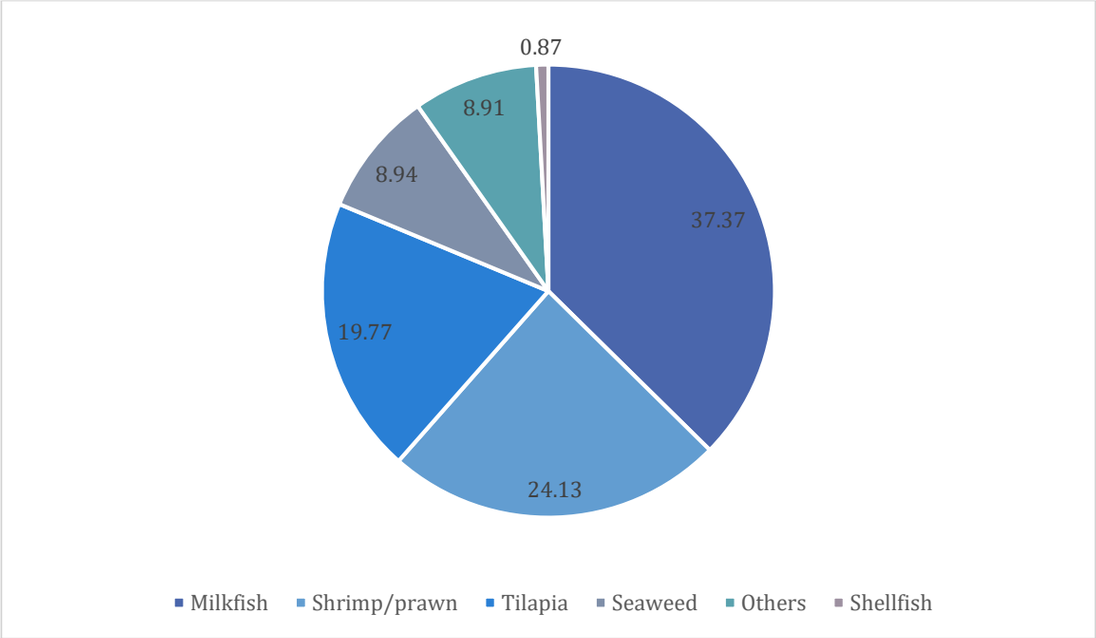


Figure 61. Proportion of major species from aquaculture value
Source: (PSA, 2017, 2020, 2022)

Fisheries Contribution to the National GDP

Gross Value Added (GVA) of Fishing and Aquaculture in Agriculture Sector

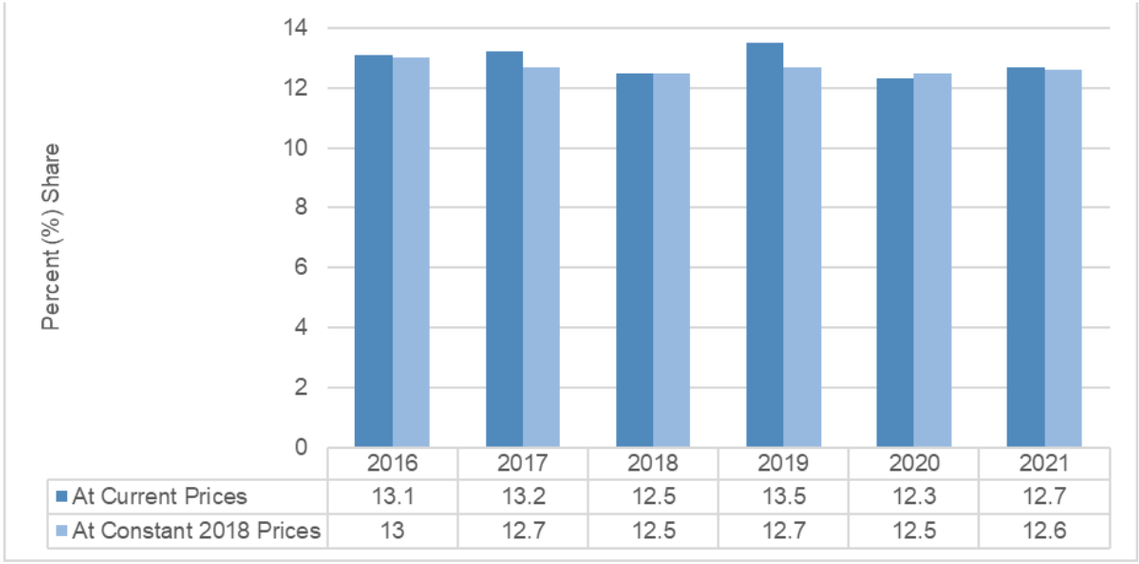
The GVA of agriculture sector at constant 2018 prices was valued at PhP 1,954.35 billion while at current prices the sector amounted to PhP 1,775.36 billion. Among the industry group of the agriculture sector, fishing and aquaculture got the 2nd and 3rd rank based on the percent share to total GVA in agriculture at constant 2018 prices and at current prices, respectively. Fishing and aquaculture sector was valued at PhP 223.5 million and PhP 248.3 million based on the constant 2018 prices and current prices of the GVA, respectively. **(Table 14)**

Table 14. Contribution to GVA in agriculture, by industry group

GVA in Agriculture, Forestry and Fishing	At Current Prices (in million PhP)	Percent (%) share to total GVA in Agriculture	At Constant 2018 Prices (in million PhP)	Percent (%) share to total GVA in Agriculture
Agricultural crops (Palay, corn, coconut, etc.)	951,414.00	48.68	934,930.00	52.66
Livestock	267,860.00	13.71	179,029.00	10.08
Poultry	201,451.00	10.31	174,978.00	9.86
Other Animal Production	66,122.00	3.38	69,263.00	3.90
Forestry	1,372.00	0.07	2,691.00	0.15
Fishing and Aquaculture	248,266.00	12.70	223,529.00	12.59
Agricultural Activities	217,859.00	11.15	190,937.00	10.75
Total	1,954,345.00	100.00	1,775,358.00	100.00

Source: (PSA, 2017, 2020, 2022 and BFAR, 2020)

The percent share of fishing and aquaculture in agriculture sector ranges from 12.3 to 13.5 at current prices and 12.5 to 13 at constant 2018 prices from 2016 to 2021 GVA **(Figure 62)**.



	2016	2017	2018	2019	2020	2021
At Current Prices	13.1	13.2	12.5	13.5	12.3	12.7
At Constant 2018 Prices	13	12.7	12.5	12.7	12.5	12.6

Figure 62. Percent share of fisheries and aquaculture to GVA at current prices and at constant 2018 prices from 2016-2021
Source: (PSA, 2017, 2020, 2022)

The GVA of fishing and aquaculture in agriculture sector at constant 2018 prices posted a 0.2 percent increase in 2021 compared with the previous year's contraction of -1.4 percent. At current prices, the GVA in fishing and aquaculture bounced back from the previous year's slump of -3.6 percent and posted a 10.5 percent increment in 2021 **(Figure 63)**.

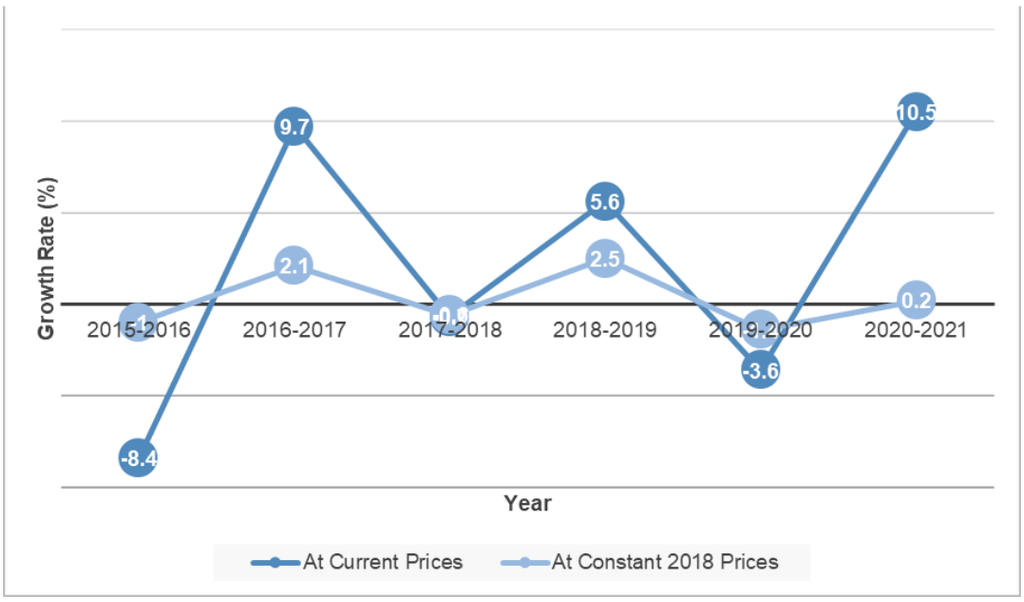


Figure 63. Growth rates in GVA of fishing and aquaculture
Source: (PSA, 2017, 2020, 2022)

Priority Research Areas

Aquaculture

INPUT - FEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Validation of feed formulation using low-cost feeds	Commercially available cost-efficient feeds	DA-NFRDI, DA-BFAR, UPV
2023	Low-cost feed production	Locally sourced and cost-efficient feed formulation	DA-NFRDI, DA-BFAR, SUCs

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Assessment of resources and spawning areas	Spawning and resource maps	DA-NFRDI, DA-BFAR, SUCs
2024-25	Seedstock production through validation and piloting of existing protocols and marker assisted breeding strategy	Seedstock and protocols on marker-assisted breeding strategy	DA-NFRDI, DA-BFAR
2024-25	Development of hatchery protocol for indigenous aquatic species (finfish and other aquatic fish)	Benchmarking, protocol, and economics related to hatchery production	DA-BFAR, DA-NFRDI, SUCs (MSC)

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Production of quality seedstocks through captive breeding and genetics	Quality seedstocks from capture breeding and genetics	DA-NFRDI, DA-BFAR, DA-BPO
2024-25	Diversification of sustainable mariculture system for coastal communities	Protocols on culture systems and policy recommendations on resource management	DA-NFRDI, DA-BFAR, SUCs (UP-MSI, etc.), LGUs
2024-25	Quality assessment of fish culture in Laguna Lake	Fish quality cultured in Laguna Lake	DA-NFRDI, DA-BFAR 4A, SUCs
2026-28	Adaptability trial of growing silver therapon (*Leiopotherapon plumbeus*) in different stocking density and under different culture enclosure	Growl trial of silver therapon in different cultured condition feasibility studies	DA-NFRDI, DA-BFAR

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Field validation of production protocols of other aquaculture species such as mudfish/dalag and climbing perch/puyu and other indigenous species	Validated protocols for the production of other aquaculture species such as mudfish/dalag and climbing perch/puyu and other indigenous species	DA-NFRDI, DA-BFAR

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Value chain analysis and food development	Market-driven value chain development initiatives and food products	DA-NFRDI, DA-BFAR, UPV

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Review of policies on aquaculture located in Environmental Critical Areas (ECAs)	Policies on aquaculture located in Environmental Critical Areas (ecas)	DA-NFRDI, DA-BFAR, SUCs
2026-28	Sustainability and ecological impacts	Studies on sustainability and ecological impacts of aquaculture	DA-NFRDI, DA-BFAR, SUCs
2026-28	Sustainable development bottomlines for aquaculture production with focus on social and inclusive benefits and environmentally sound economic benefits gain	Bottomlines in aquaculture	DA-NFRDI, DA-BFAR, SUCs

Capture Fisheries

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Assessment on the biology of species and distribution	Stock assessment	DA-NFRDI, DA-BFAR, DA-BFAR CAR, DA-BFAR 10
2024-25	Mapping and assessment of fisheries resources	Maps of fisheries resources and resource assessment	DA-NFRDI, DA-BFAR, SUCs
2025-27	Characterization of aquatic habitats in connection to protection and conservation of important whether freshwater or marine species for the sources of broodstocks	Quality assessment of the aquatic habitats	DA-NFRDI, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Studies on the seasonality and life stages of fishes	Data on the seasonality and reproductive biology of fishes	DA-NFRDI, DA-BFAR, DA-BFAR CAR
2025-27	Impact study of closed season on fisheries and stocks	Data on the advantages and disadvantages of closed seasons on fisheries and stocks	DA-NFRDI, DA-BFAR, SUCs
2024-25	Carrying capacity studies of inland and marine waters	Fisheries' carrying capacity of inland and marine waters	DA-NFRDI, DA-BFAR, DA-BFAR 3, SUCs (UP-MSI, etc.)

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Marketing strategies employed by the capture fishers in the far-flung areas of CAR	Marketing strategies of capture fishers in the far-flung areas of CAR	DA-BFAR, DA-BFAR CAR
2024-25	Development of marketing strategies and adoption of different scale enterprises	Appropriate marketing strategies for different scale enterprises	DA-NFRDI, DA-BFAR, SUCs
2026-28	Value chain analysis and development	Market-driven value chain development initiatives and food products	DA-NFRDI, DA-BFAR, SUCs

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Strategical research in reducing postharvest losses	Strategies that could reduce losses in postharvest	DA-NFRDI, DA-BFAR, DA-BFAR 3, SUCs (UPV, etc.)
2024-25	Traceability studies for all fish and fish-related products	Catch documentation and traceability system	DA-NFRDI, DA-BFAR, DA-BFAR 3, SUCs (UPV, etc.)
2023	Traditional postharvest practices of the indigenous fishing communities in CAR	Traditional postharvest practices of the indigenous fishing communities in CAR	DA-BFAR, DA-BFAR CAR

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment of fish assemblages including (invasive) alien species in freshwater ecosystems	Fish species lists occurrence or distribution maps of (invasive) alien species	DA-BFAR, DA-BFAR CAR
2023	Development of hatcheries and technology for high value freshwater fish species	Hatcheries and technologies for high value freshwater fish species for stock enhancement	DA-BFAR, DA-BFAR CAR
2024-25	Biological and medicinal importance of freshwater fish and other aquatic species	Inventory of freshwater fish and other aquatic species with biological and medicinal importance	DA-BFAR, DA-BFAR CAR
2024-25	Characterization of fishing grounds through biophysical and ecological assessment, pests occurrences, and carrying capacity	Information on the biophysical and ecological assessment of fishing grounds	DA-NFRDI, DA-BFAR, DA-BFAR CAR
2024-25	Development of harvest control rules for sustainable stocks and biomass	Harvest control rules for stock and biomass status data on stock assessment and enhancement	DA-NFRDI, DA-BFAR
2024-25	Research on the pros and cons of alternative fishing gears	Data on the impact of using alternative fishing gears	DA-BFAR CAR
2024-25	Establishment of fish aggregating device accessory	Fish aggregating device accessory	DA-NFRDI, DA-BFAR, SUCs
2024-25	Impact study of payao or FADs in tuna management zones	Policy recommendations on the Impact study of payao or fads in tuna management zones	DA-BFAR, SUCs
2024-25	Policy studies on catch composition	Information on fish catch composition	DA-NFRDI, DA-BFAR, SUCs

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Invertebrate fisheries including gleaning and small-scale artisanal fisheries, valuation in relation to the well-being of coastal communities (i.e., source of income, domestic food security, nutrition, management and conservation, and replication in different coastal communities)	Local policies and incentives for improved management contribution of SGD (e.g., poverty, food security, conservation of diversity, etc.)	DA-NFRDI, DA-BFAR, SUCs (UP-MSI)
2026-28	Interdisciplinary research	Food safety, sustainability, institutional and policy outputs, among others	DA-NFRDI, DA-BFAR

Milkfish

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Mapping of resources specifically milkfish wild fry	Milkfish fry source maps Status of milkfish fry stocks Habitat/resource characteristics	DA-NFRDI, DA-BFAR, SEAFDEC
2024-25	Improvement and upgrading of the existing breeding and hatchery facilities for efficient hatchery production	Upgraded breeding and hatchery facilities Recirculating aquaculture system	DA-NFRDI, DA-BFAR, SEAFDEC
2024-25	Modalities for effective adoption of available technologies for milkfish broodstock management	Approaches for effective adoption of available technologies for milkfish broodstock management	DA-NFRDI, DA-BFAR NFDC, UP-MSI, UPV, SEAFDEC
2024-25	Benchmarking milkfish hatchery systems of ASEAN neighbors (i.e., Indonesia)	Protocols of milkfish hatchery systems and optimum parameters on specific geographic locations	DA-NFRDI, SUCs, SEAFDEC
2026-28	Identifying the gaps on milkfish genomics	Information on the identified gaps on milkfish genomics	SUCs, SEAFDEC
2026-28	Validation studies on feed formulations using low-cost feeds	Commercially available cost-efficient feeds	DA-NFRDI, DA-BFAR, UPV, SEAFDEC
2026-28	Establishment of refined protocols and techniques for the larval rearing of milkfish	Refined protocols and techniques for larval rearing	DA-NFRDI, DA-BFAR, SEAFDEC
2026-28	Utilization of available raw materials as alternative for low-cost feed formulation and establishment of a village-type small-scale feed mills	Locally sourced and cost-efficient feed formulation	DA-NFRDI, DA-BFAR, SEAFDEC
2026-28	Growth comparison of milkfish reared in different environments	Report on the growth of milkfish reared on different environments	DA-NFRDI, DA-BFAR, SUCs, SEAFDEC

INPUT - FEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Strengthening innovations on natural food production technology and	Innovative technology on natural food production	DA-NFRDI, DA-BFAR, SEAFDEC, UPV

INPUT - FEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	improvement of mechanical feeders	Fully automated mechanical feeder	

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Oceanographic survey on protected areas including the flora and fauna	Assessment report for protected areas	DA-NFRDI, DA-BFAR, SEAFDEC
2026-28	Development of technologies for genetically improved milkfish	Technologies for genetically improved milkfish	DA-NFRDI, DA-BFAR, SEAFDEC, SUC
2026-28	Ideal species combination for aquaculture integrated systems per area	Multi-species aquaculture systems	DA-NFRDI, DA-BFAR, SEAFDEC, SUC

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Postharvest and processing techniques for export market acceptability of milkfish	Efficient and cost-effective deboning process (techniques and equipment)	DA-NFRDI, DA-BFAR, DOST, UPV, food science research institutions
2026-28	Innovations in product development (e.g. development of mechanical fish sorter)	Machine or equipment for processing fishery products such as mechanical fish sorter	DA-NFRDI, DA-BFAR, DA-PhilMech, SUCs
2024-26	Postharvest handling logistics transport	Effective postharvest logistics	DA-NFRDI, DA-BFAR, SUCs
2024-26	Modalities for effective adoption of packaging technologies	Effective management of the adoption of packaging technologies	DA-NFRDI, DA-BFAR

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Value chain analysis and food development through wastes utilization	Products from fish waste materials	DA-NFRDI, DA-BFAR, SUCs
2026-28	Development of marketing strategies and adoption of different scale enterprises	Recommended marketing strategies for different scale enterprises	DA-NFRDI, DA-BFAR

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Food safety: reducing histamine production and microbial contamination in milkfish	Information on the extent of heavy metals and microplastic contamination on milkfish	DA-BFAR, DA-NFRDI, DOST, SUCs
2026-28	Review of the implementation of policies related to milkfish fry importation	Policy review and recommendations on the assessment of the implementation of policies related to milkfish fry importation	DA-NFRDI, DA-BFAR
2026-28	Sustainability and ecological impacts	Studies on sustainability and ecological impacts of milkfish cultures	UP-MSI
2026-28	Improvement/upgrading of laboratory and improvement of human resource competencies in the fisheries sector	Equipment human resource policy recommendations and requirements aligned with the international standards	DA-NFRDI, DA-BFAR, DA-FDC

