DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL RESEARCH

CRAFT R4D
MEDIUM TERM PLAN
2024-2028




Climate Resilient Agriculture and Fisheries through Transformative Research for Development

Climate Resilient Agriculture and Fisheries through Transformative Research for Development: Medium Term Plan 2024-2028

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ACRONYMS

ADB	Asian Development Bank
BAR	Bureau of Agricultural Research
BAU	Business As Usual
CC	Climate Change
CCC	Climate Change Commission
CCAP	Climate Change Action Program
CRA	Climate Resilient Agriculture
CRAO	Climate Resilient Agriculture Office
DA	Department of Agriculture
FAO	Food and Agriculture Organization of the United Nations
GMO	Genetically Modified Organism
GVA	Gross Value Added of Agriculture
M&E	Monitoring and Evaluation
NbS	Nature-based Solutions
NAFMIP	National Agriculture And Fisheries Modernization And Industrialization Plan 2021-2030
NEDA	National Economic and Development Authority
NCCAP	National Climate Change Action Plan
NGO	Non-Governmental Organization
NIRAS	NIRAS Consulting in Asia Manila Inc. (Philippines)

NOAP	National Organic Agriculture Program
PPAN	Philippine Plan of Action for Nutrition
OECD	Organization for Economic Co-operation and Development
PSA	Philippine Statistics Authority
R&D	Research and Development
R4D	Research for Development
R4DE	Research for Development and Extension
RBME	Results-Based Monitoring and Evaluation
RDEAP	Research and Development and Extension Agenda and Program
RFO	Regional Field Office
SSNM-NE	Site Specific Nutrient Management - Nutrient Expert
SUC	State Universities and Colleges
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TA	Technical Assistance
TOR	Terms of Reference

MESSAGE FROM THE DIRECTOR

It is with utmost pleasure that I share with you the Climate Resilient Agriculture and Fisheries through Transformative Research for Development (CRAFT R4D): Medium Term Plan for 2024-2028!

Research for development should no longer take a back seat in addressing climate change. The Department of Agriculture-Bureau of Agricultural Research (DA-BAR), as the lead research for development (R4D) agency of the department, has taken the initiative to review Climate Change R4D investments from 2022-2024, allowing an overview of what has been done and what is still left to accomplish. Further to this, the DA-BAR is shifting its investment efforts on R4D that is geared towards transforming food systems for food and nutrition security amidst climate change.

A product of in-depth consultations and collaborative discussions among various agri-fisheries R4D stakeholders, this document outlines a medium-term plan of action in an attempt to provide responsive interventions to address the gaps and challenges in light of the challenges brought by climate change.

To materialize the plans and programs laid out in this Climate Change R4D agenda, the bureau encourages all its partners and stakeholders to make use of this document as reference in undertaking R4DE programs and projects transforming the Philippine Agriculture and Fisheries Sector towards food and nutrition security amidst climate change.

May this initiative be a legacy intended to guide the sector in better understanding the department's R4DE thrusts and priorities.

Thank you and *Mabuhay*!

JUNEL B. SORIANO, PhD

FOREWORD

Considering the impact of climate change on the agriculture and fisheries (AF) landscape, it becomes even more important to strengthen Research for Development (R4D) initiatives to achieve full modernization for the sector. The lackluster performance of the country's agriculture and fisheries sector can be attributed to its unchanged structure over the past fifty years. However, within the context of the Agriculture and Fisheries Modernization Act (AFMA), the AF sector has gradually modernized through the development and improvement of technologies, albeit at a slower pace compared to neighboring countries.

Innovation and knowledge generation are crucial elements of modernization. Numerous pieces of evidence and studies affirm the significance of R&D as an important tool for AF development. However, the current R&D system in the Philippines has perennially suffered from weak support and investments. The Philippine Development Plan for 2023-2028 emphasizes that the budget allocation for agriculture, fisheries, and forestry (AFF) research, development, and extension (RDE) programs within the Department of Agriculture (DA) remains low, undermining the importance of technology development and the dissemination of sustainable farm and fishery management practices. Similarly, the National Agriculture and Fisheries Mechanization and Modernization Plan (NAFMIP) 2021-2030 recognizes the urgent need to support RDE to accelerate agricultural transformation.

Consequently, the Department of Agriculture-Bureau of Agricultural Research (DA-BAR), in collaboration with various attached government agencies and bureaus, has actively worked towards securing an increased R&D budget for the proposed Government Budget Allocation for fiscal year 2024. However, to ensure sustainable funding and assist DA-BAR in expanding its R4D support for the development of climate-smart technologies, it is imperative to develop a cohesive Research for Development (R4D) roadmap for climate-resilient R&D, in conjunction with an extension agenda for agriculture, natural resources, and the environment (ANRE).

Therefore, a comprehensive document titled ***"Climate Resilient Agriculture and Fisheries through Transformative Research for Development (CRAFT R4D) Medium Term Plan for 2024-2028"*** has been developed. This living document details the research for development and extension (R4DE) framework, action plan, and roadmap for transforming Philippine agriculture into a climate-resilient agriculture and fisheries sector.

From 2024 to 2028, DA-BAR will prioritize a climate-resilient R4D strategy for the AF sector adopting a value chain and nature-based solution perspectives. The suite of R4D measures is organized into 7 sub-themes, each with indicative potential R4D topical areas for climate resilient agriculture and fisheries sector.

The roadmap and action plan, along with implementation and R4D impact pathways, a robust result-based monitoring and evaluation (RBME) system, and a communication plan, provide a strong justification for the need to sustainably increase the R4DE budget from 0..19% in 2023 to 1.2% of gross value added (GVA) in 2028.

EXECUTIVE SUMMARY

This executive summary encapsulates the strategic intent and key components of the Climate Resilient Agriculture and Fisheries through Transformative Research for Development (CRAFT R4D) Medium Term Plan for 2024-2028. Developed through consultations with key stakeholders, including researchers, farmers' and fisherfolk groups, agro-industry players, policy experts from both public and private institutions, and local and international partners, the CRAFT R4D plan aims to address the critical challenges and harness opportunities for the agriculture and fisheries sector in the Philippines.

Key Challenges: The Agriculture and Fisheries Modernization Act (AFMA) of 1997 aimed to modernize the Philippines' agriculture and fisheries sectors. The modernization pathway is defined as transforming the sectors from being resource-based to being dynamic, technologically advanced, and competitive while centering on human development, sustainability, and social justice. However, after a quarter-century, the sector has only gradually modernized, displaying low productivity indices across its three subsectors—crops, livestock and poultry, and fisheries—along with anemic total factor productivity and diminishing exports relative to rising imports. Although the sector's share in GDP has declined to an average of 9% in recent years, indicating some structural transformation, the high share of employment in the sector shows that this transformation has been slow.

Food and nutrition insecurity persist, particularly among the poorest populations. Undernutrition and malnutrition remain significant issues. Climate change exacerbates these challenges, threatening food security and the livelihoods of small-scale farmers and fishermen. The Philippines faces rising temperatures, increased natural disasters, and other climate impacts, all of which negatively affect agriculture and fisheries. These challenges result in decreased productivity, higher pest and disease rates, limited income and employment sources, and unstable food prices. Additionally, global geopolitical conflicts, potential pandemics, and domestic socio-economic issues further complicate the path to modernization. Food policy shortcomings, such as food self-sufficiency and agriculture trade restrictions, also weigh down the performance of the AF sector.

Call for Action – More R4D for AF: Research for Development (R4D) is crucial for accelerating the modernization of the AF sector and enhancing its climate resilience. Many country experiences demonstrate the catalytic role of R4D in driving more prosperous, inclusive, and environmentally sustainable growth. R4D investments have helped make the

AF sector more resilient to climate change, partly mitigating its adverse effects and more significantly adapting to the new normal. Recent work by Perez (2024) showed that among various intervention measures simulated in the IMPACT model on climate change and Philippine agriculture, R4D stood out in improving productivity, stabilizing food prices, and addressing social costs such as health issues related to undernutrition and malnutrition.

The Bureau of Agriculture Research (BAR) leads R4D efforts within the Department of Agriculture, generating technologies and innovations essential for addressing climate change uncertainties and risks while putting the AF sector on a path toward prosperous, inclusive, and sustainable growth. However, BAR faces significant constraints, including a disconnect from the major stakeholders who demand its services and a weak R4D landscape characterized by numerous fragmented and uncoordinated public-run R&D institutions and centers, piecemeal and small-scale short-term R&D funding support, a focus on commodity production (particularly rice) rather than an agri-based and agri-food system lens, low investments, and a declining number of scientists and professionals engaged in R4D. These chokepoints hinder BAR's ability to become an effective catalyst for transformational change in the AF sector.

A major bottleneck to robust and responsive R4D is the dismally low expenditure on research for development. In recent years, government spending on DA R4D has been a paltry 0.19% of GVA, rising to 0.20% in 2024, far short of AFMA's stipulated 1%. Increasing R4D funding is crucial for developing and widely adopting climate-smart technologies and practices.

CRAFT R4D: 2024-2028: The CRAFT R4D action agenda takes a programmatic approach to incorporating climate resilience into the modernization pathway of the AF sector. It focuses on three main areas of reform: (1) Enhancing Resilience to Climate Impacts: This area aims to develop and disseminate climate-resilient technologies, practices, facilities, infrastructure, policies, and protocols that enhance the transformative adaptive capacities of the agriculture and fisheries sector and its stakeholders. The focus is on poor men and women farmers, fisherfolk, livestock producers, landless rural workers, and small and micro-enterprises directly involved in the agri-based and agri-food systems. (2) Strengthening Institutional Linkages for Climate Action: This area aims to enhance coordination among R4D partners and funding mechanisms to support the wide-scale transfer, replication, adoption, commercialization, and sustained development of climate-smart technologies and practices. These technologies and practices are science-based, tailor-fit to local conditions, and are environmentally sound. (3) Bolstering

Agri-Food Value Chains: This area promotes forward and backward linkages and develops midstream and downstream nodes of agri-based and agri-food systems. The goal is to establish robust private-run systems capable of effectively managing and directing resources towards climate resilience. This includes promoting nature-based solutions, improving agricultural practices, and building resilient infrastructure to safeguard against climate-related disasters through novel and digitalized approaches.