Tilapia

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Site assessment and resource mapping using GIS	Tilapia input and fry resource maps	DA-BFAR 12, SUCs
2024-25	Resource need mapping	Tilapia fry source maps	DA-BFAR 12
2024-25	Validation studies on feed formulations using low-cost feeds	Commercially available cost-efficient tilapia feeds	DA-NFRDI, DA-BFAR
2024-25	Pilot testing of feeds utilized from alternative feed materials and insect-based feed formulation	Cost-efficient tilapia feed formulation from alternative and insect-based materials	DA-NFRDI, DA-BFAR CAR
2026-28	Market-driven Broodstock improvement for fillet yield	Benchmark Improved broodstock management Cost competitiveness High fillet-yield tilapia strains	DA-NFRDI, DA-BFAR, SEAFDEC, CPF, GENOMAR, other private sector research institutions
2024-25	Sex reversal technologies	Alternative technologies to induce sex reversal of tilapia	DA-NFRDI, DA-BFAR
2024-25	Saline tilapia broodstock management research and development	Improved management practices for saline tilapia	DA-NFRDI

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of protocols for improving hatchery productivity including the protocol for detecting diseases in fishes	Quality and disease-resistant tilapia strains and seedstocks	DA-NFRDI, DA-BFAR
2026-28	Site carrying capacity assessment	Assessment maps on carrying capacity of tilapia production areas	DA-NFRDI, DA-BFAR, DA-BFAR 12

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of biotechnology products from fish wastes	Biotechnology products from tilapia wastes	DA-NFRDI, DA-BFAR CAR, TAU
2024-25	Utilization and development of waste to fertilizers and nutrient enhancers	Tilapia waste to fertilizers and nutrient enhancers	DA-NFRDI, DA-BFAR, TAU

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Food safety research on heavy metal residues, antimicrobial resistance, microbial contamination, and biotoxin residues	Information on heavy metal residues, antimicrobial resistance, microbial contamination, and biotoxin residues	DA-NFRDI, SUCs

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of marketing strategies and adoption of different scale enterprises	Appropriate marketing strategies for different scale enterprises	DA-NFRDI, DA-BFAR
2026-28	Value chain analysis and food development through wastes utilization	Products from tilapia waste materials	DA-NFRDI, DA-BFAR, TAU

Shellfish

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Assessment and culture potential of other species of shellfish	Information on the identified culture potential of other species of shellfish Benchmarking of shellfish Optimum parameters needed for culture	DA-NFRDI, DA-BFAR, SUCs (CBSUA, DEBESMSCAT, PSU/ParSU, SSC [Sorsogon], SSC [Sulu], etc.)
2024-25	Culture of shellfish in hatcheries and captivity	Protocols on shellfish culture	DA-NFRDI, DA-BFAR, SUCs (CBSUA, DEBESMSCAT, PSU/ParSU, SSC [Sorsogon], SSC [Sulu], etc.)
2024-25	Validation of available hatchery, nursery, and grow-out culture technologies on green mussel and slipper oysters (*Magallana bilineata*)	Validated technologies for hatchery, nursery, and grow-out culture of green mussels and oysters	DA-NFRDI, DA-BFAR, SUCs
2026-28	Resource need mapping	Shellfish needs source maps	DA-NFRDI, DA-BFAR, SUCs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Mapping and profiling of shellfish available and areas in Luzon for shellfish production	Map and profile of shellfish available in Luzon area for shellfish production	DA-NFRDI, DA-BFAR, SUCs
2024-25	Innovations for hatchery and grow-out technology for oyster	Innovative hatchery and grow-out technology for oyster	DA-NFRDI, DA-BFAR

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Product development of shellfish products	New shellfish products	DA-NFRDI, DA-BFAR
2024-25	Development of machines for the utilization of empty shellfish shells	Machines and equipment for utilization of empty shellfish shells	DA-NFRDI, DA-BFAR

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Value chain analysis and food development through wastes utilization	Products from fish waste materials	DA-NFRDI, DA-BFAR
2026-28	Development of marketing strategies and adoption of different scale enterprises	Appropriate marketing strategies for different scale enterprise	DA-NFRDI, DA-BFAR

Shrimp

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Resource need mapping	Shrimp fry source maps	DA-NFRDI, DA-BFAR

INPUT - FEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Validation studies on feed formulations using low-cost feeds	Commercially available cost-efficient feeds	DA-NFRDI, DA-BFAR
2024-25	Identification of alternative raw materials for feeds	Locally sourced and cost-efficient feed formulation	DA-NFRDI, DA-BFAR

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Utilization of alternative raw materials for shrimp feeds	Locally sourced and cost-efficient feed formulation for shrimps	DA-NFRDI, DA-BFAR

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Development of market models for different scale and production (strengthening of the Philippine shrimp market industry through HACCP certification and linkages)	Working market models for different scale and production Policy recommendations	DA-NFRDI, DA-BFAR, SUCs
2026-28	Development of marketing strategies and adoption of different scale enterprises	Benchmarking Appropriate marketing strategies for different scale enterprises	DA-NFRDI, DA-BFAR, DA-BFAR 12
2024-25	Utilization of appropriate performance indicators to improve resource management and reduce extra activities and thus distribution and logistics cost	Improved resource management through appropriate performance indicators	DA-NFRDI, DA-BFAR, DA-BFAR 12
2026-28	Value chain analysis and food development through wastes utilization	Products of shrimp waste materials	DA-NFRDI, DA-BFAR, DA-BFAR 12
2023	Shrimp product traceability and quality	Enhanced quality assurance system	DA-NFRDI, DA-BFAR, DA-BFAR 12

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
	assurance system enhanced and conduct of residue analysis	Enhanced shrimp product traceability Data on residue analysis	

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Establishment of breeding facilities	Established breeding facilities	DA-NFRDI, DA-BFAR 12
2023	Management of the shrimp industry policies and database	Systematic policies and database for shrimp industries	DA-NFRDI, DA-BFAR
2023	Mitigation and adaptation options from altered resources and diversification of livelihood	Mitigation and adaptation strategies and livelihood diversification options	DA-NFRDI, DA-BFAR
2023	Conversion of wastewater into plant fertilizer	Wastewater-based plant fertilizer	DA-NFRDI, DA-BFAR, DA-BFAR 12
2024-25	Alternative energy and fuel source for hatchery, nursery, grow-out for shrimp production	Technologies on alternative energy/ fuel source for hatchery, nursery, grow-out for shrimp production	DA-NFRDI, DA-BFAR, DA-PhilMech, DA-BAFE, SUCs
2024-25	Benchmarking of farming practices and existing policies	Farming practices and policies for shrimp	DA-NFRDI, DA-BFAR

Seaweed

INPUT - SEEDS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2024-25	Site characterization of nursery sites to hold tissue culture for seaweeds	Suitability assessment of areas for tissue cultured seaweed	DA-NFRDI, DA-BFAR, WPU
2024-25	Resource need mapping	Seaweed propagules source maps	DA-NFRDI, DA-BFAR
2026-28	Refinement and adaptation of existing seaweed rearing procedures for small and medium-scale farmers	Adoption of enhanced seaweed production protocols for small/medium scale farmers	DA-NFRDI, DA-BFAR, DA-BFAR 13, UP-MSI, LGUs

PRODUCTION			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Utilization of alternative tying materials (coir rope) for seaweed farming	Improved and alternative tying materials for seaweed farming	DA-NFRDI, DA-BFAR
2024-25	Refinement protocol for hatchery and feasibility of seaweed farming in open sea	Improved protocol for open-sea seaweed farming	DA-NFRDI, DA-BFAR

POSTHARVEST AND PROCESSING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Enhancement of seaweed postharvest and processing	Newly developed seaweed products	DA-NFRDI, DA-BFAR, SUCs (SSC [Sulu])
2024-25	Utilization of macrolagae detritus for seaweed-based feeds	Seaweed-based feeds	UP-MSI

MARKETING			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Value chain analysis and food development through waste utilization	By-products from seaweeds	DA-BFAR 13, SUCs (NWSSU, UNP)
2026-28	Development of marketing strategies and adoption of different scale enterprises	Appropriate marketing strategies for different scale enterprises	DA-NFRDI, DA-BFAR

BY-PRODUCT UTILIZATION AND WASTE MANAGEMENT			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2026-28	Development of seaweed-based fertilizers	Seaweed-based or fish waste liquid or powder fertilizers	DA-NFRDI, DA-BFAR, SUCs (SSC [Sulu], UNP, etc.)

OTHERS			
Period	**Research Area**	**Expected Output**	**Possible Implementing Agency**
2023	Broodstock and hatchery development for emerging species of seaweeds	Upgraded tissue culture laboratory	DA-BFAR 12, DA-BFAR 13, UP-MSI

Cross-cutting R4D Areas

Cross-cutting R4D Areas

In recognition of complex issues that underlie agricultural development, R4D agenda in the next five years promotes cross-disciplinary efforts to understand and help address some of the enduring challenges in the Philippine agri-fishery sector. Cross-cutting thematic areas of research touch on general principles and relevant perspectives for the development of subsectors and priority commodities and their respective environments. Such general principles of cross-cutting themes espouse democracy, equality, sustainability, and good governance.

Five (5) cross-cutting thematic areas represent crucial concerns in the agricultural sector.

1. Enhancing natural resources for agricultural development
2. Advancing the agricultural innovation system
3. Strengthening policy and institutions
4. Ensuring food safety through one health
5. Assessing and evaluating impacts

Thematic Area 1: Enhancing Natural Resources for Agricultural Development

Agricultural production occurs within agroecosystems, rendering it as a driving force behind both economic development and environmental sustainability (Blandford et al., 2014[1]). Farming activities enable the provision of food and raw materials for various industries, thereby determining food security and economic well-being. On the other hand, farming activities tend to adversely affect the structure of the agroecosystem through disruptions in wildlife habitats and diversity, soil and water pollution, green-house gas emissions, among other means. Such environmental impacts have sustainability implications for the agricultural economy.

Agroecosystems are dynamic and complex natural ecosystems influencing crop and livestock growth (Yadav et al., 2021[2]). This definition comprises not only land and water resources deemed as primary material inputs, but the climatic, biotic, and other physical elements of the entire ecosystem dedicated for planned production activities. In highlighting the relation of the ecosystem to agriculture, this thematic area broadens the scope of the DA's interest in RDE to cover environmental consequences of agricultural activities such as those that pertain to imbalances in climatic conditions, biodiversity, soil health, water quality, among others. Many of such impacts remain to be further understood, monitored, and addressed by scholars and practitioners in the Philippine agriculture sector.

Soil and water are the foundations of food security. They provide the essential natural resources for our domesticated livestock- and crop-based food production systems. With agricultural intensification degrading soil and water quality, RDE activities to better understand conservation and mitigation of resource degradation are imperative.

Additionally, the pervasive effects of climate change on agriculture and fishery resource base continue to pose grave threats to the livelihood of rural communities and the country's food security. RDE activities and initiatives related to climate change must focus on ensuring food security by mitigating the effects of climate change on the productivity and incomes of farmers and fisherfolk while maintaining the long-term sustainability of the AF resource base.

As a holistic production management system, organic agriculture promotes agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. Organic agriculture technologies emphasize the use of management practices over the use of off-farm inputs and utilizes cultural, biological, and mechanical methods as opposed to synthetic materials. As a research area under this theme, organic agriculture RDE is deemed to combine tradition, innovation, and science to benefit the shared environment and promote fair relationships and a good quality of life for all stakeholders.

Lastly, the stock and diversity of genetic resources are very important for sustainable and secure agricultural production. Erosion of plant genetic resources, from replacement of traditional cultivars by modern varieties, natural catastrophes, urbanization and industrialization, and habitat loss due to changes or excesses in land use and climate change pose threats to food security (Upadhyaya & Gowda, 2009[3]). Likewise, preserving animal genetic resources diversity is very important to meeting future production challenges by enabling response to the future, oftentimes unpredicted changes in the production environment (ERFP, n.d. [4]). Collection, curation, and conservation studies are critical to ensure future adaptability of cultivars and wild populations.

The following matrix summarizes the four (4) research areas classified under the theme of enhancing natural resources for agricultural development.

Research Area	Description	Possible Topics
Soil and Water	Research spanning basic and applied soil science and water science. Includes but not limited to soil hydrology, erosion research and control, drought and flood control, soil or water contamination, land use, wetland restoration and protection, surface and ground water protection, measures for improving and protecting soils or water resources.	• Soil assessment, soil health mapping • Conservation agriculture technology in agroecosystems, i.e., natural ecosystems that have been modified to produce food and fiber (Hodgson, 2012[5]). • Water and carbon footprint studies • Assessment studies in support of utilization and optimization of agricultural resources (e.g., Improved irrigation systems, Water harvesting, Watershed assessment, etc...) • Fisheries Management • Catch management using catch composition and abundance (e.g., catch per unit effort) • Fish stock assessment and management • Water quality assessment, characterization, and improvement
Climate and Climate Change	Research on development of technologies and strategies to enhance resilience of rural communities to immediate and long-term threats of climate change	• Climate Suitability Maps • Climate change impact and resilience studies in production systems • Climate change adaptation and mitigation practices, e.g., climate-resilient housing for livestock -raising • Climate risk insurance models • Climate-based extension advisory

Research Area	Description	Possible Topics
Organic Agriculture	Studies that investigate biological and physical processes innate to plants, soils, invertebrates, and microbes that naturally control pests, enhance soil fertility, promote animal nutrition and health. All these to develop or enhance practices alternative to those that intensively use synthetic material inputs. Market intervention, commercialization, or extension schemes can also be studied to aid scaling of promising technologies/practices.	• Development, testing, scaling processes for organic crop farming inputs, e.g., fertilizer, soil ameliorant, soil conditioner, etc. • Development, testing, scaling processes for organic alternative feeds for livestock, poultry, and fisheries, and veterinary medicines • BioControl Agents (BCA) product development • Market/consumer studies on organic produce
Genetic Resources	Research covers acquisition, evaluation, preservation, and distribution of critical plant, animal, insect, and microbial material genetic resources crucial for agri-food production. Also includes basic and applied cutting-edge genetic improvement studies for crops, livestock and fisheries.	• Varietal development or animal breeding programs • Development and/or improvement of varieties and cultural practices for specific agri-food products • Enrichment, collection, characterization, and evaluation of germplasm • Genetic resources conservation • Genomics application and bioinformatics

Thematic Area 2: Advancing the Agricultural Innovation System

An agricultural innovation system (AIS) is described in terms of a network of individuals, organizations, and enterprises that interact to come up with new products, processes, or forms of organization for productive use in the agricultural sector (WB, 2006[6]). Institutions and policies influence these actors' behavior and performance. Advancing the AIS of the country means moving away from the status quo, i.e., empowering the actors, laying down an enhanced and efficient environment for all stakeholders, and capacitating farmers (especially smallholders) to adapt to modern technologies to be able to meet the global demands and become resilient.

Agriculture 4.0 refers to the digitalization of farming operations with the use of advanced technologies such as sensors, artificial intelligence, Internet of Things (IoT), drones, remote sensing, GPS and information technology. It focuses on precise and accurate agricultural operations for the efficient use of resources. It calls for new and more efficient ways of food production to face the modern challenges of increasing population, deteriorating natural resources, climate change, food wastes, and poverty and hunger. Better known by the use of digital technology for agriculture, Agri 4.0 involves the development new production technology, using advanced technology to bring produce to consumers more efficiently, and using technology from other industry/ disciplines for agricultural production.

An effective knowledge transfer system complementing a strong capacity for research and development is necessary for society to benefit from new knowledge and technology. Considering R4D as investments, knowledge and technology transfer allows society to reap the benefits of such investments by converting R4D outputs into something important and of value economically, socially, and even personally. Commercialization of technology creates jobs, and better and more affordable products for consumers making it an essential component of the innovation system.

With the developments alongside Agriculture 4.0, the supply and value chain of agricultural products will benefit from innovations by increasing competitiveness through new and low-cost food and non-food agricultural products, efficiency of marketing systems, and improvement in food safety. More importantly, innovations can focus on transforming the Philippine agricultural supply and value chain to a more robust system that is sustainable (i.e., climate-friendly, socially responsible, and economically equitable) and resilient both to climate and non-climate (global) disruptions.

The following matrix summarizes the three (3) research areas and indicative topics that can be pursued under the thematic area of advancing the agricultural innovation system.

Research Area	Description	Possible Topics

Agri 4.0/5.0: Digitalization of Agriculture	Research that explores feasibility and scalability of Agri4.0/5.0 technologies	• Improvement of precision and digital technology for agriculture
		  ○ Yield forecasting
		  ○ Use of drones and sensors in fertilizer and pesticide application
		  ○ Web platforms and mobile applications
		  ○ Use of IoT in aquaculture management like in brackish water seabass

Research Area	Description	Possible Topics
		○ Drone-supported crop damage estimation and pest/disease surveillance ○ Commodity inventory planning ○ GIS-based site suitability assessment • Development of decision support systems • Soil health cards for crop recommendations • Development of efficient and cost-effective handling, storage system, and extension of shelf life • Willingness and readiness of smallholder farmers to adopt digital farming technologies
Technology and Knowledge Transfer	Studies that examine technology transfer processes	• Pilot Testing, Upscaling, and commercialization of production, post-harvest or processing technology • Benchmarking studies on technology business incubators • Innovation / Technology adoption studies ○ Constraints and facilitating factors ○ Assessment of technology promotion models (e.g., LSTD) ○ Improvement of technology delivery system (e.g., AgRIDOC) • Open systems agricultural machinery manufacturing • Development of real-time recording system/database for crop, livestock, and fisheries (e.g., for volume of production, number of heads of animals, list of available breeds and varieties, etc.) • Use of new breeding techniques to a wider selection of crops • Establishment, development, and improvement of research facilities (infrastructure) for dissemination of technology
Innovations Along the Value Chain	Research that investigates activities and strategies that create differentiation advantage to the producers	• Development of competitive advantage through value chain development (food and non-food) • Improving market linkages • Development of modern/digital marketing system • Traceability of agricultural products • Development of a sustainable value chains

Research Area	Description	Possible Topics
		• Feasibility and market studies on new production systems and new products • Value chain and supply chain infrastructure

Thematic Area 3: Strengthening Policy and Institutions

Understanding of institutions are a necessary element in making good policies. Institutions refer to both the regular patterns of behavior and the rules, norms, practices, and relationships that influence behavior (Cairney, 2012). Individual and societal behavior is closely linked to many of the problems in the agri-fishery sector and policy can be a potent in being able to influence behavior for positive change.

This thematic area focuses on the strengthening policies to provide an enabling environment for the attainment of efficiency, effectiveness, equity, and other valued outcomes for the Philippine agri-fishery sector. Modernizing and streamlining policies can ensure the harmonious coordination across institutions toward this end. For this purpose, the DA-BAR expands the breadth of its research portfolio to accommodate research explore individual, organizational, social, cultural, and institutional considerations for designing policies and programs that support the attainment of the DA's target outcomes for the sector.

Growing recognition of the complexity of problems faced by the agri-fishery sector necessitates an approach to agricultural policy research that combines a multiplicity of perspectives. Organizational studies, public administration, anthropology, political science, as well as the paradigm of new institutional economics is provided space in the DA-BAR's research portfolio under the theme on policies and governance. This research area is dedicated to enhancing understanding of institutional processes that explain behaviors and actions that shape agricultural development outcomes.

One of the areas relevant to the theme pertains to gender. With growing evidence of the importance of addressing gender issues to increase agricultural productivity, identification of significant ways in which gender can be integrated into development programs in agriculture is necessary. Understanding gender relations in agriculture requires bringing together different sources of information and different methods of analysis. A gender-responsive agricultural research, development, and extension system therefore needs to address women as well as men as both the clients and actors in agricultural research (Quisumbing et al., 2014[7]).

Land consolidation has been viewed as a strategic measure to optimizing efficiency and incomes from farming by increasing volumes of production and reducing its costs. As a constantly evolving concept, it has come to include issues concerning gender equity, human rights, tenure rights, and nature conservation (Mekouar, 2020[8]). A research area for land consolidation and property rights is hence provided in this theme on policy and governance to accommodate interests in enriching understanding about relevant issues surrounding this rural development paradigm.

The FAO (2018) describes food systems as an encompassing system actors and activities along the value chain that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded. It is broad enough to consist of smaller systems such that a change in one subsystem can impact changes in another.

As a complex system, it faces issues concerning governance, economics, and sustainability of food production, as well as its consumption and effects on the environment and human health. A research agenda that incorporates dynamics and shocks to the food system is hence necessitous to meet the increasingly complex challenges to food security in the country.

The fifth and final a research area under the theme on policy and governance concern human resource development. This part of the agenda is intended to respond to the declining trend of individuals engaging in agriculture and allied disciplines such as forestry, fishery, and veterinary medicine is declining. Such pattern is alarming as it imposes concern over the possible future gap in terms of human resource requirements for agriculture and fisheries. Establishing programs and policies that will upgrade the quality and competitiveness of agricultural human resources, ensure the sustainability of the agri-fisheries sector, and promote global competitiveness is of the essence.

The following matrix summarizes the five (5) research areas and indicative topics that can be pursued under the thematic area on strengthening policies addressing governance challenges in the agricultural sector.

Research Area	Description	Possible Topics
Policy Landscape and Governance	Studies that investigate decision-making processes, institutional arrangements, policy measures, and other factors in the system that shape the enabling environment for agricultural development	• Institutionalization of production related R4D activities by the LGU (up to the municipal level) • Review, streamlining and removal of redundant policies and guidelines (i.e., quarantine regulation, pollination guidelines, IPR) • Compliance monitoring and assessment of current government policies and programs on planting material distribution/dispersal • Collaborative governance arrangements for common pool resources • Review and assessment of policy on credit facility and indemnification fund • Policy on protection of maritime borders and development of marine resources • Role of crop insurance in resilience of farmers • Relationships and interaction among actors in agri-fishery sector • Institutional development in the agri-fishery sector, including establishment, improvement, and development of research facilities and ancillary services • Capacity building for development and maintenance of research facilities • Development and improvement of the digital infrastructure and internet connectivity especially of the small and marginalized farmers • Benchmarking on existing credit policies
Gender in Agriculture	Studies that investigate gender equity issues and gender relations in agriculture	• Gender sensitivity of developed technologies, farming systems and enterprises

Research Area	Description	Possible Topics
Land consolidation and property rights	Studies that examine the process, challenges, results of land fragmentation and consolidation, along with other agrarian issues concerning land management and property rights	• Land consolidation and contiguous mechanized farming • Land use and land conversion • Community-based agro-processing schemes • Conflict and security studies in capture fisheries areas • Collective action issues in common pool resource communities
Food Systems	RDE activities tackling challenges along the agri-food value chain, including various forms of disruptions in the supply chains, sustainability in food production and consumption	• Improving resilience of the Food Systems or supply chains to climate related or non-climate shocks • Understanding local knowledge systems in food and agriculture • Feed industry and its impact on livestock, poultry, and aquaculture • Socio-cultural and biophysical studies production and consumption
Human Resource Development in Agri-fishery Sector	Studies on quality and competitiveness of human resources in the agricultural sector across different occupations	• Capacitating the agriculture and research and development personnel • Re-skilling/upskilling of farmers in enterprise development • Immersion programs • Technology business incubation programs • Capacitating for Agri 4.0 • Future farmers, youth involvement in agriculture, new entrants in agriculture, adult-youth interaction in agricultural production systems • Aging population in the agriculture sector

Thematic Area 4: Ensuring Food Safety Through One Health

The pursuit of food and nutrition security for the country comprises safety of food as an essential criterion. As defined in the Food Safety Act of 2013, food safety is the assurance that food will not cause harm to the consumer when it is prepared or eaten according to its intended use. Prevalence of food-borne diseases necessitates targeted attention to food safety research as it has reverberating effects on labor productivity and well-being.

As collaborative, multidisciplinary effort—working locally, nationally, and globally to attain optimal health for people, animals, and our environment (King et al., 2008), the "One Health" approach has come to be recognized and adopted in many countries as a holistic, proactive approach to food safety. (IOM, 2012). The World Health Organization (WHO) ascribes the approach to aim of sustainably balancing and optimizing the health of people, animals, and ecosystems. With the challenges brought about by the Covid-19 pandemic, the relevance of One Health and what FAO espouses as agrifood system transformation for the health of people, animals, plants and the environment is now gaining more attention than ever.

This thematic area aligns with the greater One Health agenda in recognizing that the health of humans, domestic and wild animals, plants, and the wider environment are closely linked and interdependent. With food safety as a critical point of focus, it promotes a research portfolio for scholars and practitioners in the Philippine agriculture sector to enhance understanding and help address challenges in agri-food safety through the holistic lens that takes into animal, plant, forest, and aquaculture health in relation to actors and activities along the agri-food value chain.

One area of focus for research concerns food safety quality standards, which determine what the Australian Institute of Food Safety sets as the best way of handling, preparing and storing food that can reduce the risk of individuals becoming sick from foodborne illnesses. The Food Safety Act of 2013 likewise defines food safety as the assurance that food will not cause no harm to the consumer when it is prepared or eaten according to its intended use. This research area also includes development of mitigating measures against contamination in processing and handling agriculture and fisheries products.

Contending the inextricable link among food safety, nutrition and food security, the World Health Organization (WHO, 2022[9]) explains how health is dependent on access to sufficient amounts of safe and nutritious food. The DA helps ensure such a strong food system by supporting basic and applied research in the area of food and nutrition. The range of topics in this area is broad enough to accommodate nutrition-focused product and technology development, as well as ideation of strategies to make them accessible to all consumers.

A third research area in this theme recognizes how human health and well-being is directly affected by agri-fishery issues and practices. While the Covid-19 pandemic has demonstrated the possibility of a rather extreme (and hopefully rare) zoonotic disease outbreaks, there are health concerns related to agricultural and fishery activities that may be understated yet just as alarming.

The following matrix summarizes the three (3) research areas and indicative topics that can be pursued under the thematic area on ensuring food safety through the one health approach.

Research Area	Description	Possible Topics
Food Safety Quality Standards and Protocols for Agricultural and Fishery Products	Research that involves development or improvement of technologies or protocols in support of food safety standards.	• Development of quarantine and phytosanitary protocols • Improvement of epidemiological surveillance and biosecurity measures for crops, livestock, and fisheries • Development and promotion of sustainable, food-safety compliant, and biosecure livestock production systems • Development of detection kits for food safety-related contaminants • Traceability systems for biological, physical, and chemical food safety-related contaminants.
Food and Nutrition	Research that involves development or improvement of technologies that would improve the consumers' access to nutritious, affordable, and safe food.	• Biofortification • Phenolic in pigmented agri-food commodities
Agricultural Practices and Human Health	Research that explores the effects of agricultural pests or diseases and their management on human health	• Pesticide contamination in agricultural products • Zoonotic risk studies • Consequences of farm chemical use on human health and environment • Fishing practices and human health

Thematic Area 5: Assessing and Evaluating Impacts

This thematic area supports the development of an evaluative culture in government that the Joint Memorandum Circular No. 2015-01 of the National Economic and Development Authority and Department of Budget and Management promotes in defining a national evaluation policy framework (NEPF).

Impact assessment (IA) is a means of measuring the effectiveness of organizational activities and government programs and thus understanding the significance of changes brought about by these activities, programs and interventions. It is not just enough for governments to implement and later assume that successful implementation will automatically lead to intended socio-economic improvements. IA serves as a powerful public management tool that aid understanding of how past and present initiatives contribute to the improvement of the lives of target beneficiaries or stakeholders, and the continuous flow of information back into the system to help improve the overall implementation as well as future undertakings.

IA, as a component of the policy or programming cycle in public management can be performed prospectively (Ex-ante) and retrospectively (Ex-post). Ex-ante IA supports planning and decision making by generating information about potential impacts of a policy or program. On the other hand, ex-post IA generates evidence about results attributable to the implemented policy or program.

This thematic area also covers the broader field of evaluation to include concerns over the improvement of public management work (Kusek & Rist, 2004[10]), spanning intervention design itself, as well as the fidelity, cost and efficiency of its implementation, and unintended consequences. From these learnings, evaluation is able to guide how policies and programs can be sustained or enhanced in future periods.

The matrix below provides brief descriptions and indicative topics that can be pursued under three research areas in the assessment and evaluation of impacts.

Research Area	Description	Possible Topics
Ex-ante Impact Assessment	Prospective analyses of potential impacts of an intervention	• Economic costs of non-adoption of GAP or GM • Ex-ante impact assessment of GMO and similar technologies • Feasibility studies for adoption of emerging technologies
Ex-post Impact Assessment	Assessment studies of impacts attributable to a delivered/completed intervention	• Impact assessment of DA banner commodity programs • Socio-economic studies on agricultural interventions/technologies • Industry impact of technologies • Impact assessment of agricultural production systems • Impact assessment of institutional development projects (e.g., establishment of research facilities) • Mixed-method IA of complex and/or long-term interventions

Research Area	Description	Possible Topics
Evaluation Studies	Research that looks into different aspects of an intervention that has influenced or can prospectively influence the extent of an intervention's impact.	• Mixed-method evaluation of complex and/or long-term interventions • Formative and process evaluation studies for on-going programs • Participatory impact assessment studies

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Annexes

List of Available Technologies per Commodity Group

This section contains the developed agriculture and fisheries technologies through R4D from 2016 to 2022 based on the gathered data from various R4D agencies on the agriculture and fisheries sector. These technologies were vetted among various stakeholders in the field to further substantiate the research areas initially identified. Serving as an additional guide for researchers and the public alike, the list provides a comprehensive view of the technologies that are readily available as well their respective recommended pathway.

The recommended technology pathway indicates the next step suggested for the developed technology, to wit:

1. **Adaptation**
   - ➔ The technology is now for on-station and/or on-farm trials composing a series of treatments/trials/experiments within regional location sites but in small plots
   - ➔ The activities in this pathway are researcher-managed

2. **Verification**
   - ➔ The technology is now for on-farm trials composing at least X number of trials/treatments/experiments needed or appropriate to come up with a statistically acceptable analysis within a provincial/municipal location sites for multi-location testing in large plots
   - ➔ The activities in this pathway are farmer-managed with research supervision

3. **Dissemination**
   - ➔ The technology/information is now for utilization in identified location-specific sites (regional, provincial, municipal). Further, the technology is for integration with existing practices and culture of individuals within communities/groups/organizations
   - ➔ The activities in this pathway are managed by the community/group/ organization with assistance from extension service providers, LGUs, private sector, and NGOs

4. **Commercialization**
   - ➔ The technology is now for:
     - Utilization of intended end user (e.g. FCAs, private sector, etc.) for scaled-up production
     - Compliance to regulatory agency requirements (e.g. FDA, FPA, etc.)
     - Display and sale in RDI/FCA-based showroom or through temporary or short term market channels (e.g. exhibits)
     - Mainstream market (i.e. malls, supermarket, etc.) characterized with regular/consistent logistics and financial operations