CRAFT R4D is strategically linked to the Philippine Development Plan 2023-2028 and is an essential intervention for the modernization of the AF sector. It integrates a climate-resilient lens into the National Agriculture and Fisheries Modernization Plan (NAFMIP) and aligns with the Philippine Plan of Action for Nutrition, emphasizing food and nutrition security.

Impact: The implementation of CRAFT R4D is expected to yield significant positive impacts across various aspects of the Philippine agriculture and fisheries sectors. Ensuring a stable and diversified supply of nutritious food is its primary impact, addressing food security and nutritional needs, particularly for vulnerable populations. Improving agricultural yields and diversifying incomes and job opportunities will elevate the economic status of farmers and fisherfolk, leading to substantial poverty reduction. Enhanced productivity and profitability will drive economic growth and uplift rural communities. The action agenda provides opportunities for marginalized groups, including landless rural workers, women, and youth, granting them access to resources, training, and market opportunities, promoting social equity, and bridging social inequalities. Sustainable farming practices will conserve natural resources, reduce degradation, and preserve biodiversity, ensuring the long-term sustainability of agricultural landscapes.

Key Expected Outcomes: The CRAFT R4D action agenda focuses on achieving the following key outcomes: improving agriculture and fisheries yields, diversifying incomes and jobs, and sustaining biodiversity. The adoption of climate-resilient technologies and practices is expected to enhance the productivity of crops, livestock, and fisheries. The plan aims to create diverse income opportunities and quality jobs for farmers and fisherfolk, supporting agribusiness development and fostering entrepreneurship, leading to higher incomes and better employment prospects at on-farm, off-farm, and non-farm levels. It will also facilitate the traditional food supply chains to move up the value chain ladder. The implementation of sustainable agricultural practices will help conserve and enhance biodiversity by protecting natural ecosystems, promoting agroecological approaches, and encouraging the responsible use of natural resources.

Priority Climate Resilient Sub-Themes: The menu of climate resilient R4D interventions is divided into seven sub-themes: ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock; ST 2: Natural Resource Use Efficiency; ST 3: Zero waste, recycling, and circular economy; ST 4: Climate-resilient agri-based and agrifood processing, marketing, and logistics systems; ST 5: Digitalization; ST 6: Nutritious food, sustainable diets, and consumption; and ST 7: Landless rural workforce and off-farm and non-farm jobs. Cross cutting themes are embedded in the STs; these are gender inclusiveness and empowerment, policies, and financing.

Majority in the immediate (2024) and short-term (2025) R4D projects aim at improving productivity and producing through more efficient resource use of its natural resources, especially land and water. These will have positive outcomes on enlarging production and help in stabilizing food prices, essential for ensuring low inflation and food security. For 2026-2028 (medium term), the indicative R4D projects will still have a large proportion of ST1 and ST2 interventions on technology and innovations, but calls for proposals will also increasingly encourage innovation in ST 3 of recycled food products from byproducts of agriproducts, ST 4 for value chain upgrades, ST 6 and ST 7. More emphasis on the nutrition aspect of food security shall be promoted.

Digitalization efforts will include developing dashboards for a compendium of technologies, protocols, practices, and policies funded by BAR to encourage the out-scaling and up-scaling of financially and socially viable climate-smart technologies and innovations. Additionally, commodity-based systems focusing on their value chains with analytics such as supply and demand analysis and cost-benefit analysis will be developed.

Transformative Implementation Tasks of BAR: In implementing CRAFT R4D, BAR will proactively perform tasks beyond conventional coordination, funding, and management of agriculture and fisheries research. These transformative tasks include scaling out agri-tech solutions, developing partnerships and linkages with local and international research organizations, facilitating wide-scale technology utilization, strengthening institutional capabilities, managing knowledge, and advocating policies for progressive agricultural and fishery sector value.

Results-Based Monitoring and Evaluation: To ensure the effectiveness of R4D initiatives, the plan includes a robust results-based monitoring and evaluation (RBME) framework. This framework will track the progress and impact of R4D projects, ensuring they meet the desired outcomes. Key performance indicators (KPIs) include the number of skills training

programs conducted, the creation of quality jobs, the adoption of climate-smart technologies, and improvements in productivity and resilience, and the implementation of policies, protocols and regulations conducive for more climate resilient R4D. The RBME framework will involve regular assessments, feedback mechanisms, and adaptive management practices to address challenges and incorporate lessons learned, ensuring continuous improvement and alignment with the overall goals of the CRAFT R4D plan.

Communications: The CRAFT R4D Plan's communication strategy aims to raise awareness, build partnerships, and ensure transparency among stakeholders to advocate for and integrate climate resiliency strategies into the R4D budget and agricultural policies in the Philippines. The plan emphasizes the importance of climate resiliency and advocates for budget reallocation towards climate-resilient practices. The content strategy leverages data to support budget arguments, shares success stories, creates visual aids, provides educational materials, and maintains regular updates through blogs and newsletters. Outputs and metrics include developing policy briefs, conducting workshops, organizing field days, launching social media campaigns, producing blogs and videos, and disseminating educational content to measure and ensure the plan's effectiveness.

Funding: Increasing R4D funding is essential, aiming to raise research intensity from 0.19% to at least 1.2% of GVA by 2028, equivalent to approximately PhP 21.4 billion. This funding is crucial for the development and widespread adoption of climate-smart technologies and practices. The plan emphasizes institutional capacity building, international collaborations, and transparent fund utilization. To achieve these funding goals, the CRAFT R4D plan outlines a comprehensive strategy to mobilize resources from various sources, including government budgets, international donors, private sector investments, and public-private partnerships.

Moving Forward: The CRAFT R4D document will be regularly updated based on emerging trends and lessons learned. The focus areas for this implementation period include generating climate-resilient technologies and practices, ensuring their wide-scale application through out-scaling and up-scaling, building a cadre of agri-practitioners and promoting agri-preneurs and registered small and micro-enterprises engaged in modern agribusiness endeavors, and providing policies and regulations for developing robust, resilient, and sustainable agri-food and agri-based systems. Success relies on the collaboration and dedication of various stakeholders, including government agencies, non-governmental organizations, academic institutions, and the private sector, to achieve the objectives

outlined in the CRAFT R4D plan and foster a resilient and sustainable agriculture and fisheries sector.

The CRAFT R4D Medium Term Plan for 2024-2028 is a crucial initiative of the Bureau of Agricultural Research that aims to transform the agriculture and fisheries sector of the Philippines into climate-resilient and sustainable systems. This plan focuses on prioritizing research and development, building institutional capacities, and fostering partnerships to secure a climate-resilient future for the country's agriculture and fisheries. Its ultimate goal is to ensure food and nutrition security and promote sustainable but inclusive economic growth even in the face of climate change challenges. This is the modernization pathway that the climate resilient R4D strategy and action plan will espouse for the Philippine agriculture and fishery sector.

Chapter I
CURRENT LANDSCAPE OF PHILIPPINE AGRICULTURE AND FISHERIES

The landmark legislation Republic Act 8435, otherwise known as the Agriculture and Fisheries Modernization Act (AFMA) of 1997 institutionalized a nationwide policy for modernization of the Philippines' agriculture and fisheries (AF) sector. Alongside the vision of development, AFMA emphasizes the role and protection of smallholder farmers and fisherfolk as it states in Sec 2: "...*to enable those who belong to the agriculture and fisheries sectors to participate and share in the fruits of development and growth in a manner that utilizes the nation's resources in the most efficient and sustainable way possible by establishing a more equitable access to assets, income, basic and support services and infrastructure."* Further, AFMA lays the principles to empower the sector, to wit: 1) Poverty Alleviation and Social Equity; 2) Food Security; 3) Rational Use of Resources; 4) Global Competitiveness; 5) Sustainable Development; 6) People Empowerment; and 7) Protection from Unfair Competition. Hereby, the Act seeks to attain long term sustainability by exerting care and prudence in carrying out AF activities hence, preserving the ecosystem whilst promoting development.

Endowed with natural resources, the Philippines is primarily an agricultural country. Twenty-four percent (or 71,900 sq km) of the country's total land area is dedicated to agriculture wherein, 48% is allocated for temporary crops, and 46% is for permanent crops. Rice, corn and coconut remain as the prime commodities utilizing up to 74% of arable land. About 40% of crops focus on rice production and its share is increasing over time (DA, 2022). Meanwhile, the country's fisheries resources include 2.2 million sq. km of marine water or total territorial water area, both coastal and oceanic. Coastline length is 26,289 km., considered as one of the longest in the world. Additionally, the country has inland water resources such as swamplands (246,063 ha), existing fishponds (253,854 ha) and other inland sources being lakes, rivers and reservoirs (250,000) (BFAR,2022).

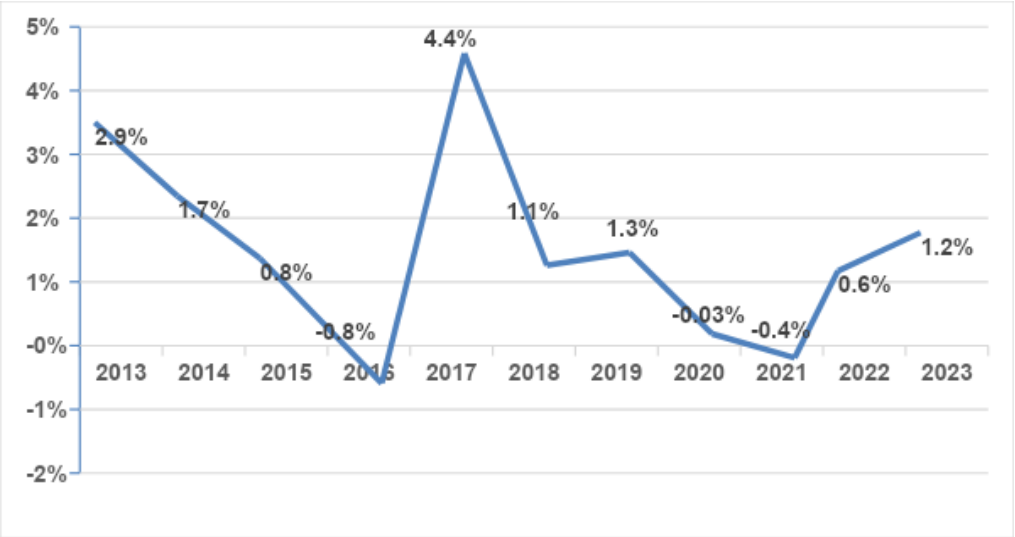
A. Lackluster Performance: low growth, poor productivity index, misguided subsidy support

The AF sector's growth performance in the past decade revealed a poor trend. It began with a 4-year downtrend from 2.9% in 2013 to -1% in 2016 (Figure 1). The sector had a growth boost of 4.4% in 2017 but declined again from 2018 to 2023, peaking only at 1.2%. The

growth contracted in 2020 to 2021 due to the restrictions and impacts of the COVID-19 pandemic, aggravated by the outbreak of African Swine Fever (ASF).

Additionally, the overall poor performance is a manifestation of the sector's structure wherein support is heavily focused on crop production. Almost 50% of the support goes to rice in the form of producer subsidies; 30% to pork and poultry; and 13% to sugar production. In contrast, despite extensive aquatic resources, fisheries development for both capture and aquaculture still needs more support (DA, 2022). The government spends about P30 billion to P40 billion annually in terms of subsidies to support producers, expand domestic supply, and keep down consumer prices, especially for rice (Briones, et. al. 2023).

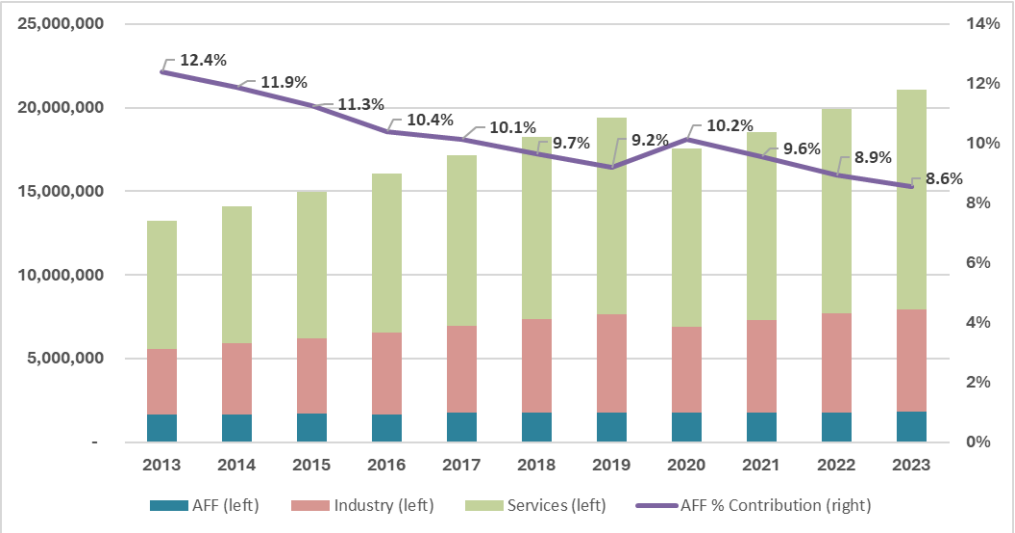
Figure 1. Growth Rate of AFF, 2013-2023 (constant prices 2018)



AFF= Agriculture, Forestry and Fisheries
Source: PSA (2024)

Over the same period, a decreasing contribution of the AF sector to the country's total Gross Domestic Product (GDP) was reported, one of the manifestations of a structural transformation from agriculture to industrial sector. As shown in Figure 2, agriculture contributed 12.4% in 2013 which consistently declined until 2019, settling at 9.2%. During the pandemic, the agriculture sector contributed more to the economy at 10.2% owing to the restrictions in the industry and services sectors that limited their productivity. However, AF declined again to 8.6% contribution in 2023. In contrast, the services sector provided the largest share throughout the decade. The declining share of AF stemmed from low productivity trends, insufficient product diversification, and trade policies that were heavily biased in favor of maintaining the food self-sufficiency objective (OECD 2021). Despite the slump in AF, the food manufacturing sector maintained its growth by shifting to importation of raw materials for processing, instead of relying on domestic products (DA, 2022).

Figure 2. Share in GDP by basic Sector in PHP millions, (constant 2018 prices 2018), 2013-2023

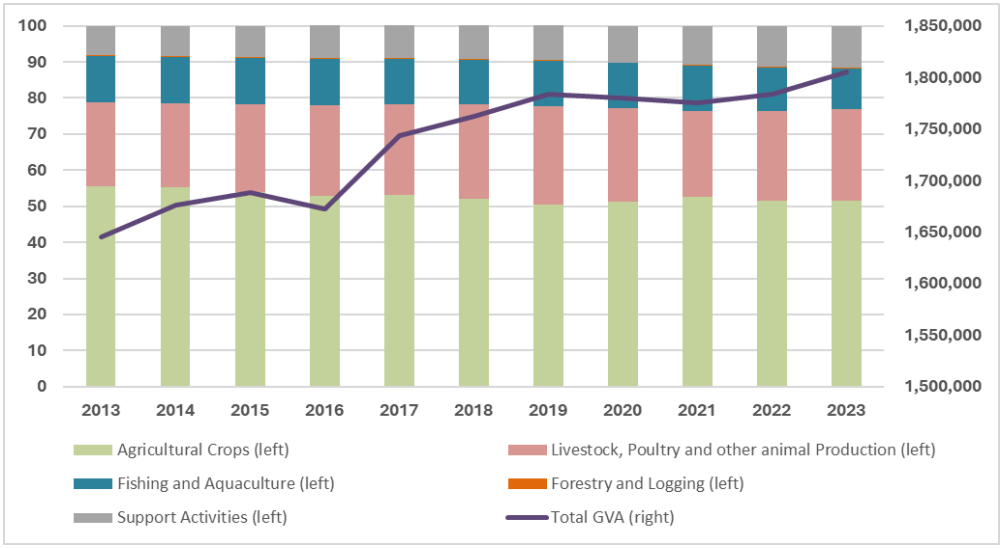


GDP = Gross Domestic Product
Source: PSA (2024)

In terms of the gross value added (GVA) in AFF, agricultural crops contributed largest averaging 52.86%, followed by livestock and poultry at 24.89%, fisheries and aquaculture at 12.54%, and the remaining at roughly 10% (Figure 3). The major crops are rice, banana, corn, coconut, mango, and sugarcane. For livestock, the most significant contributor is swine; for poultry, the leading contributor is chicken (both broiler and chicken eggs). For the fishing subsector, top aquaculture commodities are seaweed, milkfish, and tilapia; while for capture fisheries are tuna, sardines, round scad, big-eyed scad, among others (BFAR, 2023).

The current structure of Philippine agriculture has remained unchanged for over several decades where production support is skewed towards crops, mainly on rice. Over the past two decades, the share of high value crops increased incrementally from 19.6% in 2000 to 22.9% in 2019, contrary to other regional countries that were able to achieve structural transformation (away from staples to diversified crops and fishery and livestock products) in their agricultural sectors (World Bank, 2020).

Figure 3. Share in Agricultural GVA by subsector in PHP millions, (constant 2018 prices), 2013-2023



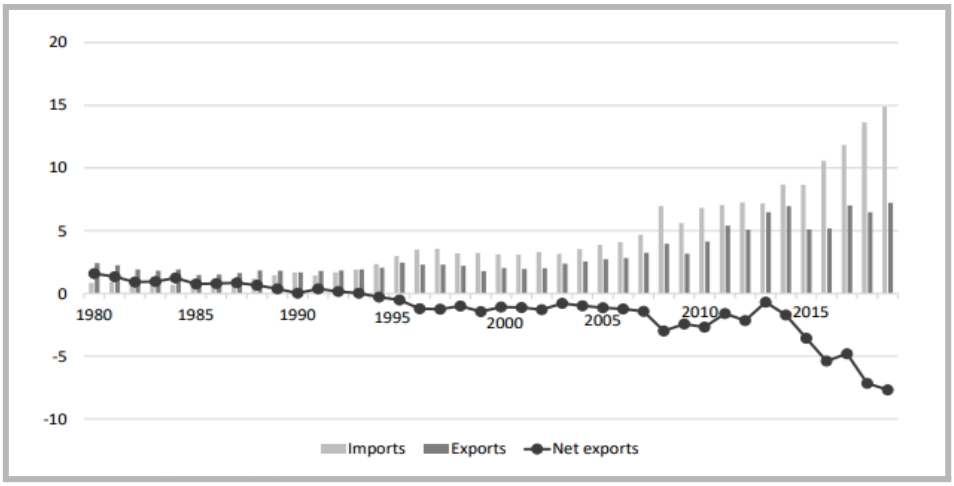
Source: PSA (2024)
GVA = Gross Value Added.

B. Poor Agriculture Trade Performance: policies not guided by comparative advantage

In terms of international trade performance, Briones (2016) reported that the Philippines was already a net agricultural importer since 1994 which indicated the loss of the country's comparative advantage for the sector. In the 1980s, the Philippines started as a minor net exporter netting USD 1 billion on average. During this period, exports were already beginning to decline while imports trended inconsistently. Thereafter, the exports plateaued, whereas imports increased steadily. By 1994, imports already exceeded past exports and were never reversed since. In 2022, PSA recorded a trade balance of USD -11,803.41 million (in FOB), the deficit tallied from total exports of USD 7,499.59 million and total imports of USD 19,303.00.