Cereal Crops

Rice

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	High-yielding rice varieties preferred by farmers in the locality and with good eating quality	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Adaptation
Input	Information on the adaptability of newly released rice varieties to different agro-ecological systems	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Adaptation
Input	Resistant varieties to major diseases and insect pests	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Adaptation
Input	Promising rice lines (from rainfed breeding and wide hybridization) with drought tolerance	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Adaptation
Input	Conserved and selected germplasm/genetic resources of promising traditional rice landraces and traditional upland rice varieties	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Verification
Input	Elite inbred and hybrid lines evaluated for agronomic performance which are screened for insect and disease reactions, evaluated for salt-tolerance, and evaluated for heat tolerance	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Next -Gen PLUS: Participatory performance Testing and Validation (PPTV)	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Verification
Input	Information on the performance testing and validation of the NSIC rice varieties for irrigated, lowland, inbred, rainfed, drought-, saline-tolerant, and special purpose rice varieties	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Verification
Input	Aerobic rice technology	DA-RFO CAR DA-RFO 2 DA-RFO 5 DA-RFO 7 DA-RFO 8 BASC MMSU UPLB	Dissemination
Input	Information on the assessment on the distribution of good quality rice starter seed distribution heirloom rice landraces	DA-RFO CAR DA-RFO 6 DA-RFO 7 CLSU	Dissemination
Input	Biosensors for early warning and fast response against the important seedborne pathogens of rice prior to storage, banking, and during seed quarantine	DA-RFO CAR DA-RFO 6 DA-RFO 7 CLSU	Dissemination
Input	Drought tolerant lowland rice varieties in upland ecosystem	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Adaptation
Input	Green Super Rice (GSR) varieties in saline, submerged, and rainfed rice areas	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Inbred varieties locally-adapted in favorable irrigated lowland, rainfed, drought-prone, and lowland	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Dissemination
Input	Selected widely adaptable and superior location-specific rice varieties (location-specific and soil type specific)	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Adaptation
Input	Information and protocol on the rice production fertilizer management in irrigated lowland	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Verification
Input	Information on the adaptability yield trial of new inbred, hybrid, and saline rice varieties	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Adaptation
Input	Top varieties for seed production under three major ecosystems	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Dissemination
Input	Information on the yield and growth performance of upland black rice varieties	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
		MMSU PSAU	
Input	Alternative rice-based cropping systems for climate change adaptation	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Adaptation
Input	Different rice cultivars in drought-prone and lahar areas	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Dissemination
Input	Traditional upland rice varieties for low-elevation upland and rainfed lowland areas	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Verification
Input	Traditional Upland Rice (TUR) germplasm conserved ex situ	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Verification
Input	Organic rice production through utilization of microbial inoculants	DA-RFO 2 DA-RFO 5 DA-RFO 6 DA-RFO 7 DA-RFO 8 DA-RFO 9 DA-RFO 10 MMSU PSAU	Dissemination
Input	Information on the impact of seeds and fertilizer usage on economic profile, yield, and technology adoption	DA-RFO 6	Verification
Input	Multi-location adaptation trials (MAT) for transplanted and direct seeded rice	DA-RFO 7 NVSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Free flow/artesian well as irrigation source for rainfed rice production	DA-RFO 2 BPSU	Adaptation
Input	Solar-powered motor pump for irrigation systems of small farms	DA-RFO 2 BPSU	Dissemination
Input	Water harvesting technologies to improve water use efficiency	DA-RFO CAR	Dissemination
Input	Alternate wetting and drying (AWD) as water-saving technology: drumseeder, water-saving technology in electric-driven water pump areas, Indian Intensification System of practice in rice production, SRI and Legowo row planting technology, water management of rice-based cropping system, and laser land leveling technology, Automon pH	DA-RFO CAR DA-RFO 2	Dissemination
Input	Aquifer characterization for groundwater source	DA-BAFE	Dissemination
Input	Site suitability analysis for small scale Irrigation through GIS-based water resource assessment	RSU	Dissemination
Input	Solar-powered irrigation system (SPIS) for rice production	DA-BAFE	Adaptation
Input	Sling pump and paddle wheel water wheels	DA-BAFE	Adaptation
Input	Nutrient management protocols	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Dissemination
Input	Baseline data on the heavy metal content of irrigated rice areas	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Verification
Input	Soil loss assessment in Small Water Impounding Projects (SWIP) areas	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Verification
Input	Soil health cards and soil test-based fertilizer recommendation	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Modern fertilization management strategies for rice production	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Dissemination
Input	Information on the yield and grain quality of black rice variety as Influenced by application of different fertilizer management	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Verification
Input	Carrageenan plant growth promoter for enhanced growth and induced pest and disease resistance in rice	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Dissemination
Input	Soil health management practices	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Dissemination
Input	Information on the microbial diversity in different types of soil with different health situations and identification and preservation of beneficial microorganisms	DA-BSWM DA-RFO 2 DA-RFO 7 DA-RFO 9 DA-RFO 10 UPLB DOST	Verification
Input	Soil and water conservation technologies	DA-RFO 2 DA-RFO 10	Dissemination
Input	Ratooning Management for lowland rice	DA-RFO 2 DA-RFO 10	Adaptation
Input	Fertility map as basis for the farmers in the application of right kind and amount of fertilizer	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Dissemination
Input	Protocol on the compost and green manure and foliar application	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Dissemination
Input	Information on the response of rice to gypsum	DA-RFO 2 DA-RFO 6 DA-RFO 7	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
		RSU UPLB	
Input	Information on the productivity and profitability of inbred lowland rice influence by carrageenan under irrigated environment	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Dissemination
Input	*Rhodopseudommonas palustris* and Jadan technology as bio-fertilizer on rice production	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Verification
Input	Utilization of entomopathogens for the management of rice brown planthopper	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Verification
Input	Bioprospecting rice bacterial endophytes: different phylogenetic groups in the microniches of Oryza species, a bioinformatics meta-analysis	DA-RFO 2 DA-RFO 6 DA-RFO 7 RSU UPLB	Verification
Input	Locally available nutrient resources	DA-RFO CAR DA-RFO 7	Verification
Input	Biological control technologies against heirloom rice pest and diseases	DA-RFO CAR DA-RFO 7	Dissemination
Input	Balanced fertilization strategies	DA-RFO CAR DA-RFO 7	Dissemination
Input	Soil ameliorants, bio stimulants, and biofertilizer	DA-RFO CAR DA-RFO 7	Dissemination
Input	Solar-Powered Fertigation System (SPFS)	DA-RFO CAR DA-RFO 7	Verification
Input	Organic solid fertilizers using locally available materials	DA-RFO CAR DA-RFO 7	Verification
Input	Biological control of rice insect pests through ecological engineering	DA-RFO CAR DA-RFO 7	Verification
Input	Pesticide use strategies	DA-RFO 2	Verification
Input	Carrageenan plant growth promoter for enhanced growth and induced pest and disease resistance in rice	DA-RFO 2	Dissemination
Input	Protocol on the use of Metarhizium sp. (fungicide) and makabuhay (botanical insecticide)	DA-RFO 2	Adaptation
Input	Entomopathogenic nematode (EPN) as potential biological control agent against fall armyworm	DA-RFO 2	Adaptation
Input	Organic pesticides to lowland rice condition	DA-RFO 2	Verification
Input	Protocol on the integrated pest management of white stemborer using bio-control agents	DA-RFO 2	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Rice Crop Manager (RCM): comprehensive decision support tool for increasing yield and income of farmers	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Dissemination
Production	Pest Risk Identification Management (PRIME): system/protocol on pest surveillance	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Dissemination
Production	Philippine Rice Information System (PRISM): operational system/decision-support tool estimating rice area, yield, and damage)	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Dissemination
Production	GIS-based soil fertility maps	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Dissemination
Production	Information on the native nutrient supplying capacity of selected lowland rice soil	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Verification
Production	Production of traditional upland rice under lower elevation upland areas	DA-PhilRice DA-RFO CAR DA-RFO 2 DA-RFO 6 DA-RFO 7 DA-RFO 10 MMSU IRRI	Verification
Production	Information on the native nutrient supplying capacity of selected lowland rice soil	DA-RFO 2 MMSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Protocol on the sustainable upgrading of rice crop manager to cover diverse rice-growing areas	DA-RFO 2 MMSU	Dissemination
Production	Information on the agronomic performance and seed multiplication of traditional upland rice varieties in rainfed lowland ecosystem	DA-RFO 2 MMSU	Verification
Production	Alternative cropping pattern for rice-based farmers	DA-RFO 2 DA-RFO 10	Verification
Production	Locally fabricated solar powered light trap	DA-RFO 2 DA-RFO 6	Verification
Production	Science-based planting calendar	DA-RFO 2 DA-RFO 6	Verification
Production	Location-specific fertilizer for rice in drought-prone areas	DA-RFO 2 DA-RFO 3 DA-RFO 6 DA-RFO 8 MMSU	Dissemination
Production	Community-based crop and livestock integration	DA-RFO 2 DA-RFO 3 DA-RFO 6 DA-RFO 8 MMSU	Dissemination
Production	Integrated farming system technologies	DA-RFO 2 DA-RFO 3 DA-RFO 6 DA-RFO 8 MMSU	Dissemination
Production	Improved methods for generating rice crop parameters, including indicators for crop health and management practices from remotely sensed data and efficient management strategies and tactics to reduce crop losses	DA-RFO 2 DA-RFO 3 DA-RFO 6 DA-RFO 8 MMSU	Adaptation
Production	Organic production management technologies for rice-based and upland agroecosystem (organic fertilizer, post-production handling strategies)	DA-RFO 2 DA-RFO 3 DA-RFO 6 DA-RFO 8 MMSU	Verification
Production	Rice-based diversification technology: gabi Integration in the rice terraces	DA-RFO CAR	Dissemination
Production	Rice-based diversification technology: mushroom species fruiting bag production and integration in heirloom rice	DA-RFO CAR	Dissemination
Production	Rice-based diversification technology: integration of muscovy duck in rice farming	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: mungbean-based products such as polvoron, noodle, and mushroom-based products (siomai, patty, dinakdakan, shanghai roll)	DA-RFO 2	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Rice-based diversification technology on the use of quality seeds, one seedling per hill, Rice Crop Manager recommendations and use of results of soil analysis, improved cropping pattern from rice-rice-fallow to rice-rice-mungbean	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: rice-based integrated cropping system models	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: integrated in native pig in rice production: rice hull as beddings during gestating, growing, and breeding period of native pig, coco dust as bedding best during farrowing period (diarrhea), and sawdust as bedding best recommended during farrowing (easy to decompose)	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: integrated native chicken in the rice production (rice grain and rice bran as feeds to the poultry)	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: five (5) breeds of native chicken (hens, bulik, itim, puti), roosters (mayahin, lasak), and enhanced forage added with rice grains and rice bran	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: integration of high value crops mungbean and watermelon) in rice production areas	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: improved cropping pattern from monocropping rice to rice-rice-mungbean and rice-white-corn/mungbean	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: rice+poultry integration	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: outscaled technologies on upland rice-based farming (upland rice+vegetables-corn+vegetables) system	DA-RFO CAR	Dissemination
Production	Rice-based diversification technology: NSIC RC27 (higher yielding variety with same taste and preference based on sensory evaluation compared to Pinilisa)	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: BCAs and compost with Trichoderma sp.	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: vegetable (*pinakbet*) production year round	DA-RFO 2	Dissemination
Production	Rice-based diversification technology: rice+onion+fish integrated farming system	DA-RFO 2	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Rice-based diversification technology: different farming system in upland ecosystem	DA-RFO CAR	Dissemination
Production	Rice-based diversification technology: protocols on land preparation, seedbed preparation, transplanting, weed management, nutrient management, water management, pest and diseases management	DA-RFO 10	Dissemination
Production	Rice-based diversification technology: productivity and profitability of rice rainfed lowland farmers through palayamanan system	DA-RFO 10	Dissemination
Production	Rice-based diversification technology: integrating assorted vegetables, fruit trees and other grain crops in upland rice-based farming	DA-RFO 10	Dissemination
Production	Rice-based in silviculture: a model farm approach for agripreneurship and agrotourism	DA-RFO 10	Dissemination
Production	Rice-based diversification technology: integrated and diversified rice-based farming systems: palayamanan in the community-BASC windmill collaborative model farm and rice-based farming system integrated with free-range chicken production for smallhold farms	BASC	Dissemination
Production	Integrated rice-fish farming systems	USeP	Dissemination
Production	Resource-efficient rice production technologies	DA-RFO 2 DA-RFO 9 DA-RFO 10 CBSUA	Dissemination
Production	Multi-purpose weeder retrofitted to a grass cutter	DA-RFO 2 DA-RFO 9 DA-RFO 10 CBSUA	Verification
Production	Automatic hand-tractor mounted leveler	DA-RFO 2 DA-RFO 9 DA-RFO 10 CBSUA	Adaptation
Production	Productive lowland rice through integration of matured technologies	DA-RFO 2 DA-RFO 9 DA-RFO 10 CBSUA	Dissemination
Production	Lowland rice field rehabilitation strategy through persistent organic application	DA-RFO 2 DA-RFO 9 DA-RFO 10 CBSUA	Verification
Production	Organic production system for lowland rice	DA-RFO 2 DA-RFO 9	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
		DA-RFO 10 CBSUA	
Production	Use of GSR 8 in upland areas	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Verification
Production	Utilization of newly released NSIC high yielding rainfed rice varieties for rainfed ecosystem	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Dissemination
Production	Adoption of NextGen rice varieties for the major ecosystems in the Philippines	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Dissemination
Production	National cooperative testing and multi-location adaptation trial of rice in the Philippines	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Adaptation
Production	Verification trial of resilient rice varieties cum seed production	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Verification
Production	Technology demonstration of promising NextGen varieties	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Dissemination
Production	Characterization of upland rice cum seed multiplication in support to AMIA project	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Adaptation
Production	Performance evaluation of special purpose rice	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Verification
Production	Community-based initiative demonstration farm in rainfed lowland ecosystem	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Dissemination
Production	Location-specific rainfed rice varieties	DA-RFO 2 DA-RFO 6 DA-RFO 9 DA-RFO 10	Dissemination
Production	Planting of different drought tolerant crops either monocropping, intercropping, and relay cropping plus the application of soil amendments that will improve water holding capacity	DA-RFO 6 DA-RFO 8 UPLB	Dissemination
Production	Kabusugan sa Kaumahan (KABSAKA) technology	DA-RFO 6 DA-RFO 8 UPLB	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Adoption of AWD and with the use of drum seeder and observation well	DA-RFO 6 DA-RFO 8 UPLB	Dissemination
Production	Technologies for rainfed and upland areas (Bhoochetana principles and approaches for natural resources management)	DA-RFO 6 DA-RFO 8 UPLB	Dissemination
Production	Multi-environment Testing (MET) system of drought tolerant rice lines for NCT	DA-RFO 6 DA-RFO 8 UPLB	Verification
Production	Improvement of cultivation techniques (e.g. yield performance of ratooned rice under two harvesting methods)	DA-RFO 6	Verification
Production	Purified upland rice cultivars thru collection, verification, and characterization	DA-RFO 8	Verification
Production	Holistic upscaling management-approach in accelerating yield (HUMAY) in the development of integrated rice-based farm villages	BPSU	Adaptation
Production	Community-based rice and mushroom production technologies	BPSU	Dissemination
Production	Upland rice based cropping patterns in the context of climate change	DA-RFO 9 MMSU	Verification
Production	Simulation of the growth and yield performance of selected rice-based cropping system using DSSAT under various climate change scenarios	DA-RFO 9 MMSU	Verification
Production	Assessment of the climate change adaptation programs/strategies of institutions in Ilocos Norte towards a resilient rice-based production	DA-RFO 9 MMSU	Verification
Production	Local observations, evidences, and adaptation strategies to climate change impacts for resilient rice-based production system	DA-RFO 9 MMSU	Adaptation
Production	Use of mechanical transplanter (i.e. used 20 kg seeds/0.50ha, seedlings transplanted 15DAS, increased yield by 0.35-0.74mt/ha, reduced cost by P0.27-0.48/kg, and reduced labor by 14-17 M/ha)	DA-PhilRice DA-RFO 2 BPSU UPLB IRRI	Dissemination
Production	Mechanized dry seeding technology with integrated best management practices, validated and adapted specific best practices for rice, corn, and mungbean with MP seeder in the target areas, adapted MP seeder plus for rained areas and water scarce lowlands, and implemented modalities for efficient dissemination and scaling out of the MP seeder dry direct seeding technology	DA-PhilRice DA-RFO 2 BPSU UPLB IRRI	Dissemination
Production	Hand-tractor drawn implements for rice-based crop production system and hand	DA-PhilRice DA-RFO 2	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
	tractor drawn multi-purpose machine for grain crop production	BPSU UPLB IRRI	
Production	Brown rice huller	DA-PhilMech DA-RFO 2 UPLB	Dissemination
Production	Information on the efficiency of mechanized rice transplanter	DA-PhilMech DA-RFO 2 UPLB	Verification
Production	Outscaled mechanization of crop establishment	DA-PhilMech DA-RFO 2 UPLB	Dissemination
Production	Protocol of the transfer of outputs and procedures to determine the level of mechanization for all regions in the Philippines	DA-PhilMech DA-RFO 2 UPLB	Dissemination
Production	Information on the level of sufficiency of different farm equipment and postharvest facilities	DA-RFO 2	Verification
Production	Operational system for rice monitoring to support decision making towards increased rice production	DA-RFO 2 DA-RFO 7 PSAU	Dissemination
Production	Automated irrigation system for rice	DA-RFO 2 DA-RFO 7 PSAU	Adaptation
Production	Farmer's rice doctor kiosk for increased production	BPSU	Verification
Postharvest and Processing	Database information system in digital form of machinery equipment and facilities	DA-RFO 2 DA-RFO 6 DA-RFO 8 DA-RFO 9	Verification
Postharvest and Processing	Postharvest practices recommendations for reducing losses on inbred and hybrid rice postproduction	DA-RFO 2 DA-RFO 6 DA-RFO 8 DA-RFO 9	Dissemination
Postharvest and Processing	Benchmarking mechanization and needs for rice sufficiency	DA-RFO 2 DA-RFO 6 DA-RFO 8 DA-RFO 9	Verification
Postharvest and Processing	Micro-impeller brown rice huller	DA-PhilMech DA-RFO 6 DA-RFO 10	Dissemination
Postharvest and Processing	Impeller-type compact rice mill	DA-PhilMech DA-RFO 6 DA-RFO 10	Dissemination
Postharvest and Processing	Information on the suitability and appropriateness of the technology and machineries introduced	DA-PhilMech DA-RFO 6 DA-RFO 10	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Improved postharvest machinery and equipment in irrigated lowland rice production	DA-PhilMech DA-RFO 6 DA-RFO 10	Adaptation
Postharvest and Processing	Information on the technical performances of the different brands of combine harvesters in term of grain losses under various operational speeds during harvesting	DA-RFO 2	Dissemination
Postharvest and Processing	Semi-automated compact biomass furnace	DA-PhilMech DA-RFO 2 DA-RFO 4A BPSU	Verification
Postharvest and Processing	Fluidized bed drying system	DA-PhilMech DA-RFO 2 DA-RFO 4A BPSU	Verification
Postharvest and Processing	Walking-type agricultural tractor (jumbo), ten-rows tractor mounted seeder, and mini rice transplanter	DA-PhilMech DA-RFO 2 DA-RFO 4A BPSU	Verification
Postharvest and Processing	Chimney-type solar rice dryer	DA-PhilMech DA-RFO 2 DA-RFO 4A BPSU	Verification
Postharvest and Processing	Grain probe moisture meter	DA-PhilMech	Dissemination
Postharvest and Processing	Kalinayan rice quality traits	DA-RFO 8	Adaptation
Postharvest and Processing	"Balatinaw" broken grains into wine	DA-PhilMech DA-RFO 2 CLSU	Commercialization
Postharvest and Processing	Processed dragon fruit to wine and vinegar	DA-PhilMech DA-RFO 2 CLSU	Verification
Postharvest and Processing	Red rice brew	DA-PhilMech DA-RFO 2 CLSU	Verification
Postharvest and Processing	brown rice cookies and brown rice puff balls	DA-PhilMech DA-RFO 2 CLSU	Commercialization
Postharvest and Processing	Packaging material for ready-to-use LAB probiotics derived from fermented rice wash and molasses for small ruminants	DA-PhilMech DA-RFO 2 CLSU	Adaptation
Postharvest and Processing	Functional food products from Special Purpose Rice	DA-PhilMech DA-RFO 2 CLSU	Commercialization
Marketing	Profile of the organic input industry in selected areas in the Philippines (i.e. policy recommendations to improve production,	UPLB CBSUA	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
	marketing and utilization of organic agricultural inputs, and recommended measures to improve packaging, labeling, and certification requirements of organic agricultural inputs)		
Marketing	Consumer awareness on low glycemic grains	UPLB CBSUA	Dissemination
Marketing	Value chain analysis of organic rice in Camarines Sur	UPLB CBSUA	Verification
Marketing	Economic analysis of organic rice production in Camarines Sur	UPLB CBSUA	Verification
Marketing	Information and marketing scheme on brown rice	UPLB CBSUA	Verification
Marketing	Information and marketing scheme on brown rice	DA-RFO 10	Verification
By-product Utilization and Waste Management	Mushroom seasoning with mixture of mushroom powder, white pepper, garlic powder, and iodized salt	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Mushroom processed products: rice-mushroom muffin, mushroom imbaliktad, rice-mushroom cake, rice-mushroom miki, mushroom ice cream, mushroom crepe/pancake, mushroom in chili oil	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Rice wash for pure culture media, alternate for PDA, potato extract, and oatmeal	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Use of palay and cracked corn as alternate for sorghum	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	IGP possible ventures: pure culture production, spawn production, fruiting bag, fruit production, processed products	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Commercialization
By-product Utilization and Waste Management	Information on the local mushroom production technologies of paddy straw, oyster, and shiitake	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
By-product Utilization and Waste Management	Mushroom technology	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Dissemination
By-product Utilization and Waste Management	Rice straw as substrate for indoor mushroom	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Dissemination
By-product Utilization and Waste Management	Shitake mushroom technology development through community-based production	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Dissemination
By-product Utilization and Waste Management	Influence of different levels of spent mushroom substrates on the production different herbs	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Mushroom culture and production using various agricultural wastes	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Adaptation
By-product Utilization and Waste Management	Culture media using sawdust and rice straw for oyster mushroom (*Pleurotus spp.*) production under different ecosystem conditions	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Dissemination
By-product Utilization and Waste Management	Products out of engineered rice residues for house construction and as source of biofuel	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Rice hull briquettes	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Commercialization
By-product Utilization and Waste Management	Biochar and bio oil from rice biomass	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
		PSAU MMSU	
By-product Utilization and Waste Management	Silica synthesis from rice hull for advance ceramic applications	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Verification
By-product Utilization and Waste Management	Unpolished organic rice snack food and beverages	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Commercialization
By-product Utilization and Waste Management	Parboiled rice and its by-products	DA-RFO 2 DA-RFO 6 DA-RFO 9 CBSUA PSAU MMSU	Commercialization
By-product Utilization and Waste Management	Mechanized substrate bagger for mushroom production	DA-RFO 2 DA-RFO 8	Dissemination
By-product Utilization and Waste Management	Refined performance of the developed machine adopted in the community-based mushroom growers and other stakeholders	DA-RFO 2 DA-RFO 8	Dissemination
By-product Utilization and Waste Management	Automatic irrigation system for mushroom production	DA-RFO 2 DA-RFO 8	Dissemination
By-product Utilization and Waste Management	Mushroom spawning device	DA-RFO 2 DA-RFO 8	Dissemination
By-product Utilization and Waste Management	Alternative source of culture media for mushroom spawn production	DA-RFO 2 DA-RFO 8	Verification
Others - Socio-economics and Policy	Information on the participation of women in rice farming	DA-RFO 2	Dissemination
Others - Socio-economics and Policy	Information on the adoption of rice from production to post-production technologies in the adverse areas in Cagayan Valley	DA-RFO 2	Dissemination
Others - Socio-	Information on the impact of seeds and fertilizer usage on economic profile, yield, and technology adoption	DA-RFO 2 DA-RFO 6	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
economics and Policy			
Others - Socio-economics and Policy	Technology adoption on managing weedy rice	DA-RFO 2 DA-RFO 6	Dissemination
Others - Socio-economics and Policy	Rice milling system	DA-PhilMech	Dissemination
Others - Socio-economics and Policy	Information on the performance of hybrid rice variety in the different provinces (i.e. effectiveness of flatbed dryers, effectiveness of different drying facilities)	DA-RFO 2 DA-RFO 6 BPSU	Dissemination
Others - Socio-economics and Policy	Inventory of agri-farm machineries	DA-RFO 2 DA-RFO 6 BPSU	Dissemination
Others - Socio-economics and Policy	Suitability and appropriateness of the technology and machineries introduced	DA-RFO 2 DA-RFO 6 BPSU	Dissemination
Others - Socio-economics and Policy	Economic analysis of farm machineries in rice production at different sizes	DA-RFO 2 DA-RFO 6 BPSU	Dissemination
Others - Socio-economics and Policy	Information on the organic and inorganic rice farming practices in Cagayan	DA-RFO 2	Dissemination
Others - Socio-economics and Policy	Profiled and mapped stakeholders of DWDA Radyo Pangkaunlaran for policy recommendations	DA-RFO 2	Dissemination
Others - Socio-economics and Policy	Information on the effectiveness of communication strategies among rice farmers	DA-RFO 2	Dissemination
Others - Socio-economics and Policy	Iron fortified rice	DOST-FNRI	Dissemination