The boom in agricultural imports can be attributed to the following: (1) increase in local demand for food products due to economic growth, especially for products with higher income elasticities; (2) declining competitive advantage in traditional crops such as rice, maize, and sugar but yet accorded huge subsidies, in contrast to the increasing competitive edge in high value crops but had minimal government support; (3) increased dependence on modern inputs that are largely imported (e.g., animal feed, fertilizers); and (4) trade liberalization, which, despite enclaves of protection, boosted agricultural imports overall (David, 2003).

Figure 4. Agricultural imports, exports, and net exports in USD Billions, Philippines, 1980-2019



USD = United States dollar
Source: WTO (2021) as cited in Briones (2016)

Shown in Table 1 are the top ten exported agricultural products in 2001-2020, by revealed comparative advantage (RCA). RCA is a metric used to measure whether the country is a "better than average" exporter of an industry. For the Philippines, the most competitive products and the top export-earning in the agriculture sector are coconut oil, followed by bananas. Abaca fiber ranked third, although not a major export, while vegetable extract (mostly from seaweed), a major export, came in fifth next to nuts. Among the top fruits after bananas are dates, figs, pineapples, mangosteen and mangoes. Live fish and prepared fish were also in the mix. Briones (2016) noted that the country performed low in terms of product innovation, having virtually the same exports throughout the period, mostly composed of fresh and semi processed produce. The Philippines is yet to expand its roster of traded goods to have more processed products.

Table 1. Ten most competitive Philippine agricultural exports by revealed comparative advantage, 2011-2020 (4-digit HS classification)

	2001	2005	2010	2015	2016	2017	2018	2019	2020
Coconut oil (0801)	77.8	64.7	69.6	55.8	51.5	58.4	52.5	54.3	44.5
Bananas (0803)	13.3	15.9	12.1	13.1	17.6	17.8	35.5	38.1	31.4
Abaca fiber (5305)	29.9	31.2	16.6	13.9	15.9	19.2	19.4	11.8	13.0
Nuts (0801)	10.8	13.5	12.1	5.9	6.6	7.4	8.8	8.4	8.6
Vegetable extract (1302)	4.3	4.1	7.8	9.1	9.4	7.2	6.9	7.8	6.8
Live fish (0301)	4.1	4.2	5.6	11.7	13.5	12.0	7.9	6.0	6.1
Pineapples, mangoes (0804)	7.1	5.6	4.7	6.2	8.0	5.2	5.5	7.0	6.9
Tobacco (2401)	1.8	3.5	8.4	5.9	4.1	4.7	6.7	5.4	4.4
Prepared fish (1604)	2.4	2.2	6.1	4.5	3.9	5.3	5.9	5.0	5.2
Vegetable oils (1302)	0.0	0.1	0.1	0.0	0.0	0.0	4.0	3.2	5.1

HS=Harmonized System
Source of Basic data: ITC (2021) as cited in Briones (2016)

C. Weak rice subsector performance

Rice is an important political commodity in the country, being the major staple of the Filipinos with its price influencing the trend of food inflation. It is no surprise that past and present Philippine governments espouse rice self-sufficiency as the major policy instrument for attaining food security. Achieving rice self-sufficiency is done through the infusion of various producer and consumer price support - or the so-called policy of “buying palay from rice farmers at high prices and selling the milled rice at low price to consumers”. However, despite the large support and focus of government interventions on rice, the crop subsector has no comparative advantage relative to its Southeast Asian counterparts (Thailand, Vietnam, Myanmar, Cambodia, and Laos).

Based on the Organization for Economic Co-operation and Development (OECD, 2021) report, from 2000-2020 rice received the highest support in terms of Nominal Protection Coefficient (NPC), a ratio between the average price received by producers at farmgate (including payments per ton of current output) and the border price (measured at farmgate). The NPC for rice remained high in 2020, even with the Rice Tariffication Law in effect, which is deemed caused by the remaining high tariffs and the lag in arbitraging the difference between domestic and border prices (Briones, 2021).

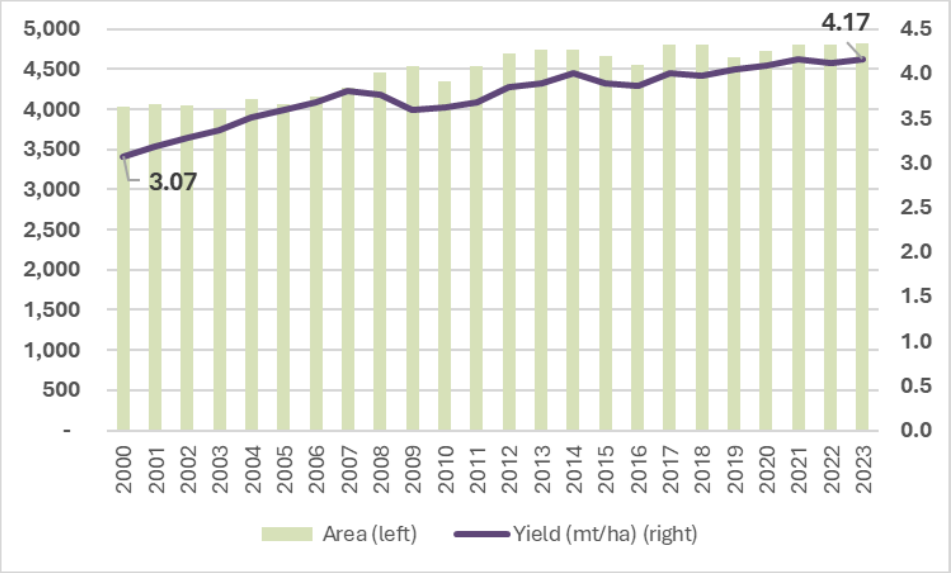
Figure 5 shows low yield productivity performance of the crop in the past 2 decades. The area of rice production (i.e. irrigated and rainfed) has minimally expanded, from around 4 million ha in 2000 to 4.8 million in 2023. Correspondingly, the national yield average only slightly improved, tallying an increase of 1.10mt/ha over the same period, from 3.07mt/ha - 4.17mt/ha.

Bordey et al (2016) reported that the Philippines’ average rice yield at 3.89 mt/ha, ranks in the middle if compared to other Asian countries. China recorded the highest land productivity with yield at 6.72 mt/ha, followed by Vietnam and Indonesia with 5.57 and 5.15 mt/ha, respectively. Meanwhile, the lowest yielding countries were interestingly the two largest exporters which were Thailand at 3.13 mt/ha and India at 3.86mt/ha.

The same study also reported that the Philippines consistently placed second to the last, among the selected Asian countries, in terms of profitability in rice production. The low performance is due to the low increase in productivity rate, compared to the faster increase in rate of production cost of rice in the country. A major expense of rice farmers is the high labor cost. For instance, in irrigated areas of Nueva Ecija, 35% of total production cost is for

labor or equivalent to PHP3.76 per one kilogram of rice produced. Other expensive inputs are imported inputs like fertilizer and diesel that are used in agriculture machinery.

Figure 5. Rice Yield, 2000-2023



Area = in thousand hectares Source: PSA (2024)

Meanwhile, one of the major support for rice is irrigation. By virtue of the law that stipulated a zero price for water, irrigation development is heavily concentrated on the rice subsector[1], a major user of water and also is responsible for agriculture emissions (globally estimated at 10% contributor for total rice cultivation world-wide). Despite not paying the real cost of producing rice, the market price for ordinary white rice (regular milled) in the Philippines is much higher than that of imported rice with similar quality (25% broken rice), and even at 35% tariff rate and without quantitative restrictions. For these reasons, Philippine rice is deemed globally less competitive.

D. Overall Mediocre Performance of the AF Sector: low Total Factor Productivity

A measure of overall performance is the total factor productivity (TFP) which indicates utilization efficiency of agricultural land, labor, capital and other inputs (e.g. seeds, fertilizer) to produce outputs. TFP is the ratio of total agricultural outputs to inputs. Hence, when more output is produced from a constant volume of resources, TFP increases (Nin-Pratt and

[1] Worth noting is that the rice subsector obtains a yearly allocation of PHP 10 billion until 2025, as stipulated under the Rice Tariffication Law (RTL).

Stads, 2023). Table 2 presents the estimated TFP of selected Asian countries from 1961 to 2016.

Table 2 Annual growth in agricultural total factor productivity (%), selected Asian countries, 1961-2016

	1961–1970	1971–1980	1981–1990	1991–2000	2000–2010	2011–2016
Philippines	0.4	2.6	0.6	1.6	1.5	-0.3
Indonesia	2.1	1.4	0.5	1.1	3.0	1.9
Malaysia	2.9	2.5	3.1	1.6	2.5	0.7
Myanmar	-0.4	1.6	-0.3	3.7	5.5	-1.8
Thailand	1.0	2.4	-0.6	3.0	1.9	2.0
Viet Nam	0.0	1.6	1.6	1.8	2.8	2.0
Bangladesh	-0.1	0.6	-0.8	0.1	2.5	1.1
India	0.8	0.4	1.5	0.8	2.3	2.5
Pakistan	2.4	0.1	2.8	1.0	-0.1	0.4

Source USDA-ERS (2021) as cited in Briones (2021)

Briones (2016) found that the TFP growth of the Philippines is mediocre at best and negative at worst. In the 1960s, rapid agricultural growth was experienced but TFP remained stagnant suggesting increases in factors of production. In the succeeding decade, TFP grew to 2.6% but was deterred by the economic crisis in the early 1980s. The sector recovered in the 1990s to 2000s recording positive TFP, largely due to the green revolution innovation. However, the growth trend was not sustained and in 2011-2016 the sector registered a -0.3% TFP which indicated lower output growth than expected, given the growth in factors of production. Meanwhile, most other countries continued to register positive TFP growth from 1991 onwards.

World Bank report (2022) opined that the country's slow TFP growth trends over the past quarter century are caused by: (a) the low rice productivity, with yields far below the average of other Southeast Asian countries, despite the inflow of huge subsidies, and (b) the lack of diversity in high-value-added products, where the country has a comparative edge, and which could have spurred local food consumption and higher export earnings.

E. Stymied structural transformational process: high rural surplus labor, high poverty and poor nutrition

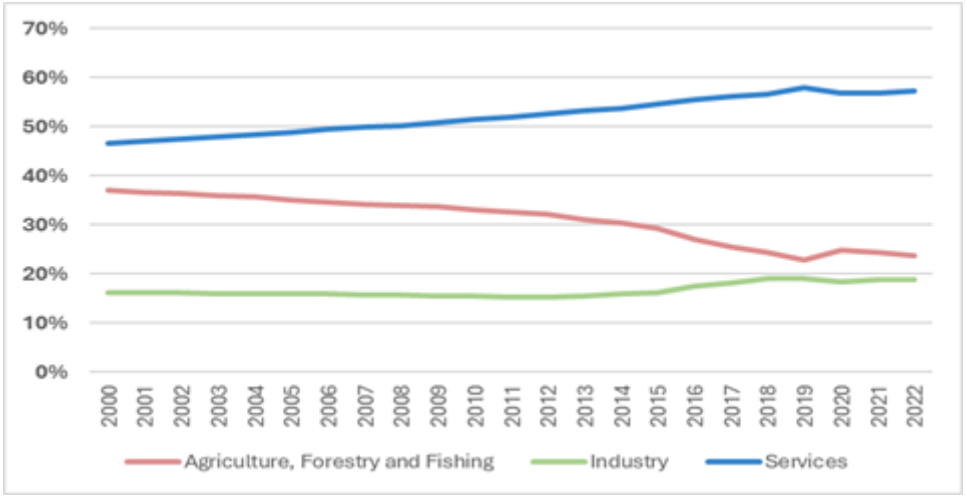
AF modernization is characterized by two stylized facts: first is the decline in the share of agriculture's value to the total gross domestic product (GDP), and second is the decrease in

the share of agriculture labor to the total workforce. While the Philippines continues to experience a downtrend of the AF sector's share to GDP now only in single digit percent values, the share of agriculture employment to the total workforce, while it showed a decrease, the trend has been slow and incrementally at low levels: from 29.5% in 2015 down to 23.1% in 2022 (World Bank).

Briones (2021) points the decline of agricultural workers to intersectoral migration (non-agricultural) with high economic activity, offering job opportunities with rising wages. The surplus labor of the AF sector moved mainly to the services rather than the industry sectors (Figure 6). Labor from the countryside also moved from low-skilled, and to low-income paying jobs in the services sector (World Bank 2023). It was observed that 90% of the jobs offered in the non-agriculture sector were from micro to small and medium enterprises (MSMEs) (ADB 2022). The normal structural transformation trend is a movement of surplus agriculture to jobs in the manufacturing and later in services sector.

Compared to other developing economies, the declining share of AF labor to total employment was also observed. From 1991-2019, South Asia also saw a decline of 20.7%, while in East Asia and the Pacific (EAP) it was 32%. Meanwhile, Sub-Saharan Africa (SSA), which underwent the least structural change, saw a decrease of 11% over the same period. Such a trend is integral to the structural transformation of the country's economies as these move from relatively low productive AF sectors to higher industrial and service sectors.

Figure 6. Employment Share by Sector (% of Total Employed), 2000-2022

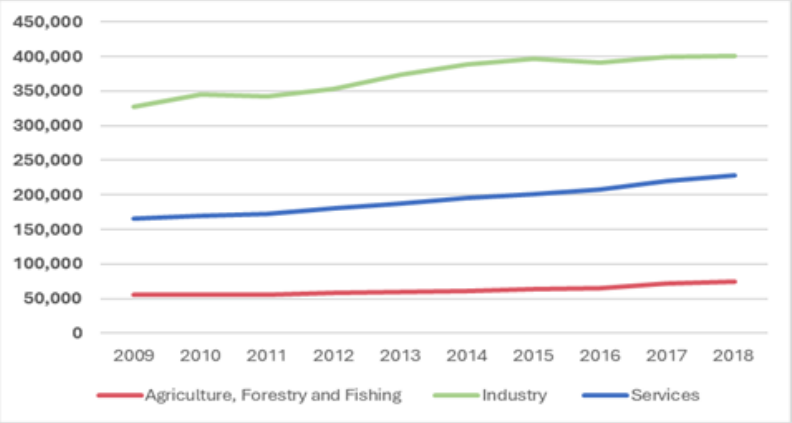


Source: World Bank (World Development Indicators)

In terms of labor productivity, Figure 7 shows the trend in output of the different sectors from 2009 to 2018. Overall, the labor productivities of the three economic sectors showed an upward trend. The industry workers produced the highest labor output, followed by the

service workers and, lowest are agricultural workers. A worker in the AF sector produced approximately only one-fourth of its industry counterparts' output. In comparison to the level of output in 1995 which was only one-fifth, significant improvements were evident in the 2010s, although still lagging far behind industry. Briones (2021) explains that the acceleration of growth in productivity by the late 2010s was attributed to the absolute decrease in the number of agricultural workers, which propelled labor productivity growth of up to 4.1% per year. Before 2010, the rate was only at 2.8%.

Figure 7. Labor Productivity by sector (constant 2000 pesos), 2009-2018

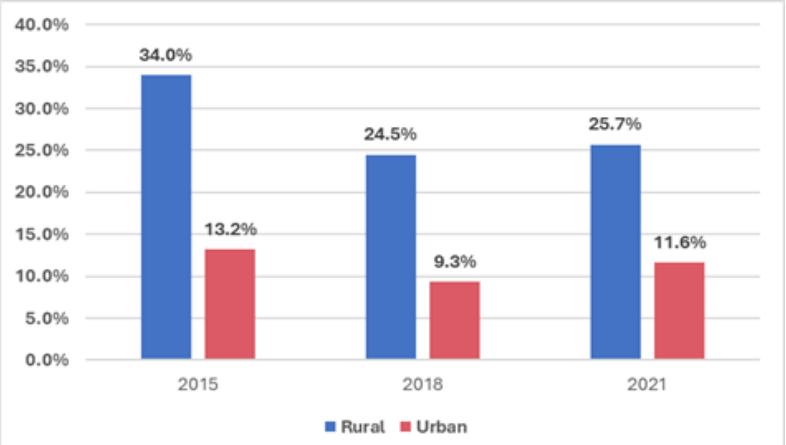


Source: PSA

F. Dismal AF sector was accompanied by High absolute and hidden hunger index, skewed income distribution, and high undernutrition and nutrition

In Figure 8 the poverty incidence in rural areas, where most of AF labor reside, was reduced to 25.7% of Filipinos in 2021 from a high 34% in 2015. Additionally, the PSA released its preliminary 2023 first semester poverty statistics which showed a decline in national average with only 22.4% compared to the 2021 first semester with 23.7%. World Bank (2020) reported the poverty incidence among farmers and fishers remain high at 34% which is well above the national average of 22%. Among the workers, fisherfolk and coconut farmers remain the poorest (DA, 2022).

Figure 8. Poverty Incidence in the Philippines (% of individuals), 2015-2021



Source: PSA

World Bank (2018) reported that the decline in agricultural workers contributed to poverty reduction owing to the shift in employment to other sectors. According to DA (2022), and as noted above, most of the surplus labor that shifted from AF, who are mostly undereducated, have likely ended up in low skilled and low paying informal jobs (e.g. household services, retail trade, land transportation and construction), primarily in MSMEs. Such have also low employment productivity and may have contributed to urban poverty. In early 2024, the country has been experiencing more quality job opportunities (DOF, 2024).

Despite the reduction in poverty incidence, income inequality remains present in rural areas where poor households are concentrated. PSA reported inequality using Gini index of household income which is a coefficient ranging from 0 to 1; with 0 indicating perfect equality, and 1 indicating absolute income inequality among families. The national coefficient in 2015 is 0.444 which suggests an adequate equality. Although, there is notable increase in the number of households whose income is in the bottom 10% compared to that in the upper 10%. The ratio grew from 8.6% in 2006 to 10.95% in 2015. Similarly, the income share of the bottom 30% and 10% of families/individuals to total income increased over the same period suggesting a growth in income inequality in the bottom percentile.

Table 3. Income Inequality in the Philippines, 2006-2015

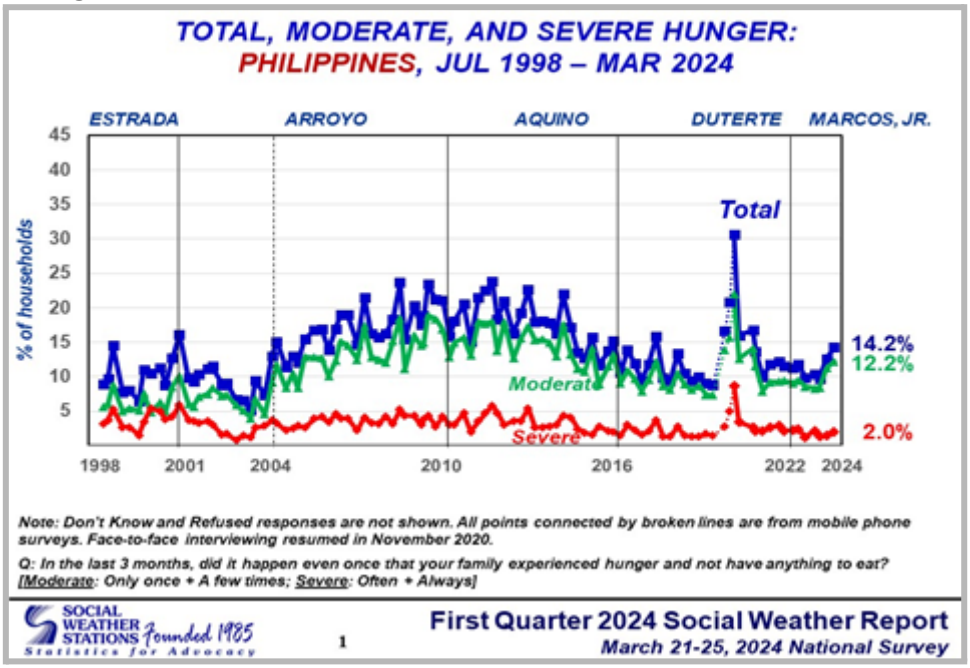
Inequality Measure	2006	2009	2012	2015
Gini index of household income	0.458	0.464	0.461	0.444
P10/P90 (%)	8.6	9.68	9.61	10.95
Income Share of Bottom 30% to Total Income (%)	10.79	11.51	11.45	12.49
Income Share of Bottom 10% to Total Income (%)	2.72	2.98	2.92	3.23

Source: PSA

Based on March 2024 survey results from the Social Weather Stations (SWS), the hunger incidence among Filipino families was at 14.2% which rose from 12.6% in December 2023. Looking at the trend, the trajectory of hunger declined starting in the 2010s until 2019. In 2020 when the pandemic hit, a record-high rate of hunger rose to 21.2% full year average. As shown in Figure 9, the country is still struggling to return to pre-pandemic levels of only 9% hunger rate.