Corn

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	5 FCAs across ecosystems with 25 ha involved in BF	DA-RFO 2	Verification
Input	Microbial biopesticide against FAW	DA-BPI DA-NCPC	Verification
Input	Site specific nutrient management	UPLB	Adaptation
Input	Location specific variety	DA-RFO 10	Verification
Input	Low input technology option for corn production	DA-RFO 10	Verification
Input	SCoPSA technology	DA-RFO 2	Commercialization
Input	IES OPV White Flint corn varieties - IES 89-12 - IES 89-10 - IES 89-06 - IES 10-04 - IES 12-06	DA-RFO 2	Dissemination
Input	High-yielding OPV corn varieties	DA-RFO 2	Adaptation
Input	NSIC 8 CVRC bred varieties	DA-RFO 2	Commercialization
Input	Information on the effect of population densities on the growth and yield of corn Kalimpos in Samar and Leyte	DA-RFO 8	Verification
Input	Improved high yielding corn Kalimpos strain for NCT to address low productivity of white corn and inadequate supply of OPV seeds	DA-RFO 8	Verification
Input	Beneficial fungus as natural enemies of FAW	DA-RFO 8	Verification
Input	High yielding corn Kalimpos strain	DA-RFO 8	Verification
Input	Climate-resilient traditional corn varieties	DA-RFO 8	Verification
Input	NSIC 2016 Cn 308 or MMSU Glut 2, NSIC 2018 Cn 315 or MMSU Glut 3, and NSIC 2020 Cn 327or MMSU BMIR Glut 1	MMSU	Dissemination
Input	Information on the sources of resistance to corn diseases and emerging virus disease, its alternative host and vector.	UPLB	Verification
Input	Maize populations derived from native corn germplasm resistant to biotic and abiotic stresses as the parents of new open-pollinated varieties and hybrids	UPLB	Verification
Input	Improved ACB-resistant, CW-resistant, and CPH-resistant traditional maize varieties	UPLB	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Data on the performance of different traditional corn varieties in the respective Region.	UPLB	Verification
Input	Philippine Corn Genetic Resources Information Database (PCGRID) deployed online hosted via BlueHost, a commercial webhosting and domain registry and cloud storage services provider through www.pcgridph.org (*The technology can track inventory status both for seed stocks and viability status, evaluation of other seed germplasm materials.*)	UPLB	Dissemination
Input	Information on heterotic groups will aid in the development of composite varieties, improved native corn varieties, and eventually inbred lines and hybrids with adaptive traits (i.e. tolerance to abiotic and biotic stresses).	UPLB	Dissemination
Production	Open pollinated varieties of corn pest resistance	CBSUA	Verification
Production	Technologies that will improve soil health and quality	CLSU	Dissemination
Production	Double row technology: (80cmx30cmx20cm) increased yield by 600-2500kg/ha - RR+Gypsum (2 bags/ha)	DA-RFO 2	Commercialization
Production	GAP Corn using double row technology (80cmx30cmx20cm)	DA-RFO 2	Verification
Production	Established data/information on the effect of glyphosate on arthropod species diversity and population and fertility status	DA-RFO 2	Verification
Production	Established data/information on the performance of hybrid corn seeds in double-row planting	DA-RFO 2	Verification
Production	Three times planting of hybrid glutinous corn and silage for feeds for small and large ruminants	DA-RFO 2	Verification
Production	Information on the response of corn to gypsum	DA-RFO 2	Verification
Production	Nutrient expert software for yellow corn and white corn and refined and science-based fertilizer recommendations through	DA-RFO 2	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
	the Nutrient Expert Software Applications for corn		
Production	Computer beta version of Corn Crop Manager	DA-RFO 2	Adaptation
Production	Established use of Carrageenan as supplement fertilizer for corn	DA-RFO 2	Commercialization
Production	Protocol on using SCoPSA, double-row planting technology, and use of jabber	DA-RFO 2	Commercialization
Production	SALT in banana-based areas OPV/Mungbean-Hybrid Corn OPV/Cowpea-Hybrid Corn Showcased SALT in banana-based areas Showcased cropping pattern on: - (OPV//Mungbean-Hybrid Corn) - (OPV//Cowpea-Hybrid Corn)	DA-RFO 2	Commercialization
Production	Developed IPM of corn plant hopper	DA-RFO 2	Dissemination
Production	Technologies on Corn + Peanut Production and Corn + Sweet Potato production	DA-RFO 2	Adaptation
Production	Improved cropping pattern from corn-corn to corn (white corn)-mungbean intercropping under clay soil condition	DA-RFO 2	Adaptation
Production	Corn (white corn)-peanut intercropping under sandy soil condition: IES 10-04 was adaptable and socially accepted due to its high yield potential and its good eating quality	DA-RFO 2	Adaptation
Production	POT on double row technology, use of jabber, Bio-N inoculant, and fertilizer recommendation of soil analysis and integration of mungbean	DA-RFO 2	Commercialization
Production	Corn-legumes and livestock integration (triple cropping of glutinous corn production and silage production)	DA-RFO 2	Adaptation
Production	POT on improved production technologies for yellow corn and silage production and cattle production	DA-RFO 4A	Commercialization
Production	Efficient ameliorant to correct acidic soil	DA-RFO 5	Verification
Production	Maize Nutrient Expert	DA-RFO 5	Verification
Production	Sustainable farming system	DA-RFO 6	Dissemination
Production	Collection and characterization of native corn	DA-RFO 6	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Conservation and management of germplasm	DA-RFO 6	Verification
Production	Improvement and evaluation of native corn	DA-RFO 6	Verification
Production	Occurrence of pests and diseases	DA-RFO 6	Verification
Production	Conventional corn varieties	DA-RFO 6	Adaptation
Production	Integrated pest management strategies of FAW	DA-RFO 8	Verification
Production	Yield performance of DMR corn varieties	DA-RFO 8	Verification
Production	Sustainable source of corn seeds with capacitated farmer breeder of traditional corn varieties	DA-RFO 8	Verification
Production	Integrated pest management strategies of FAW	DA-RFO 8	Verification
Production	Improved corn production management practices	DA-RFO 8	Verification
Production	Information on the Participatory Varietal Selection (PVS) on OPV white Corn in Aurora, ZDS and on farm evaluation in region 9 on the Nutrient Expert for Maize Software-Philippines	DA-RFO 9	Verification
Production	Protocol in upscaling of OPV yellow corn Production in Antique using different nutrient management	DA-RFO 6	Dissemination
Production	Information on pathogens that are associated with seed diseases in the corn grit production system	UPLB	Dissemination
Production	Information on factors predisposing corn seeds to fungal contamination and factors influencing pathogen survival, growth and development	UPLB	Dissemination
Production	Management options for seed pathogens within the corn grit production system	UPLB	Dissemination
Production and Marketing	Protocol in optimizing production of white flint varieties	DA-RFO 6	Verification
Production, By-product utilization, and Waste management	Production and by-product utilization of hybrid corn	DA-RFO 6	Verification
Postharvest and Marketing	Information and education on food safety for corn	DA-RFO 6	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Marketing	Postharvest practices and management	DA-RFO 6	Verification
Postharvest and Processing	Low-cost storage and packaging technologies	DA-RFO 10	Verification
Postharvest and Processing	Chemically treated corn seeds in hermetic plastic bag stored in a typical warehouse with ambient temperature and relative humidity of ranging 25-30^{o}C and 63-68 percent respectively at initial moisture content of 10.7 percent (A2B1C3) and 12.0 percent (A2B2C3) have the excellent performance in making the seeds viable even in longer duration of 86 percent and 87 percent germination test result respectively in 12 months	DA-RFO 2	Verification
Postharvest and Processing	Small-scale air flow mobile corn flatbed dryer	DA-RFO 8	Adaptation
Postharvest and Processing	Storage techniques	MMSU	Verification
Marketing	Maize Silky Sip	DA-RFO 2	Dissemination
Marketing	Result on data on corn clusters, problems of key implementers, yield of corn, profit, level of aflatoxin per cluster area, and recommendations from the result of the study	UPLB	Dissemination
Marketing	Consumption of Corn Grits	DA-RFO 10	Verification
Marketing	Value chain analysis for White Corn	DA-RFO 10	Dissemination
Marketing	Information on the status of corn eating municipalities	DA-RFO 2	Dissemination
Marketing	Pinoy GOURmix, a disaster relief food	DA-RFO 2	Commercialization
Marketing	Processed corn-based products (e.g. Cafe Bagga, Cracknic, Kornbi, Rice-Corn Mix, Purro Bagga (grits), White Corn Grits (Corn Blend)	DA-RFO 2	Dissemination
Marketing	Information on the aflatoxin content of corn	DA-RFO 2	Dissemination
Marketing	Data on aflatoxin occurrence in corn from the different mechanical drying facilities of Isabela and Quirino	DA-RFO 2	Dissemination
By-product Utilization and Waste Management	Renewable energy, bioprocess engineering, feedstock for bioethanol production, and waste-to-energy technologies	CLSU	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
By-product Utilization and Waste Management	Corn waste management practices	DA-RFO 10	Adaptation
By-product Utilization and Waste Management	Corn processed products	DA-RFO 8	Dissemination
By-product utilization and waste management	Organic fertilizer and animal feed	MMSU	Verification
By-product Utilization and Waste Management	Charcoal briquettes from rice hull and bamboo wastes using chichacorn processing effluent as binder	MMSU	Dissemination
By-product Utilization and Waste Management	Corn waste as support to organic agriculture	DA-RFO 6	Adaptation
Others - Socio-economics and Policy	Information on the adoption of different corn technologies in region 02 for policy making/ recommendation	DA-RFO 2	Dissemination
Others - Socio-economics and Policy	Information on the utilization of village-type dryers	DA-RFO 2	Dissemination

Adlay

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	(4) four adlay varieties: Gulian, Pulot, Tapol, and Ginampay)	DA-RFO 2	Adaptation
Input	(3) three GTRRO registered adlay varieties	IPB-UPLB	Dissemination
Input	Adlay milling machine	DA-RFO 2	Verification

Root crops

Cassava

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	POT/basic information on identity of *Candidatus phytoplasma* causing witches broom disease of cassava	UPLB	Dissemination
Input	Identified cassava varieties produced by farmers in Western Visayas	DA-RFO 6	Verification
Input/ Production	High yielding varieties by cassava farmers in Western Visayas and promotion of intercropping technology on cassava production	DA-RFO 6	Dissemination
Production	Site-specific fertilizer recommendations, management practices, SSNM computer tool/nutrient expert	DA-RFO 2	Dissemination
Production	POT on cassava production in Region 8	DA-RFO 8	Dissemination
Production	POT on the five cassava varieties at two planting orientation as affected by different levels of vermicast application	DA-RFO 9	Verification
Production	POT on the cassava as influenced by pruning at different growth stages in varying cutting lengths	DA-RFO 9	Verification
Production	Genetic diversity of 47 cassava varieties using barcoding genes and DNA fingerprints using SSR markers of cassava varieties	UPLB	Dissemination
Production	Site-specific nutrient management fertilization rate for cassava	UPLB	Dissemination
Production	Site-specific nutrient management for cassava	DA-RFO 4A	Dissemination
Production	Promising cassava accessions for Ilocos farmers	MMSU	Adaptation
Production	New MMSU cassava accessions	MMSU	Adaptation
Production	Production using different nutrient management	DA-RFO 6	Adaptation
Production	Tolerant cassava varieties for insect and diseases	DA-RFO 10	Verification
Production	Low input technology option for cassava production	DA-RFO 10	Adaptation
Production	Efficient cassava digger/harvester	DA-RFO 10	Adaptation
Production	Developed technology of farming system in hillyland	DA-RFO 10	Adaptation
Production	Biological control of cassava red spider mite	VSU	Adaptation
Production	NSIC-registered cassava varieties resistant to cassava red spider mites	VSU	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Preplanting treatment of cassava stakes for the control of pests and diseases	VSU	Commercialization
Production	NCM-ELISA detection for cassava phytoplasma	VSU	Dissemination
Postharvest and Processing	Cassava-based products	DA-RFO 2	Commercialization
Postharvest and Processing	Information, process/protocol, and recommendation on the exact harvest age for harvest of different cassava varieties	DA-RFO 6	Adaptation
Postharvest and Processing	Efficient cassava digger/harvester	DA-RFO 10	Adaptation
Postharvest and Processing	Cyanide analysis and shelf life studies of selected cassava varieties at different maturity stages	UPV	Commercialization
Postharvest and Processing	Manual, package, process, and protocols of best postharvest practices	DA-RFO 6	Commercialization
Postharvest and Processing	Best postharvest practices for cassava	DA-RFO 6	Verification
Postharvest and processing	Improved postharvest technology for small-enterprise farmers	MMSU	Adaptation
Postharvest and processing	Flour preparation from cassava	MMSU	Verification
Postharvest and processing	Enhanced cassava production and processing	DA-RFO 9	Verification
Marketing	Identified target buyer and trained cassava by-products processor	DA-RFO 6	Commercialization
Marketing	Information and education on food safety	DA-RFO 6	Commercialization
By-product Utilization and Waste Management	Information and protocol on the effects of leaf harvesting frequency on yield of cassava for utilization as animal and human food	DA-RFO 6	Verification
By-product Utilization and Waste Management	Protocol in the utilization of cassava waste as feed and organic sources	DA-RFO 10	Verification
By-product Utilization and Waste Management	Best agronomic practices for cassava leaf production and harvesting using top cassava varieties	UPLB	Dissemination
By-product Utilization and Waste Management	Processes that address the toxin elimination and antinutritive characteristics of cassava leaves	UPLB	Dissemination
By-product Utilization and Waste Management	Quality standard for a safe cassava leaf-based products for human and animal consumption	UPLB	Dissemination
By-product Utilization and	Identified technology for utilization of cassava waste and by-products	DA-RFO 10	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Waste Management			
By-product Utilization and Waste Management	Development of various products out of raw materials of cassava	DA-RFO 6	Adaptation
By-product Utilization and Waste Management	Production and development of cassava for food, livestock, and poultry	DA-RFO 6	Adaptation
By-products utilization and waste management	Formulated animal feeds for swine and livestock	MMSU	Verification
Others	Market analysis of cassava	CBSUA	Verification

Other Root Crops

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Process/protocol on enhanced tuber yield production	DA-RFO 6	Verification
Input	Low input technology option for root crops production	DA-RFO 10	Adaptation
Input	Fertilizer application scheme for kamangeg (*Dioscorea luzonensis*)	MMSU	Verification
Production	Information, process, and protocol in increasing tuber yield	DA-RFO 6	Dissemination
Production	Resistant varieties of root crops to insect and diseases	DA-RFO 10	Verification
Production	Organic fertilizer management protocol for sweet potato	MMSU	Verification
Production	Intensified root crops production protocol in rice-based areas	TAU	Dissemination
Production	Protocols on the propagation of sweet potato quality planting materials	TAU	Dissemination
Production	Standardized protocol on the identification of viruses using the PCR-based ELISA technique	TAU	Dissemination
Production	Sweet potato weevil control using pheromone	VSU	Dissemination
Production	Sweet potato resistant varieties to scab	VSU	Dissemination
Production	Biological control for taro hornworm	VSU	Dissemination
Postharvest and Processing	Postharvest facilities for root crops	DA-RFO 10	Adaptation

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Protocol on the proper shelf life of selected root crops	DA-RFO 10	Verification
Postharvest and Processing	Storage technique for kamangeg (*Dioscorea luzonensis)* tubers	MMSU	Verification
Postharvest and Processing	Kamangeg processing technology for flour, cheesecake, and improved detoxification technique for *D.hispida*	MMSU	Commercialization
Postharvest and Processing	Product development on root crops	ASU	Adaptation
Postharvest and Processing	Mechanical root crops washer	CBSUA	Dissemination
Postharvest and Processing	Sweet potato chips and wine	CBSUA	Verification
Postharvest and Processing	Ube processing technologies	DMMMSU	Commercialization
Postharvest and Processing	Optimized product utilizing colored sweet potato and cassava varieties	TAU	Commercialization
Marketing	Value chain analysis for root crops	DA-RFO 10	Dissemination
Marketing	Market analysis of taro	CBSUA	Verification
Marketing	Market analysis of sweet potato	CBSUA	Verification

Vegetables and Legumes

Garlic

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Utilization of Batanes Red and Itbayat White garlic varieties	DA-RFO 2	Commercialization
Input	Protocol on organic fertilization compliant to standards	DA-RFO 2	Commercialization
Input	Protocol on using organic-based pesticides compliant to standards	DA-RFO 2	Commercialization
Input	Protocol in using dibble method for planting distance of 15-20 cm x 10-25 cm in garlic production	DA-RFO 2	Verification
Input	Protocol in using rice straw, cogon, grasses, and hulls with 3-5 cm thickness for mulching for garlic production	DA-RFO 2	Verification
Input	Application of 1/3 in volumes of soil (1/3 organic fertilizer + 1/3 volume sand) to clay soil laid-out in bamboo sided plots for backyard garlic production	DA-RFO 5	Commercialization
Input	Application of 1/3 in volumes of soil (1/3 organic fertilizer + 1/3 volume sand) to clay soil laid-out in bamboo sided plots for backyard garlic production	MMSU	Commercialization
Production	Late planting of local garlic planted on elevated plots/small well-conditioned bamboo sided plots at maximum fertilizer application	DA-RFO 5	Verification
Production	Multi-location adaptability trial of registered garlic varieties and other cultivars	DA-RFO 1	Verification
Production	On-trial of different garlic varieties	DA-RFO 6	Verification
Production	Garlic pest and disease management	DA-BPI	Verification
Production	Multi-location adoptability trial of promising garlic varieties in regions 1, 2, and CAR	MMSU	Verification
Production	Protocol against pest and natural enemies associated in garlic as affected by change in environment	MMSU	Adaptation
Production	Phenophases of garlic as biological calendar for pest management	MMSU	Adaptation
Postharvest and Processing	Processed black garlic using Maillard reaction process, best packed and marketable	DA-RFO 5	Commercialization
Postharvest and Processing	Sustainable mass production of garlic through in-vitro culture	DA-BPI	Dissemination
Postharvest and Processing	Garlic storage technology	MMSU	Adaptation

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Processing of garlic herbal tablet and the other products	MMSU	Adaptation
Postharvest and Processing	Information on the evaluation of black garlic as potential medicinal product through analysis of its nutritive content chemical properties and anti-cancer activities	MMSU	Adaptation

Onion

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Utilization of yeast as fertilizer on the growth and yield of green onion	SSC	Adaptation
Production	Improved biosensors	CLSU	Verification

Vegetables and Legumes

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	GAP technology and off-season vegetable production protocols	DA-RFO 2	Commercialization
Input	Mungbean GAP-based technology	DA-RFO 2	Commercialization
Input	Organic fertilization technology for mungbean and soybean (rhizobium inoculant, vermicompost, foliar fertilizers) Rhizobium inoculant, gypsum & boron fertilization in peanut	DA-RFO 2	Commercialization
Input	Arachis pintoi as biological mulch for lowland vegetables	DA-RFO 2	Verification
Input	New tomato varieties: NSIC Tm17 (Animax 1) and NSIC Tm18 (Animax 2)	DA-RFO 2	Verification
Input	Quality mungbean planting materials	DA-RFO 2	Commercialization
Input	Organic snap beans varieties	DA-RFO 2	Dissemination
Input	Protocol on the mass production of sweet potato through macro propagation techniques using vine cuttings	DA-RFO 2	Verification
Input	Conventional seed rhizome techniques on ginger	DA-RFO 2	Verification
Input	Application of Boron (Solubor Borax) to peanut	DA-RFO 2	Dissemination
Input	Application of 150-200 kgs/ha. of Gypsum (Calcium sulfate) in side placement at peak flowering regardless of soil test	DA-RFO 2	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Site-specific low input technology option for legumes	DA-RFO 10	Adaptation
Input	Green manuring technology	DA-RFO 10	Adaptation
Input	Sustainable seed system in legumes production	DA-RFO 10	Dissemination
Input	Low input technology option in highland and lowland vegetables	DA-RFO 10	Adaptation
Input	Sustainable lowland vegetable seeds	DA-RFO 10	Verification
Input	Seed production and seed enhancement under organic agriculture	DA-RFO 5	Verification
Input	Protocol on using pyroligenous acid as alternative growth enhancer on vegetables	DA-RFO 6	Adaptation
Input	Protocol on identifying the fertility status and nutrient holding capacity of sandy soil applied with carbonized rice hull for peanut production	DA-RFO 6	Verification
Input	Efficacy of oyster mushroom substrates as soil amendments for growth and yield performance of solanaceous crops	DA-RFO 9	Verification
Input	Information on the long-term effect of organic fertilizers in upland vegetables	DA-RFO 9	Verification
Input	Selection of open-pollinated accessions of eggplant (*Solanum melongena L.*)	DA-BPI (Manila)	Verification
Input	Protocol on the varietal crop improvement of tomato (hybridization and selection, preliminary yield trial, general yield trial, and national cooperative trial)	DA-BPI (Manila)	Verification
Input	TAU SMART Center/ Sustainable Mechanized Agriculture for Research and Technology	TAU	Adaptation
Input	POT on the community-based seedling, production, and distribution towards seed banking	TAU	Dissemination
Input	Organic production system for tomato and lettuce	CBSUA	Dissemination
Input	Information and protocol on the effect of yeast as fertilizer on the growth and yield of green onion	SSC	Adaptation
Input	Process on the effect of food waste composting on the yield performance of winged beans	SSC	Verification
Input	Process on the performance adaptability of carrots on different organic fertilizers	SSC	Adaptation
Input	Effect of different levels of vermicompost on the growth and yield of pechay through sack gardening	SSC	Dissemination
Input	Utilization of seed system to support commercialization and promotion of selected cereals, vegetables and legumes	CLSU	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	NSIC-approved varieties of snap beans (bush and pole types) and garden pea and salad tomatoes under conventional/organic production system	BSU	Dissemination
Input	NSIC-approved varieties of snap beans (bush and pole types) and garden pea and salad tomatoes under conventional/organic production system	UPLB	Dissemination
Production	Utilization of biological control agents (e.g. trichogramma cards, earwigs, and metarhizium)	DA-RFO 2	Commercialization
Production	Superior peanut lines for the national cooperative test/evaluation (CVRC Pn 2011-001 and CVRC Pn 2011-002)	DA-RFO 2	Adaptation
Production	Pilot testing and technology transfer of improved IPM and INM strategies of mungbean	DA-RFO 2	Dissemination
Production	Integrated farming system (rice-vegetables-poultry) in irrigated lowland	DA-RFO 6	Dissemination
Production	Adaptability Trial of China's Paste Tomato Variety in Upland Condition	DA-RFO 9	Verification
Production	Open Field, Low Cost and greenhouse Production Technology for Selected High Value Vegetables	DA-RFO 10	Adaptation
Production	Greenhouse Production Practices for Selected High Value Crops	DA-RFO 10	Adaptation
Production	Varietal Development on Yardlong Bean	DA-BPI (La Granja)	Verification
Production	Installation of Drip Irrigation System for Bamboo Shoot and Mungbean Seeds Production - TAU	TAU	Adaptation
Production	Integrated Rice-Legumes Cropping Systems	TAU	Adaptation
Production	Off-season Tomato Production Technology Towards Enterprise Development Project	TAU	Commercialization
Production	Varietal Improvement of Soybean	CLSU	Adaptation
Production	Organic Seed Quality of Tomato	CBSUA	Verification
Postharvest and Processing	Five (5) different packaging material used for Formal Seed System (Cold Storage and ambient condition)	DA-RFO 2	Verification
Postharvest and Processing	Promotion of village-level seed storage technology (Hermetic Cocoon and Super Grain Bags)	DA-RFO 2	Dissemination
Postharvest and Processing	Identified plastic containers and plastic/glass jar as commonly used seed storage of squash, pole sitao, cowpea, eggplant, garlic, and onion	DA-RFO 2	Adaptation
Postharvest and Processing	Improved mungbean varieties: Pag-asa 7 and Pag-asa 19	DA-RFO 2	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Mungbean-based products	DA-RFO 2	Commercialization
Postharvest and Processing	Soybean-based products	DA-RFO 2	Commercialization
Postharvest and Processing	Soybean utilization for household protein-rich food and processing into attractive and healthy food products and eventually feeds formulation for indigenous swine feeding	DA-RFO 2	Commercialization
Postharvest and Processing	Local soy TVP (full-fatted meal) product using the single screw food extruder with complete nutritional and shelf-life analysis	DA-RFO 2	Commercialization
Postharvest and Processing	Processing technology for six (6) peanut food products and its appropriate packaging materials	DA-RFO 2	Commercialization
Postharvest and Processing	Local soy TVP full-fatted product and soy-based products (soy balls, soy longganisa and soy patty)	DA-RFO 2	Commercialization
Postharvest and Processing	Appropriate mixture of mungbean to produce various food products for nutrition and feeding program and disaster foods	DA-RFO 2	Commercialization
Postharvest and Processing	Post-production technologies in smart greenhouse and open field production	DA-RFO 10	Adaptation
Postharvest and Processing	Information on the assessment of the postharvest facilities for enhanced productivity and quality in legumes	DA-RFO 10	Adaptation
Postharvest and Processing	Protocol on soybean meal production and other PHF for Legumes	DA-RFO 10	Adaptation
Postharvest and Processing	Information and protocol on the viability/storability of soybean seeds using different storage containers under cold storage and farmer's conditions	CLSU	Dissemination
Postharvest and Processing	Pigeon pea food products (cookies, cupcake, milk)	CBSUA	Dissemination
Marketing	Supply chain analysis of selected legumes	DA-RFO 10	Dissemination
Marketing	Information on the development and commercialization of marketing strategy on legumes in Northern Mindanao	DA-RFO 10	Commercialization
Marketing	Protocol on the seed multiplication of newly released varieties of soybean, mungbean, and peanut for commercial planting	DA-BPI (La Granja)	Verification
Marketing	Grating technology on tomato and bitter gourd	DA-BPI	Commercialization
Socio-economics and Policy	Data/information on the status of Isabela Agricultural Trading Center in Cagayan Valley for policy making/ recommendation	DA-RFO 2	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Socio-economics and Policy	Established data/information on the effectiveness of spring development projects for vegetables production in Cagayan Valley for policy making/recommendation	DA-RFO 2	Dissemination

Fruits

Banana

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Germplasm collection of banana cultivars conserved and characterized	DA-BPI	Dissemination
Input	Germplasm collection of banana cultivars conserved and characterized	UPLB	Dissemination
Input	Tissue culture laboratory in Luna, Apayao	DA-RFO CAR	Dissemination
Input	Mass produced banana quality planting material through tissue culture and macropropagation	DA-RFO 2	Commercialization
Input	Banana micropropagation techniques and protocols	DA-RFO 5 PSAU IPB-UPLB NVSU	Adaptation
Production	Information on the molecular Identity and detection of microbial pathogens of banana	SKSU	Dissemination
Production	Information on the molecular Identity and detection of microbial pathogens of banana	IPB-UPLB	Dissemination
Production	Information on the molecular Identity and detection of microbial pathogens of banana	DA-BPI	Dissemination
Production	Information on the performance of different banana varieties planted of Fusarium Wilt Infested Area and developed banana inflorescence protection through mechanization	USeP IPB-UPLB	Dissemination
Postharvest and Processing	Hole digger	DA-PhilMech	Adaptation
Postharvest and Processing	Information on the feasibility of using a Solar-Powered Reefer Container Van	DA-BAFE	Verification
Postharvest and Processing	Banana Powder	DA-PhilMech	Verification
Postharvest and Processing	Developed processing technology for wine and vinegar production from Bungulan variety of banana	SKSU	Verification
By-product Utilization and Waste Management	Developed value-added products from the leaves of different types of banana	DA-BPI	Verification

Mango

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Germplasm collection of mango	MMSU BPI IPB-UPLB	Dissemination
Production	Integrated crop management and integrated pest management	BASC	Verification
Production	Mapping and Geo-tagging using GIS with Field Validation of NCS-ISE Device for Mango Orchards in Bataan / Development of Electronic Device for Determining the Nitrogen Content of Soil using Ion-Selective Electrode (NCS-ISE) with Field and Cooperating Agencies Validation	BPSU	Verification
Postharvest and Processing	Information on the feasibility of using a Solar-Powered Reefer Container Van	BAFE	Dissemination
Postharvest and Processing	Processing technologies of Carabao mango (puree, jam, dried, mango, etc.)	MMSU	Verification
Postharvest and Processing	Developed mango wine, mango vinegar, dried mango and pickled mango	PSAU UPLB	Verification
Postharvest and Processing	Developed bottled Indian mango salsa	MSC	Verification
Marketing	Marketability of Mango-based Products: Input to Product Development of Local Farm-produced Mangoes in Central Luzon	BPSU	Verification

Pineapple

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	New propagation technologies on producing quality and disease free planting materials	DA-RFO 5 IPB-UPLB	Adaptation
Input	Nutrient media use for tissue culture of Queen and MD2 pineapple planting materials	DA-RFO 5 IPB-UPLB	Adaptation
Input	Information on the recommended size of planting materials and the appropriate time for flower induction to produce optimum yield of Queen pineapple	DA-RFO 5 DOST-PCAARRD	Verification
Input	Integrated pineapple-based farming system	DA-RFO 5	Adaptation
Production	Information on identified major pests of Queen Pineapple	VSU DA-RFO 5	Dissemination
Production	Information on the optimum plant population of queen pineapple under intercropped systems	DA-RFO 5	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Information on the growth performance of Queen pineapple using different types and rates of organic fertilizer	DA-RFO 5	Verification
Production	Optimized planting density regulation for Queen Pineapple in intercropped system	VSU DA-RFO 5	Verification
Production	POT to enhance fruit size and quality of Spanish Red Pineapple	DA-RFO 5	Verification
Postharvest and Processing	Information on the feasibility of using a solar-powered reefer container van	BAFE	Verification
Postharvest and Processing	Value chain analysis of pineapple technology in Aklan	ASU	Verification
Postharvest and Processing	Protocol in utilization of Spanish Red Pineapple fibers and dyes	ASU	Verification

Plantation and Biofuel Crops

Abaca

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Protocol for micropropagation through shoot tip tissue culture	DA-PhilFIDA	Dissemination
Input	Protocol, information, policy, and optimized PCR protocol in detecting bunchy top viruses in weeds associated with abaca	DA-PhilFIDA	Verification
Input	Developing abaca hybrid resistant to bunchy top	UPLB	Verification
Input	Germplasm collection of banana and abaca cultivars conserved, characterized and documented at NPGRL, UPLB	UPLB	Verification
Input	Germplasm collection of abaca cultivars conserved, characterized, and documented	DA-PhilFIDA	Dissemination
Input	NARC Abaca germplasm collections	VSU	Dissemination
Input	Abaca varieties/genotypes screened for bunchy top resistance in different regions	DA-PhilFIDA VSU	Verification
Input	Protocol on the slow growth system for abaca germplasm	DA-PhilFIDA	Verification
Input	Entomopathogenic fungi for biocontrol of abaca aphid, high yield and bunchy top resistant abaca genotypes, detection kits for bunchy top virus, and potential elicitors of abaca resistance	VSU	Verification
Input	Nursery management: inoculation of mykovam in abaca plantlets	UPLB	Dissemination
Production	Phenological monitoring protocol for abaca	UPLB	Dissemination
Production	Comparison of GAP and Non-GAP for sustainable abaca production	VSU DA-PhilFIDA	Dissemination
Production	Alley cropping of abaca	DA-PhilFIDA	Dissemination
Production	Information and protocol on the appropriate, cost-effective, and climate-resilient technologies	VSU DA-PhilFIDA	Dissemination
Production	Biopesticides for abaca insect pests	VSU	Verification
Production	Information and protocol for the identified plant characteristics and specific genes associated to various environmental stressors	DA-PhilFIDA	Verification
Production	Information and protocol for the identified plant characteristics and specific genes associated to various environmental stressors	VSU	Adaptation
Production	Agro-ecosystem analysis of abaca growing areas	VSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Antimicrobial compound from abaca extracts	VSU DA-PhilFIDA	Verification
Postharvest and Processing	Improved, lighter and cheaper portable abaca spindle stripping machine	VSU	Verification
Postharvest and Processing	Optimized abaca leaf sheath-decorticator	VSU	Verification
Postharvest and Processing	Working prototype of a portable spindle stripping machine with 24TPI blade	VSU	Verification
Postharvest and Processing	Working prototype of an electric-driven fixed-type abaca spindle stripping machine	VSU	Verification
Postharvest and Processing	Mobile, cheaper, and lighter prototype of a trailer-mounted abaca spindle stripping machine	VSU	Verification
Postharvest and Processing	Postharvest and processing machine using renewable energy sources: working prototypes of solar powered abaca spindle stripping machines and decorticators	VSU	Verification
Postharvest and Processing	Products from abaca fiber	VSU	Verification
Postharvest and Processing	Optimized process in the production of medium density fiber cement-board	VSU	Verification
Postharvest and Processing	Process and products of laminated housing materials	VSU	Verification
Postharvest and Processing	Working prototype of fishing boat with abaca-fiber hull	VSU	Verification
Marketing	Information on the comparative cost and return analysis of different methods of abaca stripping	VSU	Verification
Marketing	Business support model for the commercial operation of the networks of tissue culture laboratories in Eastern Visayas	VSU	Verification
Marketing	Information exposure and knowledge of market information among abaca farmers in Eastern Visayas	VSU	Verification
By-product Utilization and Waste Management	Processing of ethanol products from abaca wastes	VSU	Verification
By-product Utilization and Waste Management	Essential oil for cosmetics and medicinal uses	VSU	Verification
Others - Policy, Socio-economics, and Extension	Integrated Abaca Extension Program - Management of abaca diseases in Leyte through interagency/ multisectoral cooperation - Capability enhancement on abaca technologies - Information, education, communication,	VSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
	and promotion - Propagation and distribution of planting materials		
Others - Policy, Socio-economics, and Extension	Socio-economic Program - Impacts of ABTV and adaptive strategies of farming households - Economic value of abaca germplasm conservation - Ex-post impact assessment of abaca technologies developed at NARC Proposed/NARC - Ex-ante evaluation of abaca research and development programs for resource allocation and prioritization Proposed/NARC	VSU	Verification
Others	Assessment of carbon balance in different abaca-based production system	VSU	Verification

Cacao

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Bamboo-Cacao propagation and commercialization	AkSU	Verification
Input	Collection, conservation, characterization, evaluation and utilization of coffee and cacao	DA-BPI	Verification
Input	Multilocation trial of 10 promising varieties of cacao in different agro-climatic zones in the Philippines	SKSU	Verification
Production	Quality cacao beans from natural fermentation	CBSUA	Verification
Production	Framework of cacao and its production in Camarines Sur	CBSUA	Verification
Postharvest and Processing	Design, development, and performance evaluation of cacao bean extractor	DA-BPI	Verification
Postharvest and Processing	Sensor device for cacao quality measurement	DA-PhilMech	Verification
Postharvest and Processing	Tablea processing system	DA-PhilMech	Verification
Postharvest and Processing	Hole digger	DA-PhilMech	Verification
Postharvest and Processing	Automated combined mechanical cacao demucilager-fermenter-dryer	USeP	Verification
Postharvest and Processing	Split-type cacao bean fermenter	CBSUA	Verification
By-product Utilization and	Protocol on the utilization of cacao wastes for industrial and commercial applications	DA-PhilMech	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Waste Management			

Coconut

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Characterized coconut-based farming system in Camarines Sur and Camarines Norte	CBSUA	Verification
Input	Integrated nutrient management of coconut plantations: utilization of organic fertilizers (vermicast, probiotics, bioactive-N, and IMO)	VSU	Verification
Production	Protocol on the nutrient and water management for a climate change resilient coconut agroecosystem in Luzon, Visayas and Mindanao	DA-PCA	Verification
Production	Information on the evaluation of adaptable planting systems and product-based farming in calamity-prone coconut growing regions	DA-PCA	Verification
Production	Regenerated coconut accessions in the DA-PCA's genebank in Zamboanga as core collections	DA-PCA	Verification
Production	Appropriate farming system for coconut toddy production for sugar, ethanol, and other sugar-based products	DA-PCA	Verification
Production	Sustainable coconut somatic embryogenesis tissue culture protocol for the mass propagation and multi-locational testing of DA-PCA recommended plumule-derived varieties in selected provinces	DA-PCA	Commercialization
Production	Protocol on the propagation of quality planting materials of selected tall, dwarf and hybrid coconut varieties through coconut somatic embryogenesis technology (CSet)	DA-PCA	Verification
Production	Information on the gene expression analysis during somatic embryogenesis	DA-PCA	Dissemination
Production	Protocol on the mass production of macapuno and other soft-endosperm coconut planting materials using embryo culture technique	DA-PCA	Dissemination
Production	Protocol on the molecular disease diagnosis for the identification and indexing of *Cadang-cadang*-free coconut palms (*Cadang-cadang* indexing sub-activity)	DA-PCA	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Protocol on the mass production and delivery systems for biological control agents of new, emerging, and re-emerging coconut pests	DA-PCA	Verification
Production	Optimum combination of low-cost organic fertilizer	VSU	Verification
Production	Controlled fertigation system for coconut production	VSU	Verification
Production	Sustainable biological control for coconut pests	VSU	Verification
Production	GAP for coconut farming	VSU	Verification
Production	Feasible multi-cropping system under coconut	VSU	Verification
Production	Feasible crop combination under coconut	VSU	Verification
Production	Banana intercropping under coconuts	UPLB	Dissemination
Production	High yielding and disease resistant coconut varieties	VSU	Verification
Production	VCO production: centrifuge, natural fermentation, and freeze-thaw methods and protocols	DA-PCA	Verification
Production	Real-time Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) and Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP) protocols for coconuts	DA-PCA	Verification
Postharvest and Processing	Coconut-based products and materials for industrial, health, and environmental applications	DA-PCA	Verification
Postharvest and Processing	Village-level postharvest and processing machineries designs for coconut	DA-PCA	Verification
Postharvest and Processing	Information on the efficacy of different coagulating agents in producing coconut cheese	DA-PCA	Dissemination
Postharvest and Processing	Coconut yoghurt	DA-PCA	Dissemination
Postharvest and Processing	Macapuno and macapuno-based products (e.g. custard coconut ice cream)	DA-PCA	Dissemination
Postharvest and Processing	Coconut Methyl Ester (CME) from upgraded village-level oil mill	DA-PCA	Verification
Postharvest and Processing	Spray-dried coconut sugar, cocowater, and cocomilk processing technologies	DA-PCA	Verification
Postharvest and Processing	Utilization of palm biomass (coconut & oil palm) for ethanol and other chemicals	DA-PCA	Adaptation
Postharvest and Processing	Characterization of the sugar contents of coconut water of different coconut cultivars in different stages of maturity	DA-PCA	Adaptation
Postharvest and Processing	High-value coconut food products	VSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Information on the physicochemical and fatty acid profiling of recommended coconut cultivars for the production of good quality VCO	VSU	Verification
Postharvest and Processing	Information on the storage characteristics of coconut food products	VSU	Verification
Postharvest and Processing	Coconut water-powered lamp	CvSU	Verification
Postharvest and Processing	Biofuel from palm sap	CvSU	Verification
Postharvest and Processing	Pasteurized pure and fruit-blended coconut water	CBSUA	Verification
Postharvest and Processing	Propagation of stevia cutting using coconut water	CBSUA	Verification
Postharvest and Processing	Pasteurized coco water	CBSUA	Verification
Postharvest and Processing	Information on the profitability of coco water enterprise	CBSUA	Verification
Postharvest and Processing	Results of the sensory evaluation of pasteurized coco water	CBSUA	Verification
Postharvest and Processing	Market analysis of coco water	CBSUA	Verification
Postharvest and Processing	Processing of virgin coconut oil for organic use	SSC	Verification
Marketing	Information on the industry and socio-economic profiling of coconut	VSU	Verification
Marketing	Investment portfolio for commercialization of science-defined technologies on coconut-based farming systems	DA-PCA	Verification
By-product Utilization and Waste Management	Fuel briquettes from coconut wastes	VSU	Verification
By-product Utilization and Waste Management	Small-scale bioethanol production system using coconut husk extract as feedstock	BPSU	Verification
By-product Utilization and Waste Management	Ready-to-use cocopeat, coco coir plant box, soilless potting medium with cocopeat, and coco coir as mulching material	MSC	Verification
By-product Utilization and Waste Management	Plastic packaging alternatives from coconut biomass	DA-PCA	Verification
By-product Utilization and Waste Management	Low-cost biofuel blend from different plant oil sources for diesel engine	VSU	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Others	Modalities on climate-resilient coconut-based farming systems	DA-PCA	Verification

Coffee

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Protocol on the molecular detection of resistant coffee varieties to pests and diseases	UPD	Verification
Input	Information on the regional multi-location variety trial of Arabica coffee	SKSU	Verification
Production	Effect of Mokusako in Arabica coffee in Bakun	DA-RFO CAR	Verification
Production	Production system of coffee in Benguet and Mt. Province	DA-RFO CAR	Verification
Production	Selected botanicals in controlling fungal pathogens of coffee	CvSU	Verification
Production	Endophytes and mycoparasites for biological control of coffee rust	CvSU	Verification
Production	Information on the selected botanical pesticides against coffee berry borer	CvSU	Verification
Production	Information on the optimization models for coffee-based production system	CvSU	Dissemination
Production	Forest resources conservation and management	AkSU	Verification
Production	Agroforestry and intercropping farming system	BASC	Verification
Production	Statistical Analysis and Learning Tool (SALT)	BASC	Verification
Production	Protocol in the management of coffee rust (*Hemileia vastatrix*) and leaf rust (*Hemileia vastatrix*) in Robusta coffee using biological control agents from plant and animal teas in Sultan Kudarat and South Cotabato	SKSU	Verification
Postharvest and Processing	Moisture meter for coffee beans	DA-PhilMech	Verification
Postharvest and Processing	Coffee depulper	DA-PhilMech	Verification
Postharvest and Processing	Drying technologies for coffee beans	DA-PhilMech	Verification
Postharvest and Processing	Hole digger	DA-PhilMech	Verification
Postharvest and Processing	Manually-operated pulper	PSAU	Verification
Postharvest and Processing	Embryo-cultured growth chamber	CvSU	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Postharvest and Processing	Ergonomically-designed laboratory-scale coffee dryer and huller	CvSU	Verification
Postharvest and Processing	Automated laboratory-scale green coffee beans grader and storage equipment	CvSU	Verification
Postharvest and Processing	Localized processing machine for roasting and grinding of dried coffee beans	BPSU	Verification
Marketing	Cup-brewed coffee in a bag	PSAU	Verification
Marketing	Commercialized specialty coffee food products	CvSU	Commercialization
Marketing	Information on the marketing strategies for Aguinaldo blend coffee in the selected cities of Cavite	CvSU	Verification
By-product Utilization and Waste Management	Coffee pulp briquettes and pellets	PSAU	Verification
By-product Utilization and Waste Management	Coffee husk compost utilization in pechay	PSAU	Verification
Others	Mobile base app "CAPHE" harvest date estimator	UPLB	Verification
Others	Civet coffee quality standards using NIRS	CvSU	Verification

Pili

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Pili resin from promising pili varieties	CBSUA	Verification
Production	Pili pulp oil	CBSUA	Verification
Production	Benchmarked/identified additional superior quality pili cultivars, including the dual type "Fruit-Elemi" producing *Canarium ovatum* cultivars	DA-RFO 5	Verification
Production	Asexual propagation of pili varieties for early bearing	DA-RFO 5	Verification
Postharvest and Processing	Information on the causes and established or recommended control measures for the produce of quality nuts	DA-RFO 5	Verification
Postharvest and Processing	Best packaging materials for storing pili kernels and products	DA-RFO 5	Verification
By-product Utilization and Waste Management	Feeds, fertilizers, fashion jewelries, oil, etc.	DA-RFO 5	Verification