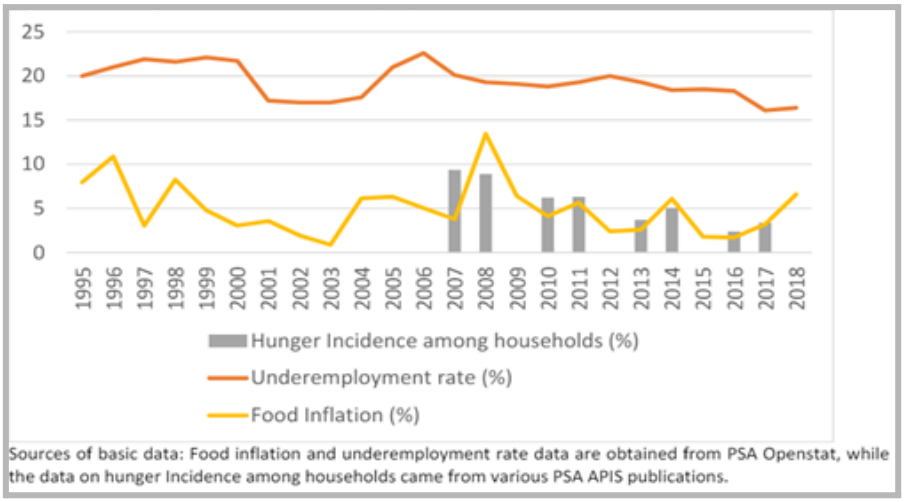
According to Mapa et al. (2016), the major determinants of hunger incidence are food prices and quality of jobs (as proxied by underemployment). They found out that a one-time price hike in food can lead to increases in hunger incidence that will last for five quarters, while a one-time increase in underemployment can lead to increases in hunger incidence for two quarters. Presented in Figure 10 is the historical trend of hunger incidence vis-a-vis food inflation and underemployment rate from 1995 to 2018, showing the correlation of variables.

Figure 9. Hunger incidence in the Philippines (%), 1998-2024



Source: Social Weather Stations (2024)

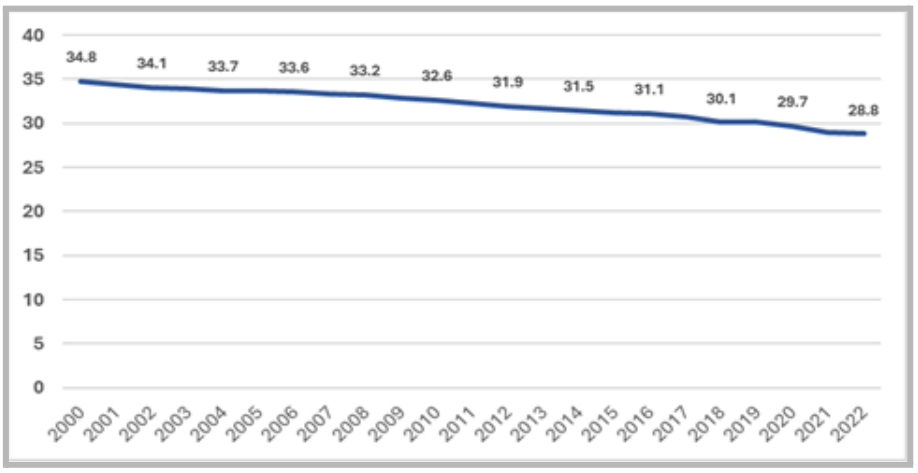
Figure 10. Hunger incidence, underemployment rate, and food inflation (%), 1995-2018



Source: PSA as cited in Galang (2022)

The Philippines' food security improved significantly throughout the decades since the 1990s. Briones (2021) explained that the data supports adequate domestic supplies and an upward trend in per-capita food availability, notwithstanding growth in population. Correspondingly, the hunger incidence declined and the number of food secure households increased over time prior to the pandemic. However, indicators related to accessibility and utilization lag behind other Southeast Asian counterparts, especially on malnutrition indicators. The stunting prevalence among children under 5 years old (Figure 11) in the Philippines is recorded at one out of three. Ulep (2021) highlighted the rate of decline in the Philippines was only at 0-1 percent annually from 2000-2018. It was far below that of the other ASEAN countries, like Vietnam, who were able to achieve 5-6 percent annual decline. While indeed the trend is gradually decreasing, it still warrants full attention from policymakers as there is only a minute window to avert potential irreversible cognitive and other health effects prior to adulthood.

Figure 11. Stunting Prevalence in Children Under 5 Years Old (%), Philippines, 2000-2022

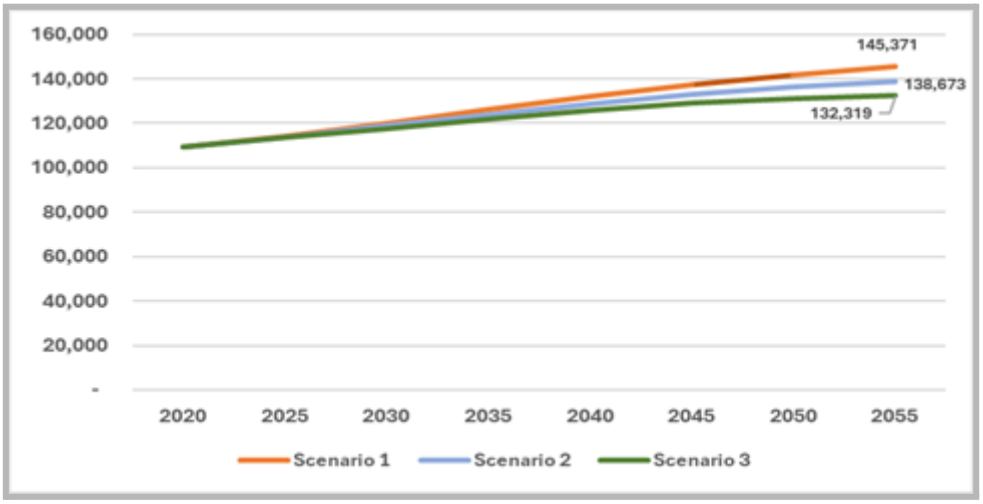


Source: UNICEF (2023)

Galang (2022) reported many Filipino households are deprived of nutrient-adequate diets due to unaffordability. The World Bank reported that one out of three Filipino households are unable to afford a nutrient-adequate diet. As of 2023 first semester, 8.7% of Filipinos were not able to meet their basic food needs (PSA, 2023). The poorest families who are able to only consume diets of low quality have high incidence of malnutrition and effectively suffering from food insecurity. In terms of food expenditure, those who belong in the bottom 20% of the population allot more than 70% of their total expenses for food products. Meanwhile, the top 20% only allot 30% of total expenditure for food in general and 3-6%, specifically for rice (DA, 2022). Hence, policies should also put emphasis on nutrition as a dimension of food security.

The population growth of the Philippines is expected to reach 145 million by 2055 (Figure 12). The PSA estimated three projections under three different scenarios[2]. Alternatively, the Philippine population is estimated to reach 138 million and 132 million by 2055, using scenario 2 and scenario 3 respectively. Regardless of the scenario, the population is anticipated to rise in a steady fashion.

Figure 12. Philippine Population Growth Rate Projections (in thousands)



Source: PSA

The prospective growth in population posits a surge in demand for agricultural products and nutritious diets. The already poor social indicators may continue to decline if not properly addressed. Sustained growth in AF productivity is imperative to counter the worsening social conditions. Briones et al. (2023) reported that key to improving the dietary quality for an energy-

[2] *Scenario 1 assumes that the National Total Fertility Rate (TFR) will rebound from 1.9 children in 2021 to 2.1 children in 2025, which will be sustained until 2055. Scenario 2 assumes that the TFR of 1.9 children in 2021 will be sustained until 2025. Scenario 3 projects that the TFR will decline from 2.1 children in 2020 to 1.7 children in 2055.*

and protein-sufficient diet, the Philippines needs to sustain a 5-6 percent annual growth in AF productivity to ease up the food prices. With this outlook, the growth in agricultural productivity must employ efficient utilization of natural resources to preserve the health of the environment and prevent degradation of natural resources (e.g. soil degradation, water scarcity, ecosystem stress, biodiversity loss, decreasing fish stocks and forest cover, pollution, high greenhouse gas emissions).

G. Challenge for AF modernization: weak R4D support, climate change

The lackluster performance of the AF sector is mainly attributed to its structure that remained unchanged throughout the past half a century. There is a lack of diversification in crop production due to an incentive system that heavily favors rice (staple) and sugar (traditional) production. These crops get the bulk of support but are not in the list of products where the Philippines has a comparative advantage (DA, 2022). Further, the government established self-sufficiency programs for rice and corn to achieve food security. This created a negative effect by absorbing a bulk of resources that could otherwise have been invested in other programs such as for fruits, vegetables and aquaculture products where there is comparative advantage.

Similarly, production support for irrigation is concentrated on rice instead of aiming for multipurpose water management to service diversified crop systems, drainage and other water demands (Briones, 2021). There should be active effort in pushing for crop diversification to ensure development of other non-rice segments of the sector.

Expenditure programs are commodity-specific, instead of systems-based, which come in the form of banner programs under DA. In practice, the delivery mechanisms for producer support in Philippine agriculture are largely for irrigation, input (e.g. seeds, fertilizers, agri-chemicals) and equipment subsidies which cater to specific commodities. These are not essentially aligned with a market-driven approach, as promoted in AFMA, that aims to support healthy market functioning or address failures such as provision of public goods (e.g. agricultural innovation) (Briones, 2021). Restructuring expenditures by cutting down commodity specific interventions and redirecting funds to R&D to catalyze technological change and productivity growth would translate into major economic benefits.

In the context of AFMA, the AF sector has gradually modernized with the development and improvement of technologies, albeit slower than its neighboring countries. The inconsistent policies on government interventions are a symptom of the disparity problem, prevalent in middle income economies, which causes pressures from contending interest groups (Briones, 2021). Herein lies the challenge for modernization where interventions must consider the declining trend

in agricultural labor, low productivity, and land frontiers already been reached, which may result in decreasing supply of food and increasing prices. Additionally, the projected population growth, rising income and changing consumer taste preference, will heighten the demand for food and affordable diets. The AF sector needs to increase total productivity to meet the growing demand. In effect, resources must be efficiently managed to prevent further ecosystem degradation and other negative socio-economic impacts. Hence, optimal AF modernization is imperative and should take precedence to ensure the country's sustainable growth trajectory.

The AF modernization pathway is most challenged by the variabilities and intensifying effects of climate change. The Philippines is vulnerable to many climate hazards such as typhoons, earthquakes and volcanic eruptions, among others. Huge damages are incurred by the AF sector year in and year out which negatively affects productivity. The onslaught of several disasters due to climate change greatly impact the AF landscape. The rising levels of temperature and greenhouse gas emissions also affect the physiology, reproduction of pests in crops, and the water parameters optimum for aquatic flora and fauna. Considering climate change into AF landscape heightens the importance to strengthen R&D initiatives to achieve full modernization.

Chapter II
WEATHERING CLIMATE CHANGE: TRENDS, IMPACTS, AND IMPERATIVES

In the famous book of T. Mosher (1966), *Getting agriculture moving: essentials for development and modernization,* he stressed productivity, competitiveness, and sustainable use of scarce natural resources – land and water- as the foundations for "getting the agriculture (and fisheries) moving". Today, amid complex and dynamic interplay of global and domestic forces, ensuring that the agriculture and fishery sector is on track to a modernizing development path that accomplishes these essentials as outlined by Mosher becomes an extra challenging feat. Multiple societal problems have emerged, particularly insecure food and nutrition, high poverty incidence, environmental degradation. The recent global health pandemic and the intensifying regional geopolitical conflicts also highlighted the importance of building a resilient agriculture and fishery sector as another essential dimension of the modernizing pathway. As the country goes into the post-pandemic recovery stage, the revitalization of the agriculture and fishery sector is urgently needed to contribute in spurring and sustaining a high growth trajectory. However, as discussed in Chapter 1, the sector is at a doldrum state. More push and pull to get it moving to the right modernization pathway- one that leads to productivity, competitiveness, inclusive growth, and sustainability - is urgently required.

A major threat to revitalizing the agriculture and fishery sector in its present weak state is climate change. It "is a growing and lasting threat to the Philippine agriculture," as noted by Perez (2024). This chapter discusses the climate change trends, their adverse impacts on the sector, and the intervention areas that will make the sector adapt to the uncertain vagaries of climate change. Among the interventions, R4D comes out as the lead public sector good for preventing and preparing to climate change hazards through proactive adaptation and mitigation measures. The last sections stress the importance of R4D in building the resilient dimensions of the agriculture modernization pathway. It notes however, the ill-equipped state of the R4D for the agriculture and fishery sector. Urgent action for a climate resilient focused R4D for the sector is imperative.

A. Changing climate patterns in the Philippine Agriculture and Fisheries Setting

This Chapter is mainly source and benefitted from the recent work of Perez (April 2024) *Institutionalization of climate resilient agriculture policy options and investment roadmap for*

building long-term resilience in agri-food value chains in the Philippines. Perez employed projections of future climates for the Philippines and the world by comparing the average historical (baseline) climate data for 1970-2000 with projections of future climate for 2040-2060, with 2050 as the central axis; he used three CMIP global climate models.[3] For the Philippines, the focus was mainly on changes in temperature and rainfall (or precipitation), the climate change features that have caused significant impact to the Philippine AF sector. The highlights of the trends from the Perez are discussed below:

1. Changes in temperature patterns[4]

IPCC projected a rising temperature with a 1-2°C increase in Philippine temperatures by the end of the 21st century. Perez's finding confirmed the rise in temperature. In the Philippines, from 1951-2015 the mean temperatures already recorded an increase of 0.68C, or a rise of 0.1°C per decade. The highest temperatures are projected in the western and southern regions of the country by 2050. The maximum average temperature increase is 4.3^0C, and minimum temperature decrease of -0.4^0C with a mean average temperature of 2.3^0C.

Table 4. Projections of Average Philippine Temperature By 2050

Temperature (°C)	Historical (1970-2000)	Change from Historical (2040-2060)			
		UK-ESM (UK-ESMM1-0-LL)	EC Earth (EC-Earth3-Veg)	MPI-ESM (MPI-ESM-ESM1-2-H-R)	Average
Maximum (°C)	28.9	5.9	4.3	2.8	4.3
Mean (°C)	25.7	3.0	2.6	1.4	2.3
Minimum (°C)	12.4	-0.1	-0.2	-0.9	-0.4

Note: The global climate models are adopted from UK Earth System Modeling (UK-ESM); European Community Earth System Model (EC Earth); and Max Planck Institute for Meteorology Earth System Model (MPI-ESM-ESM). Source of basic data: WorldClim 2.0 online

2. Changes in rainfall patterns by 2050[5]

Globally, the average mean monthly rainfall is projected to decline by 0.4 mm, but with average maximum rainfall increase of 765 mm/moth. Higher increases in rainfall are projected for the regions just below the equator – including the Southeast Asian countries like the Philippines. For the Philippines, the average rainfall is to decline by 47.2 mm/month;

[3] The global models used were the UK-ESM, EC Earth and MPI-ESM under RCP 8.5 and SSP2 (Perez 2024: 1).
[4] The discussion on this section was sourced mainly from the Perez report (2024)
[5] This section was mainly sourced from the Perez (2024) report.

the average maximum increase in rainfall is 529.7 mm/month. The eastern provinces of Visayas and Mindanao will be relatively wetter by 2050.

Table 5. Historical and Projected Average Rainfall, Philippines by 2050

Rainfall (mm/month)	Historical (1970-2000)	Change from Historical (2040-2060)			
		UK-ESM (UK-ESMM1-0-LL)	EC Earth (EC-Earth3-Veg)	MPI-ESM (MPI-ESM-ESM1-2-H-R)	Average
Maximum	389.0	701.0	589.0	299.0	529.7
Mean	209.8	-59.4	-26.3	-56.1	-47.2
Minimum	80.0	0.0	0.0	0.0	0.0

Source: Perez, 2024

B. Impacts of climate change on the AF sector

Perez (2024) applied a Philippine version of the IFPRI's modeling framework called International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT-Phil). The framework combines biophysical indicators (climate, hydrology, and crop growth) with economic indicators to project water and food supply and demand, as well as food trade and prices under climate change. The effects of climate change on the AF sector are:

- Heat and water stress induce a decrease in yields unevenly, with the highest yield declines for corn (23%) and sugar crops (11%); the decrease in rice yield was at 5%. The least affected are rootcrops and other crops.
- With reduction in yields and production globally, agriculture prices would increase, encouraging farmers to produce more. As land frontiers have been reached, the price increases would encourage farmers to adopt better technologies such as climate-smart technologies to take advantage of the rising prices.
- Farmers' supply response to the combined effects of decreases in yields and price increases could result to reversals in terms of yield losses due to the price-induced effects on yields. This is the case for vegetables. ***Overall, however, without other government interventions to minimize the yield reductions because of climate change, the price-induced effects on yields will not be sufficient to counter the yield decreasing effects of climate change*** (Table 6). Growth rates of yield will still generally increase in a scenario of climate change, but without appropriate interventions, the yield gaps between a no climate change and with climate change

will widen. It should be stressed that with climate change, the yields of corn and sugarcane will be on a downtrend.

- Production of most food commodities, including animal-sources foods are projected to decline due to climate change; exceptions to this negative production trend are those for root crops, fruits and vegetables. Highest production declines are observed for pulses (-9.55%), corn (-21.57%), and rice (-8.10%); production of eggs and mutton will increase slightly at 2.02% and 0.39%, respectively (Table 7).
- As mentioned, food prices will increase especially for corn, rice and oilseed crops making these food items less affordable and less accessible for the poor. Relating these to trade, high prices will generally dampen imports of rice, corn, sugar, wheat, and meat, but would encourage the export of fruits and vegetables.
- Similarly, consumption will also decrease. In terms of calorie intake, daily per capita consumption declines by 2.32% with climate change.
- With less access to food due to higher prices, the number of undernourished populations is projected to increase by 8% and malnourished children by 3%.
- The economic costs to the Philippine population are around $17.2 billion for the years 2025-2050, or $690 million per year. Filipino consumers bear the brunt of these costs averaging at $3,207 million annually. Food producers gain at $2,517 million per year, which can compensate for the declines in the productivity. However, for small scale farmers who are net buyers of food, they absorb the economic cost due to climate change (Table 8).
- Finally, on a macro level, the World Bank estimated economic damages of up to 7.6% of GDP by 2030 and 13.6% of GDP by 2040, with agriculture suffering most from slow-onset disasters.