Sugarcane

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Information on the organic farming technologies for sugarcane production in Tarlac	TAU	Verification
Input	Information on the fertilizer recommendation for specific varieties	SRA	Verification
Input	Automated furrow irrigation system in sugarcane production	BPSU	Verification
Production	Varieties adapted to specific mill districts	DA-SRA	Verification
Production	Disease information and varietal evaluation techniques	DA-SRA	Dissemination
Postharvest and Processing	Information on the assessment and process development of muscovado production towards local tourism food product improvement and global market compliance	UPV	Verification
Postharvest and Processing	Cultivator, planter, mechanical harvester	DA-PhilMech	Verification
Postharvest and Processing	Sugarcane crop waste for fuel briquette and animal feed production	DA-PhilMech	Verification

Sweet sorghum

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Information on the performance of different sorghum varieties in Western Visayas	DA-RFO 6	Dissemination

Rubber

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Root trainer technique and precision grafting technology for the rapid production of rubber quality planting materials	DA-RFO 9	Verification
Input	Mass propagation and distribution of high-quality rubber planting materials	DA-PRRI	Verification
Input	Protocol for the efficient tissue culture propagation in rubber	USM	Verification
Production	Information and baseline data on the improved/efficient plant nutrient management of rubber in plantation area, by minimizing soil erosion, leaching, fertilizer loss and improves soil fertility as	DA-PRRI	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
	plant nutrient source for productive/mature rubber trees using the soil conservation pits technology		
Production	Information and baseline data on the alternatives to the rubber farmers from applying expensive commercial synthetic/chemical fertilizers in their rubber plantations, using the cheap and locally-available sources of organic fertilizers within the community such as vermicast and chicken dung	DA-PRRI	Verification
Production	Guide on soil fertility management in rubber plantations	DA-PRRI	Dissemination
Production	Information and baseline data on the existing rubber-based cropping systems in different climatic types of the Philippines	DA-PRRI	Verification
Production	Rubber tree rainguard for improved latex yield	DA-PRRI	Dissemination
Production	Baseline data on the collected hevea germplasm and initially developed standard descriptors for rubber germplasm collection	DA-PRRI	Verification
Production	Baseline data on potential high yielding primary clones	DA-PRRI	Verification
Production	Identification of genetically diverse and climate smart primary clones	DA-PRRI	Verification
Production	First owned rubber clone through ortet selection	DA-PRRI	Verification
Production	Recommended clones for NSIC registration	DA-PRRI	Verification
Production	Recommended specific clones for drought	DA-PRRI	Verification
Production	Information on the tapping intensity, TPD susceptibility, and yield response of rubber to management practices	JRMSU	Verification
Postharvest and Processing	Rubber sheet primary processing system	DA-PhilMech	Verification
Postharvest and Processing	Efficient rubber tapping device/knife	DA-PRRI	Verification
Postharvest and Processing	Policy recommendation for the use of low frequency tapping system	DA-PRRI	Verification
Others	Protocol on the biomass production and decomposition of Different cover crops residues in the rubber plantation in Zamboanga Peninsula	DA-RFO 9	Dissemination
Others	Information on the evaluation on the agronomic performance of Rubber RRIM Series in Luzon and Mindanao for NSIC registration	DA-RFO 9	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Others	Information on the growth and yield performance of rubber planted in non-traditional areas of the Philippines	DA-RFO 9	Dissemination
Others	Information on the adaptation and performance trials of different rubber clones in Zamboanga Peninsula	DA-RFO 9	Verification

Livestock

Ruminants (Meat and Dairy)

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Feeds and feeding systems	Data on the production performance of Anglo-Nubian breeder goats supplemented with stylo hay *(Stylosanthes guianensis)* under full confinement	DA-BAI	Verification
Input - Feeds and feeding systems	Corkwood (*Carallia brachiata)* as Feed for Beef Cattle at NBCRDC 1, Palawan	DA-BAI	Verification
Input - Feeds and feeding systems	Data on the performance of yearling Brahman Cattle supplemented with Urea Molasses Mineral Block (UMMB)	DA-BAI	Dissemination
Input - Feeds and feeding systems	Mixed grasses silage using different concentration of molasses solution	DA-BAI	Verification
Input - Feeds and feeding systems	Palatabilty of various forage-based pellets that are readily available in the NBCRDC, Nueva Ecija	DA-BAI	Dissemination
Input - Feeds and feeding systems	Management practices and utilization of selected sorghum varieties	DA-BAI	Verification
Input - Feeds and feeding systems	Seed production protocol of Indigofera zollingeriana as influenced by cutting management and plant density	DA-BAI	Dissemination
Input - Feeds and feeding systems	Data on the dry matter yield and regrowth performance of *Paspalum atratum* and fodder legumes (indigo, calliandra, ipil-ipil, and rensoni) at different cutting intervals/height	DA-BAI	Dissemination
Input - Feeds and feeding systems	Data on the herbage yield of pakchong napier fertilized with cattle manure	DA-BAI	Dissemination
Input - Feeds and feeding systems	Vermicomposting using Kakawate as a substrate to improve pasture areas of organic sheep in the NBCRDC, Nueva Ecija	DA-BAI	Verification
Input - Feeds and feeding systems	Cultivated hybrid Ipil-ipil, fleminga, and rensonii using hydroponic systems	DA-BAI	Dissemination
Input - Feeds and feeding systems	Data on the dry matter yield of Humidicola grass (*Brachiaria humidicola*) and Cook Stylo (*Stylosanthes guianensis*) under grazing condition at NFRRDC Masbate	DA-BAI	Dissemination
Input - Feeds and feeding systems	Data on the growth performance and herbage yield of different napier varieties, indigo, and Red Calliandra under different conditions/locations	DA-BAI	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Feeds and feeding systems	Data on growth performance of fattening lambs fed with different grass-based diet supplemented with different fodder legumes	DA-BAI	Dissemination
Input - Feeds and feeding systems	Madre de Agua as feed supplement to goats	BPSU	Verification
Input - Feeds and feeding systems	Pigeonpea as concentrates for growing sheep (utility model)	MMSU	Dissemination
Input - Feeds and feeding systems	Brahman cattle fed with machine-baled rice straw fortified with nitrogen from various organic and inorganic sources	DA-RFO 6	Adaptation
Input - Feeds and feeding systems	Improvement of paddock grazing techniques through legumes	DA-RFO 6	Adaptation
Input - Feeds and feeding systems	UMMB and concenrate as supplement (utility model)	MMSU	Commercialization
Input - Breeds and breeding stock	Cryopreservation technique for goat semen	DA-RFO 8	Verification
Input - Breeds and breeding stock	Semen extender using goat's milk	DA-RFO 8	Verification
Input - Breeds and breeding stock	Developed alternative breeding methods to improve native breed	DA-RFO 8	Verification
Input - Breeds and breeding stock	Characterized/profile of Native Goats in Negros Occidental	DA-RFO 6	Dissemination
Input - Breeds and breeding stock	Data on the production performance of purebred (White Dorper, Katahdin, St. Croix, and Barbados Black Belly) and crossbred sheeps at different multiplier farms/locations in Mindanao Region	DA-BAI	Dissemination
Input - Breeds and breeding stock	Data on the performance evaluation of imported goat and Sheep in nucleus and multiplier farms under Philippine conditions	DA-BAI	Dissemination
Input - Breeds and breeding stock	Characterized/profile and performance evaluation of Zamboanga del Sur and Capiz native cattle	DA-BAI	Dissemination
Input - Breeds and breeding stock	Direct Performance Test (DPT) on yearling cattle as a tool in selection process for bull semen donor and breeder dam	DA-BAI	Verification
Input - Breeds and breeding stock	Data on growth performance and carcass quality of NABC F1 Wagyu-Brahman at different finish weights	DA-BAI	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Breeds and breeding stock	Data on performance evaluation of Dumarao, Masbate and Labangan native bull at NBCRDC-Bukidnon semen collection line	DA-BAI	Dissemination
Production - Health and Nutrition	Identified risk factors associated to internal parasites of cattle in Negros Occidental	DA-RFO 6	Dissemination
Production - Health and Nutrition	Evaluated disease surveillance in dairy goats	PSAU	Dissemination
Production - Health and Nutrition	Field verification trials of low-cost rapid mastitis test kit for smallhold dairy farmers	TAU	Verification
By-product Utilization and Waste Management	Efficiency of biogas installation in cattle waste management	DA-BAI	Dissemination
Postharvest and Processing	Developed mutton sausage and burger patty (utility model)	MMSU	Commercialization
Postharvest and Processing	Processed chevon products	BPSU	Verification
Postharvest and Processing	Processing techniques for goat's milk derived products	PSAU	Verification
Others	Disaster preparedness plan for livestock animals	DA-BAI	Dissemination
Others	Utilization of pasture lease areas	DA-BAI	Dissemination

Swine

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Breeds and breeding stocks	Stocking rate for native pigs	PSAU	Dissemination
Input - Breeds and breeding stocks	Conserved and purified Marinduque native pig	MSC	Dissemination
Input - Breeds and breeding stocks	Reproductive biotechnology-based repopulation technologies	DA-BPO	Verification
Input - Breeds and breeding stock	Breeding true to type populations of Philippine native pigs with improved and predictable production performance and consistent product quality in the Cordillera Administrative Region, Cagayan Valley, CALABARZON, and MIMAROPA regions	DA-BAI	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Breeds and breeding stock	DNA marker selection protocols for meat, carcass, and fertility of the Philippine native pigs	DA-BAI	Dissemination
Input - Feeds and feeding systems	Different levels of feeding substitution using sprouted soybean to swine ration	DA-RFO 6	Adaptation
Input - Feeds and feeding systems	Standardized rate of substitution of locally available feedstuff in feed ration of native pig	MSC	Verification
Input - Feeds and feeding systems	Production and nutritive value of black soldier fly larvae fed with different waste substrates in support to native pig production	DA-RFO 9	Verification
Input - Feeds and feeding systems	Data on the growth performance of fattening hogs supplemented with fish amino acid and soybean oil meal	DA-RFO 9	Verification
Input - Feeds and feeding systems	Evaluation of feeding management and welfare of native pigs in the sustainability	PSAU	Verification
Input - Feeds and feeding systems	Preparatory analysis for the development of pelletized feeds for growing finishing native pigs	DA-BAI	Verification
Input - Housing and cooling systems	Enhancement of breeding facilities at DA-BAI-NSPRDC in support of Conservation and Sustainable Production of *Itik Pinas* and Bondoc Peninsula Native Pigs	DA-BAI	Adaptation
Input - Health and Nutrition	Efficacy of ivermectin as part of management against African Swine Fever (ASF)	DA-BAI	Dissemination
Input - Health and Nutrition	Efficacy of electrolyzed water (Anolyte Philippines®) as a modern disinfectant against ASF	DA-BAI	Dissemination
Input - Health and Nutrition	Efficacy of ASF buster as part of management against ASF	DA-BAI	Dissemination
Input - Health and Nutrition	Efficacy of cloud feed as part of management against ASF	DA-BAI	Dissemination
Input - Health and Nutrition	Data on the anthelmintic effect of indigenous medicinal plants on the carcass quality of native pig	DA-RFO 9	Verification
Input	Conservation, improvement, and production of Central Luzon Native Pig	TAU	Verification
Production - Health and Nutrition	Philippine antimicrobial resistance surveillance plan for the animal health sector	DA-BAI	Dissemination
Production - Health and Nutrition	Improved health and disease control for Australian and Philippine pig production	DA-BAI	Dissemination
Production - Health and Nutrition	Molecular detection and epidemiological surveillance of ASF in Tarlac	TAU	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Native pig production systems under smallholder farmers' management practices	DA-CAR	Dissemination
Postharvest and Processing	Low levels of *Trichinella spp.* antibodies detected in domestic pigs at selected slaughterhouses with farm-based exposure assessment in Bulacan	DA-BAI	Dissemination
Postharvest and Processing	Improved technique on pig skin tanning	DA-BAI	Dissemination
Postharvest and Processing	Pork patty, chicken nuggets, and pork hotdog using squash	DA-BAI	Verification
Postharvest and Processing	Organic meat products including Vigan sausage, pork burger, Lucban sausage, garleek sausage, and meat balls	DA-BAI	Verification
Postharvest and Processing	Solar-powered reefer container van	DA-BAFE	Dissemination
Postharvest and Processing	Native pork-based products such as lechon, tocino, longganisa, crispy pata, tapa, sisig, and vacuum fried pork	MSC	Verification
Postharvest and Processing	Animal Health Laboratory Facility of Tarlac Agricultural University to investigate antimicrobials used by farmers in Tarlac	TAU	Verification
Postharvest and Processing	Prevalence of antibiotic-resistant bacteria in the lung tissue of swine from abattoirs of Western Tarlac	TAU	Dissemination
By-product Utilization and Waste Management	Portable biogas digester	DA-BAFE	Dissemination
By-product Utilization and Waste Management	China-Fiber Glass Digester in selected farms in Indang, Cavite	DA-BAI	Adaptation
By-product Utilization and Waste Management	Data on the comparative performance and cost efficiency of reinforced fiberglass, concrete and high-density polyethylene as biogas digester material for swine manure	DA-BAI	Dissemination
Marketing	GAPs demo project for swine production	ISCoF	Verification

Poultry

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Breeds and breeding stock	Information on the genetic improvement and development of signature Philippine duck breed (*Itik Pinas*)	DA-BAI	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Breeds and breeding stock	Improved native chicken from Paraoakan, Banaba, and Joloano	DA-BAI	Dissemination
Input - Breeds and breeding stock	Breeding protocol for commercial-scale production of IP Itim and IP Khaki pure lines	DA-BAI	Verification
Input - Breeds and breeding stock	Validated egg production performance of IP Kayumanggi in private commercial-scale duck farms	DA-BAI UPLB	Dissemination
Input - Breeds and breeding stock	Satellite breeder chicken	TAU	Dissemination
Input - Breeds and breeding stock	Foundation stocks for free-range chicken production	TAU	Dissemination
Input - Breeds and breeding stock	Poultry (Chicken) Multiplier Breeder Farm	TAU	Verification
Input - Breeds and breeding stock	Purified native chicken "Camarines Strain"	DA-RFO 5	Verification
Input - Breeds and breeding stock	Verified best stocking rate of Mallard ducks in a rice-based farming system	DA-RFO 8	Dissemination
Input - Breeds and breeding stock	Stocking rate for native chickens in pasture	PSAU	Dissemination
Input - Breeds and breeding stock	Outscaled rice+duck integrated farming system	DA-RFO 8	Dissemination
Input - Breeds and breeding stock	Morphological , Histological , and Genetic diversity Analysis of Itik Pinas and Philippine Native Duck (Anas platyrhynchos L.) Breeds	CvSU	Dissemination
Input - For feeds and feeding system	Performance of layers fed with varying levels of pigeon pea leafmeal	MMSU	Verification
Input - Breeds and breeding stock	Identified and characterized non-descript chicken raised in Ilocos Norte	MMSU	Dissemination
Input - Breeds and breeding stock	Phenotypic and molecular diversity of native chicken genetic groups in the Philippines	MMSU	Dissemination
Input - Breeds and breeding stock	Commercialized improved free range native chicken for sustainable poultry production in Nueva Vizcaya	NVSU	Adaptation
Input - Feeds and feeding systems	Alternative feed ingredient from the Indigofera leaf meal (ILM) which can reduce feed cost while not affecting the overall performance of native chicken	DA-BAI	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input - Feeds and feeding systems	Data on the level of dietary energy requirement of Banaba chicken	DA-BAI	Verification
Input - Feeds and feeding systems	Data on the performance of free-range native chicken fed with forage-based ration and oregano	DA-RFO 9	Verification
Input - Feeds and feeding systems	Data on the growth performance of hardened chicks fed with different formulated ratio	DA-RFO 9	Verification
Input - Feeds and feeding systems	Chicken layer production performance fed with ginger powder	DMMMSU	Verification
Input - Feeds and feeding systems	Duckweed (*Lemna* minor L.) as replacement to soybean meal of native chicken *(Gallus domesticus Linn.)* formulated diets	BPSU	Verification
Input - Feeds and feeding systems	Data on the performance of Darag native chicken fed with house fly larvae in Capiz	DA-RFO 6	Adaptation
Input - Feeds and feeding systems	Data on the growth performance and meat quality of broilers given organic corn sprouts under different germination method	CBSUA	Verification
Input - Feeds and feeding systems	Utilization of azolla and duckweeds as alternative feed for breeder chickens	TAU	Verification
Input - Housing and cooling systems	Developed automated hybrid (solar heat and electric) egg incubator	USeP	Verification
Input - Health and Nutrition	Data on the growth performance and immunity of Darag native chicken (*Gallus gallus domesticus*) using aloe vera gel (*Aloe barbadensis miller*) Gel and fermented oregano (*Origanum vulgare*) juice	DA-RFO 6	Adaptation
Input - Health and Nutrition	Use of garlic (as natural remedy) for the prevention of respiratory disease in native chicken	DA-RFO 9	Verification
Input - Health and Nutrition	Low-cost portable molecular diagnostic platform for rapid detection of Poultry Infectious Pathogens (LMDP)	CvSU	Verification
Input - Health and Nutrition	Verified and standardized processing and concentration of garlic, betel nut, and asiatic bitter yam against *Mycoplasma gallisepticum* and internal parasites of Philippine native chicken	CPU	Dissemination
Production	Established viable enterprise using free-range chicken production technology in Bulacan	BASC	Dissemination

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Rice-based farming system integrated with free-range chicken production for smallhold farms	BASC	Dissemination
Production	Production and natural calphos for egg production of breeder chickens	TAU	Adaptation
Production	Rainfed rice-based farming system integrated with free-range chicken	TAU	Dissemination
Production	Developed production and management system of free-range chicken breeders in Tarlac	TAU	Dissemination
Postharvest and Processing	Solar-powered reefer container van	DA-BAFE	Dissemination
Postharvest and Processing	Pickled native egg	MMSU	Verification
Marketing	Transformation of the backyard chicken production into a viable enterprise	TAU	Dissemination
Marketing	Impacts of the program development of sustainable production system for Darag chicken in Western Visayas	UPV	Dissemination
Marketing	Ideal slaughter age of local Pekin duck and developed meat products and by-products	DA-BAI	Verification
Marketing	Standardized pork patty, chicken nuggets, and pork hotdog using squash	DA-BAI	Verification

Bee

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Feed materials and feeding management	PSAU	Verification
Input	Pollen analysis and nectar sources of native stingless bees	CvSU	Dissemination
Input	Lowland bee pasture area utilizing indigenous plant species	DMMMSU	Adaptation
Input	Production of quality Queen Bee	DMMMSU	Verification
Production	Meliponiculture stingless bee technology	CBSUA	Adaptation
Production	Profiling of *Apis mellifera* pests and diseases in Region 1	DMMMSU	Dissemination
Production	Protocol in using sugar dusting to control varroa mites	DMMMSU	Verification
Production	Design, development, and evaluation of beehive for *Apis cerana* and stingless bees	DMMMSU	Dissemination
Postharvest and Processing	Evaluation of appropriate equipment and packaging materials that reduce post-harvest contamination and prolong shelf-life of beehive products	DMMMSU	Verification

Aquaculture and Capture Fisheries

Aquaculture

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Protocol for Maliputo seed production	DA-NFRDI	Dissemination
Input	Protocol for sea cucumber seed production	DA-NFRDI	Dissemination
Input	Common carp seed production	DA-NFRDI	Dissemination
Input	Performance validation of SEAFDEC-developed feed vis-a-vis commercial feed in milkfish and tilapia	DA-NFRDI	Dissemination
Input	Protocol for blue-swimming crab seed production	DA-NFRDI	Adaptation
Input	Validated/refined mangrove crab hatchery protocol	DA-NFRDI	Verification
Input	Status of mangrove crabs	DA-NFRDI	Adaptation
Input	Breeding protocol of Jungle Perch in captivity	DA-NFRDI	Adaptation
Input	Information on the feeding preference and diet composition of potentially important aquaculture species and goblin fish species in Bataan	BPSU	Adaptation
Input	Use of locally available plants as alternative feed materials	MMSU	Adaptation
Input	Potential of water lettuce as replacement for fish meal on the growth performance and carcass of African fingerlings cultured in tanks	SKSU	Verification
Production	Ocean nursery and grow out culture of sea cucumbers	UP-MSI	Verification
Production	Nursery rearing of hatchery produced sandfish in marine waters	DA-NFRDI	Adaptation
Production	Different stocking ratios under polyculture system (tilapia and freshwater prawn)	PSAU	Dissemination
Postharvest and Processing	Protocol for sea cucumber processing	DA-NFRDI	Dissemination
Others- Policy and Governance	Information on the preliminary assessment of the "Sea Urchin Resource Management (SURE Management) Program through Cage Culture Technology"	UNP	Dissemination

Capture Fisheries

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Technology Pathway
Input	Ocean nursery and grow-out systems for sea cucumber *Holothuria scabra* and *Stichopus cf horrens*	UP-MSI	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Technology Pathway
Production	Pilot testing of co-culture systems with sea cucumbers	UP-MSI	Adaptation
Marketing	Enhanced Goby fry paste	UNP	Verification

Milkfish

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	SEAFDEC cost-effective formulated feeds	DA-BFAR 1	Verification
Input	Status and distribution of milkfish fry	DA-NFRDI	Verification
Input	Low-cost and efficient feed source	DA-NFRDI	Adaptation
Input	Molecular based diagnostic technique as a platform in advanced surveillance and detection of emerging Bangus viral disease syndrome/ Iridovirus/Ranavirus in Milkfish (*Chanos chanos*)	DA-BPO	Adaptation
Input	Feed formulation using locally available raw materials	DA-BFAR12	Adaptation
Input	Feed formulation using locally available raw materials	MMSU	Verification
Input	Genetic monitoring: marker development for sex determination	UP-MSI	Adaptation
Input	Sustainable bangus fry production of ALT hatchery, Panabo City, and Davao del Norte	UPV	Adaptation
Input	Sustaining the development of core satellite milkfish hatchery network in the Philippines	UPV	Dissemination
Input	Evaluation of provitamin B1 as agent to reduce feed cost of practical diet of the Nile tilapia and milkfish	UPV	Verification
Production	Adaptation of existing and applicable aquaculture technology	DA-BFAR 12	Adaptation
Production	Formulation of protocols for establishment, operation, and management of production areas	DA-BFAR 12	Adaptation
Production	Policy formulation and fishery resource management	DA-BFAR 12	Adaptation
Production	Protocol on milkfish fry to fingerling production	DA-NFRDI	Commercialization
Production	Fry to sticklings production system (1 month)	DA-BFAR 13	Adaptation
Production	Adoption of existing aquaculture technologies in new areas/sites	DA-BFAR 13	Adaptation
Production	Protocol in the culturing tilapia and milkfish using extruded floating feeds	DA-NFRDI	Commercialization
Production	Milkfish fingerling production in ponds and cages	DA-NFRDI	Commercialization

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Production	Development of diagnostic protocol, kit, and vaccine	DA-NFRDI	Adaptation
Production	Refinement of milkfish nursery culture and development of efficient juvenile transport techniques	UPV	Verification
Postharvest and Processing	Milkfish processing technology refinement towards upscaling and commercialization	BPSU	Adaptation
Postharvest and Processing	Herb-enhanced processed milkfish (smoked)	BPSU	Adaptation
Postharvest and Processing	Herb-enhanced processed milkfish (bottled)	BPSU	Adaptation
Postharvest and Processing	Profiling of smoking fish practices	DA-NFRDI	Adaptation
Marketing	Milkfish value chain analysis	DA-BFAR 13	Adaptation
Others - Policy and Governance	Fingerlings and other seed stocks production and distribution	DA-BFAR 4B	Adaptation

Tilapia

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Broodstock maintenance protocols	PSAU	Dissemination
Input	Evaluation pockets digital diagnostic kit	PSAU	Verification
Input	Utilization of marine diatoms as a dietary additives to enhance the omega-3 fatty acid of seawater strain tilapia nilotica	UPV	Adaptation
Input	Evaluation of provitamin B1 as agent to reduce feed cost of practical diet of the Nile tilapia and milkfish	UPV	Verification
Input	Pilot tests on incorporating the filamentous green algae (*Rhizoclonium riparium*) in the diet of the Nile tilapia	UPV	Dissemination
Input	Molecular identification of bacterial tilapia diseases and other emerging bacterial pathogens in freshwater fishes	DA-NFRDI DA-BPO	Adaptation
Input	Developed diagnostic protocol, kit and vaccine for tilapia lake virus (TILV)	DA-NFRDI	Adaptation
Input	Low cost and efficient feed source	DA-NFRDI	Commercialization
Input	Profilling and geo-tagging	DA-BFAR 12	Adaptation
Input	Improved GET EXCEL 2016	DA-BFAR 12	Adaptation
Input	Sex reversed tilapia	DA-BFAR 12	Adaptation

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Feed formulation process	DA-BFAR 12	Adaptation
Input	Indigenous plants as molluscicide in ponds	PSAU	Adaptation
Input	Broodstock development and sustainable fry production of red tilapia for the WPU-CFAS Extension Program	WPU	Adaptation
Input	AMR/ Virulence gene detection protocol	DA-BPO	
Input	Low-cost feed	DA-BPO	Adaptation
Input	Broodstock line improvement	DA-NFRDI	Adaptation
Input-seeds	Genetic stock inventory and genotyping	DA-BPO	Adaptation
Production	Protocol on the grow-out culture for the optimum growth of red tilapia (*O. niloticus* x *O. mossambicus*) in marine and freshwater cages in CAR	DA-BFAR CAR DA-BFAR 1	Verification
Production	Improved site- specific protocols on modified intensive tilapia production and nursery rearing of tilapia (*Oreochromis niloticus*)	DA-BFAR CAR DA-BFAR 1	Verification
Production	Advanced diagnostic detection method for tilapia lake virus (TiLV) and other remerging aquatic viruses in the Philippines: surveillance, profiling, and molecular disease diagnostic	DA-NFRDI DA-BPO	Adaptation
Production	Recombinase Polymerase Amplification (RPA) assay for the detection of Tilapia Lake Virus (TiLV) in tilapia farms in the Philippines	DA-NFRDI DA-BPO	Adaptation
Production	POT on the production of bigger-sized tilapia and milkfish fingerlings for cage culture	DA-NFRDI	Dissemination
Production	BASIL (*Balik Sigla sa Ilog at Lawa*)	DA-BFAR 12	Adaptation
Postharvest and Processing	Instant tilapia cream soup	NVSU	Commercialization
Production	Inhibitory potential of Black-chin tilapia (*Sarotherodon melanotheron*) against vibrio species	BPSU	Adaptation
Production	Black chin tilapia as intermediate product for surimi-based food processing	BPSU	Adaptation
Production	Diffusion and utilization of tilapia and catfish aquaculture and processing technologies through community participatory approach	MMSU	Verification
Production	Culturing tilapia and milkfish using extruded floating feeds	DA-NFRDI	Adaptation
Others - policy and governance	Fingerlings and other seed stocks production and distribution	DA-BFAR 4B	Adaptation

Shellfish

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Potential sites in shellfish production in Region 12	DA-BFAR 12	Adaptation
Input	Stock assessment and reproductive biology of *Paphia undulata* Born, 1778 in Maqueda Bay, Eastern Visayas (Region 8)	DA-NFRDI	Adaptation
Input	Improvement in the hatchery and nursery production of green mussel (*Perna viridis*)	UPV	Verification
Production	Protocol for the improved oyster culture (*Skeletonema diatoms*)	DA-NFRDI	Adaptation
Production	Protocol for improved oyster culture (raft and longline)	SEAFDEC	Verification
Production	Assessment of heavy metals in shellfish	DA-NFRDI	Adaptation
Production	Longline culture technology	UPV	Dissemination
Production	Profiling and diagnosis of parasites in shellfishes	DA-NFRDI	Adaptation
Postharvest and Processing	Pilot scale production of primary processed Philippine green mussel (*Perna viridis*)	UPV	Verification
Postharvest and Processing	Mussel patis	UPV	Verification
Postharvest and Processing	Mussel glycogen	UPV	Verification
Postharvest and Processing	Oyster powder	UPV	Verification
Postharvest and Processing	Mussels and Oysters Automated Depuration System (MOADS) in Vulnerable Areas of Region 3	BPSU	Adaptation
Marketing	Status of oyster farming in Ilocos Sur	UNP	Dissemination
Others - policy and governance	Socio-economic assessment of scallop fishing in Asid Gulf, Masbate	DA-NFRDI	Adaptation

Shrimp

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Biocontrol against Early Mortality Syndrome Acute Hepatopancreatic Necrosis Disease (EMSAHPND) causing bacteria using tilapia greenwater immonustimulants and microbial floc	UPV	Verification
Input	Improvement of Philippine *Penaeus vannamei* for the enhanced growth and white spot syndrome virus resistance through selective breeding	UPV	Verification

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Philippine *Penaeus vannamie* broodstock selected for the enhanced growth and white spot syndrome virus resistance	UPV	Verification
Input	Transcriptome and and gut metagenome profile of *Peneaus vannamei* exposed to fluctuating environmental temperatures	UPV	Verification
Input	Information on the effects of nutritional status and environmental challenge on acute phase response in white shrimp	UPV	Verification
Input	Intensification of shrimp sector/adoption of technologies of individual farmers	DA-BFAR 12	Adaptation
Input	Review of feeds and feed management practices	DA-BFAR 12	Adaptation
Input	Specialized strains for environments	DA-BFAR 12	Adaptation
Input	Genetic protection and genetic engineering	DA-BFAR 12	Adaptation
Input	Proactive disease management: diagnostics, probiotics, nutrition, stress mananagement, disease surveillance/response, etc.	DA-BFAR 12	Adaptation
Input	Adoption of optimal husbandry techniques, nutritional interventions, suitable hatchery and nursery protocols	DA-BFAR 12	Adaptation
Input	Develop traceability system incorporating RFID	DA-BFAR 12	Adaptation
Input	Evaluation of new ingredients and impact on nutritional value	DA-BFAR 12	Adaptation
Production	Iterative refinement and assessment of farm-specific management protocols	DA-BFAR 12	Adaptation

Seaweed

Value Chain Stage	Technologies / Research Outputs	Technology Developer	Recommended Technology Pathway
Input	Seaweed micropropagation	DA-BFAR 13	Adaptation
Postharvest and Processing	Seaweed pickles	DA-BFAR 13	Adaptation
Postharvest and Processing	Processing and composition of making Finger Algae (*Codium intricatum okamura*) Seaweed Ice Cream (utility model)	UNP	Verification
Others - Policy and Governance	Socio-economic impact of DA-BFAR's programs on seaweed farming in key seaweed farming communities in Palawan, Philippines	DA-NFRDI	Adaptation

Acknowledgments

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Rice and cereal crops

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Pompe C. Sta. Cruz, PhD	CAFS

Corn

Zenaida M. Huelgas	CEM
Jocelyn D. Labios, PhD	CAFS

Root crops

Susan T. Bacud, PhD	CAFS
Lorna E. Sister, PhD	CAFS

Vegetables and Legumes

Elmer E. Enicola	CAFS
Lei A. Pangilinan-Jamolin	CAS

Fruits

Celia DR. Medina, PhD	CAFS

Plantation and Biofuel Crops

Nico Jayson C. Anastacio, PhD	CPAf
Girlie Nora A. Abrigo	CAS

Livestock

Geny F. Lapiña	CEM
Rommel C. Sulabo, PhD	CAFS

Aquaculture and Capture Fisheries

Hildie Maria E. Nacorda, PhD	SESAM
Paul Joseph B. Ramirez	CEM

Cross-cutting A/F R4D Areas

Aileen V. Lapitan, PhD	CPAf
Agnes C. Rola, PhD	CPAf

Francis John F. Faderogao	CPAf-CSPPS
Marriz M. Garciano	CPAf-CSPPS

Hadji C. Jalotjot	CPAf-CSPPS
Karen S. Janiya	CPAf-CSPPS
Therese R. Olviga	CPAf-CSPPS

II. Initial Data Collection Participants

A. DA Operating Units

Bureau of Agricultural and Fisheries Engineering
Biotechnology Program Office
Bureau of Animal Industry
Bureau of Fisheries and Aquatic Resources
Bureau of Plant Industry
National Dairy Authority
National Fisheries Research and Development Institute
National Urban and Peri-Urban Agriculture Program
Philippine Coconut Authority
Philippine Fiber Industry Development Authority
Philippine Center for Postharvest Development and Mechanization
Philippine Rubber Research Institute
Regional Field Office - CAR
Regional Field Office 2 - Cagayan Valley
Regional Field Office 4A - CALABARZON
Regional Field Office 5 - Bicol
Regional Field Office 6 - Western Visayas
Regional Field Office 7 - Central Visayas
Regional Field Office 8 - Eastern Visayas
Regional Field Office 9 - Zamboanga Peninsula
Regional Field Office 10 - Northern Mindanao
Regional Field Office 11 - Davao
Regional Fisheries Office - CAR
Regional Fisheries Office 1 - Ilocos
Regional Fisheries Office 2 - Cagayan Valley
Regional Fisheries Office 3 - Central Luzon
Regional Fisheries Office 4B - MIMAROPA
Regional Fisheries Office 12 - SOCCSKSARGEN
Regional Fisheries Office 13 - CARAGA
Sugar Regulatory Administration

B. State Universities and Colleges

Aklan State University
Bulacan Agricultural State College
Bataan Peninsula State University
Benguet State University
Cavite State University

Central Bicol State University of Agriculture
Central Luzon State University
Central Philippine University
Don Mariano Marcos Memorial State University
Iloilo State College of Fisheries
Mariano Marcos State University
Marinduque State College
Nueva Vizcaya State University
Pampanga State Agricultural University
Romblon State University
Sultan Kudarat State University
Sulu State College
Tarlac Agricultural University
University of Northern Philippines
University of the Philippines Diliman
University of the Philippines Los Baños
University of the Philippines Visayas
University of the Philippines - Marine Science Institute
University of Southeastern Philippines
Visayas State University
Western Philippines University

III. National Multi-stakeholder Consultation Workshop Participants

A. DA Operating Units

Agricultural Credit Policy Council
Agricultural Training Institute
Bureau of Agriculture and Fisheries Standards
Bureau of Animal Industry
Bureau of Fisheries and Aquatic Resources
Bureau of Plant Industry
Bureau of Soils and Water Management
Climate Resilient Agriculture Office
Crop Biotechnology Center
Fisheries Biotechnology Center
Ministry of Agriculture, Fisheries, and Agrarian Reform
National Corn Program
National Dairy Authority
National Fisheries Research and Development Institute
National Irrigation Administration
Philippine Carabao Center
Philippine Coconut Authority
Philippine Fiber Industry Development Authority
Philippine Fisheries Development Authority
Philippine Center for Postharvest Development and Mechanization
Philippine Rice Research Institute

Philippine Rubber Research Institute
Regional Field Office - CAR
Regional Field Office 1 - Ilocos
Regional Field Office 2 - Cagayan Valley
Regional Field Office 4A - CALABARZON
Regional Field Office 5 - Bicol
Regional Field Office 8 - Eastern Visayas
Regional Field Office 9 - Davao
Regional Field Office 10 - Northern Mindanao
Regional Field Office 12 - SOCCSKSARGEN
Regional Fisheries Office - CAR
Regional Fisheries Office 1 - Ilocos
Regional Fisheries Office 2 - Cagayan Valley
Regional Fisheries Office 3 - Central Luzon
Regional Fisheries Office 4A - CALABARZON
Regional Fisheries Office 5 - Bicol
Regional Fisheries Office 7 - Central Visayas
Regional Fisheries Office 8 - Eastern Visayas
Regional Fisheries Office 13 - CARAGA
Sugar Regulatory Administration

B. State Universities and Colleges

Aklan State University
Bataan Peninsula State University
Batanes State College
Batangas State University
Benguet State University
Cagayan State University
Capiz State University
Cavite State University
Cebu Technological University
Central Bicol State University of Agriculture
Central Luzon State University
Central Mindanao University
Don Mariano Marcos Memorial State University
Ifugao State University
J.H. Cerilles State College
Jose Rizal Memorial State University
Mariano Marcos State University
Marinduque State College
Nueva Vizcaya State University
Pangasinan State University
Sultan Kudarat State University
Sulu State College

Tarlac Agricultural University
University of Antique
University of Northern Philippines
University of the Philippines Los Baños
University of the Philippines Los Baños - Institute of Plant Breeding
University of the Philippines - Marine Science Institute
University of the Philippines - Natural Sciences Research Institute
University of Rizal System
University of Southern Mindanao
University of Southeastern Philippines
Visayas State University
Western Philippines University

C. National Government Agencies

Cooperative Development Authority
Department of Health - National Nutrition Council
Department of Science and Technology - Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development
Department of Science and Technology - Philippine Council for Industry, Denergy, and Emerging Technology Research and Development
Department of Trade and Industry - Board of Investments
Department of Trade and Industry - Bureau of Trade and Industrial Policy Research
Food and Drug Administration
Land Bank of the Philippines
National Economic and Development Authority
Philippine Commission on Women
Philippine Statistics Authority

D. Non-government Organizations and Private Sector Institutions

Cacao Pilipinas Sensory Resources, Inc.
Chocoland Farms
Coffee for Peace, Inc.
East-west Seed Company, Inc.
Feedmix Specialist Inc. II
Fisherfarms, Inc.
Food and Agriculture Organization of the United Nations - Philippines
Manila Cordage Company
Mida Food Distributors, Inc.
Nestlé Philippines, Inc.
Organization for Partnerships, Teamwork, and Initiatives on Opportunities for Nature Stewards, Inc.
Project Bee Inspired Corporation

Universal Robina Corporation
Univet Nutrition and Animal Healthcare Company
World Wild Fund for Nature – Philippines

E. Farmer and Fisherfolk Cooperatives and Associations

4-H Club Philippines
Ago Magsaysay ARB Multipurpose Cooperative
Agriculture and Fishery Youth-preneur Councils
Al-mani Farmers Marketing Cooperative
Association of Rabbit Meat Producers, Inc.
Batangas Coffee Farmers Federation
Batangas Egg Producers Multipurpose Cooperative
Bohol Coconut Development Council
Bohol Coffee and Cacao Growers Marketing Association
Fisheries and Aquaculture Board of the Philippines, Inc.
Organic Coconut Association of the Philippines, Inc.
Provincial Agricultural and Fishery Councils
Pambansang Kilusan ng mga Samahang Magsasaka
Philippine Association of Feed Millers, Inc.
Pilipino Banana Growers and Exporters Association, Inc.
POPA Agriculture Cooperative
Regional Agriculture and Fisheries Councils
Regional Cacao Councils

F. Local Government Unit

Office of the Vice Governor of Bohol - Committee on Agriculture

About the cover

A convergence of perspectives and expertise from the series of multi-stakeholder consultation workshops, this researcher's guide book aims to lay down priority agriculture and fishery researchable areas for this medium term that is envisioned to be implemented in a holistic and a well coordinated manner across the different segments of the value chain. These segments are represented by the land and water (input), ready-to-harvest palay (production), harvester (postharvest and processing), commercialized food products (marketing), and organic compost (by-product utilization and waste management).

The DA-BAR, in pursuant to its mandate of ensuring maximum utility of research and research outputs for the farmers, fishers and agri-fishery sector, introduces a distinct section of the cross-cutting research areas which is depicted by the line that connects and transcends across all the segments of the value chain.

(In photos [L-R] are Mr. Jake L. Galian, one of the study leaders of the potato R&D program at Benguet State University [BSU], Ms. Marilou A. Alina, a farmer stakeholder of the DA-BAR funded project, "Support to Mass Production of Batanes Red and Itbayat White Garlic Quality Planting Materials through Seed Production Technique in Batanes", and Dr. Cynthia Kiswa, Director of the Northern Philippines Root Crops Research and Training Center, BSU)