Table 6. Impact of Climate Change on Yields of Food Commodities in the Philippines by 2050

Food commodities	2020	2050 Projections		
		No Climate Change (NoCC)	With Climate Change	Change from No CC
Yields	---------- mt/ha ----------			%
All Foodcrops	7.71	10.25	9.84	-3.93
All cereals	2.81	3.63	3.32	-8.53
Corn	2.71	3.11	2.51	-19.40
Rice	2.88	3.95	3.80	-3.76
Other Crops	1.30	1.55	1.49	-4.21
Fruits	15.26	20.52	20.18	-1.65
Vegetables	10.70	13.78	14.58	5.81
Oilseed crops	4.59	5.27	5.04	-4.29
Pulses	0.92	1.06	1.00	-4.80
Roots and tubers	8.16	10.20	10.17	-0.25
Sugar	83.19	88.46	79.93	-9.64

*Note: Results are averages of 3 climate models UK-ESM, EC Earth and MPI-ESM under RCP 8.5 and SPP2; * NoCC means no climate change that serves as the counterfactual scenario. Productivity-effects of climate change were not simulated for animal-sourced foods. Source: IMPACT-Phil simulations.*

Source: Perez, 2024

Table 7. Impact of Climate Change on Food Production in the Philippines by 2050

Food commodities		2050 Projections		
	2020	No Climate Change (NoCC)	With Climate Change	Change from No CC
Production	---------- 000 mt ----------			%
All meat products	3,234	5,090	5,016	-1.45
Beef	345	635	627	-1.28
Mutton/Goat meat	55	95	95	0.39
Pork	1,909	2,714	2,710	-0.13
Poultry meat	926	1,646	1,583	-3.79
Dairy	15	20	20	-1.68
Eggs	894	1,738	1,773	2.02
All cereals	19,835	26,476	24,179	-8.67
Corn	7,364	8,668	6,798	-21.57
Rice	12,471	17,808	17,381	-2.40
Other crops	656	1,001	955	-4.61
Fruits	20,122	33,524	33,971	1.34
Vegetables	7,178	11,575	12,629	9.10
Oilseed crops	16,877	19,809	19,520	-1.46
Pulses	76	95	86	-9.55
Roots and tubers	3,043	3,922	3,939	0.44
Sugar	3,002	4,383	4,163	-5.02

*Note: Results are averages of 3 climate models UK-ESM, EC Earth and MPI-ESM under RCP 8.5 and SPP2; * NoCC means no climate change that serves as the counterfactual scenario. Source: IMPACT-Phil simulations.*

Source: Perez, 2024

Table 8. Changes in Society's Welfare due to Climate change, World and the Philippines, 2025-2050

Country/Region	Welfare Measure		
	Producer Surplus	Consumer Surplus	Total Economic Surplus
	US$ billion		
World	2,968	-5,703	-2,734
Philippines	62.9	-80.2	-17.2
Annual value US$ million)	2,517	-3,207	-690

*Note: Results are averages of 3 climate models UK-ESM, EC Earth and MPI-ESM under RCP 8.5 and SPP2, in comparison with the no-climate-change, i.e., counterfactual scenario. *Application of real discount rate equal to 3% Source: IMPACT-Phil simulations.*

Source: Perez, 2024

C. Climate Change and Vulnerable Livelihoods

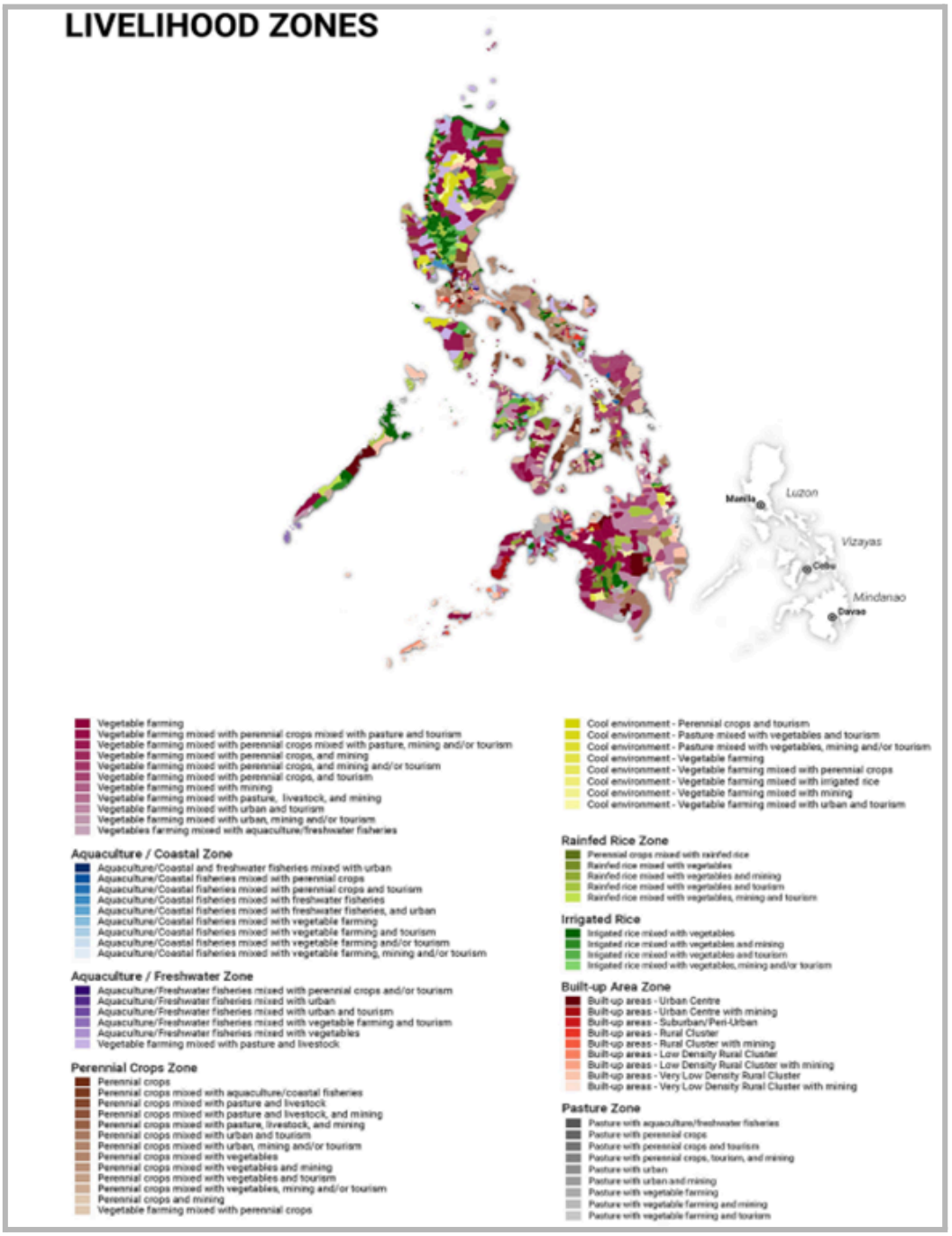
In a study conducted by Bioversity International et al. (2021), livelihood zones in the Philippines were mapped out to determine which segments of the population will be most vulnerable to climate change, in relation to food and nutrition security. The map (Figure 13) identified 9 major livelihood zones with 74 unique sub-zones . The study found that livelihoods in rural areas which depend only on agricultural income have the highest vulnerabilities to hazards and shocks due to compounding losses on productive and non-productive assets.

Based on the same study, in the coming decades the Philippines is expected to experience these top 3 climate-related risks: 1) increased rainfall variability, frequency and severity; 2) rising mean temperatures that will be conducive to the spread of crop diseases and increase incidences of drought; and 3) extreme weather events like super typhoons. Such risks are most detrimental to areas where rice and annual crops are produced. Similarly, overall agriculture and fisheries production can be affected, most especially from extreme disasters that can damage infrastructure and reduce productivity.

Additionally, Bioversity International et al. (2021) highlighted the types of livelihoods that will be most vulnerable to the impacts of climate change. Areas where rice, vegetables and perennial crops are produced will be most susceptible to flooding risks, specifically some provinces located in Northern Luzon and Southern Mindanao. Drought risks will mostly affect inland rice production areas in Mindanao, while risk of heat stress will impact pasture and livestock zones in Northern Luzon due to projected ambient temperatures of 30 °C or more

by 2050. Disease outbreaks are expected to hit livelihoods that depend on rice and vegetables, primarily because of changing rainfall patterns and conditions becoming hotter and more humid by 2050. Lastly, sea-based hazards such as sea level rise, storm surge, and saltwater intrusion will pose risks on coastal communities dependent on fisheries and aquaculture, specifically in Visayas and Mindanao.

Figure 13. Map of Livelihood Zones in the Philippines



Source: Biodiversity International et al. (2021)

D. R&D and its pivotal role in tackling the ill effects of climate change

The work of Perez (2024) employed the IMPACT model to assess various policy intervention measures that can effectively minimize the losses inflicted by climate change on agriculture particularly on production, yield, and net trade. The options were: R&D (with crop-livestock

diversification), irrigation development, and market and value chain development. The last option is waste recycling production coupled with more efficient logistics, marketing and distribution nodes. Another set of investment options provides these three interventions in conjunction with the development of agriculture enterprises organized at community level. The simulations of these interventions that examined their impact on production, yield and net trade- clearly showed that R&D, the core public good measure for generating climate-smart technologies, coupled with employment of diversified farming registered the best results in ensuring higher production, better productivity and surplus earnings from net trade in a climate change scenario.

Investing in agricultural R&D, as proven by several available literature, is a highly effective instrument in reducing poverty and hunger incidence and in addressing climate change on food systems (Rosegrant et al., 2017; Mason-D'Croz et al., 2019; Agricultural Science and Technology Indicators, 2022 as cited in Nin-Pratt and Stads, 2023). In comparison with other public expenditures, agricultural research exhibited greater impact on agricultural productivity regardless of the chosen modality of investments, timeframe, and specific targets for adaptation. Moreover, results showed that spending on agricultural research is best or second best in poverty reduction, whether the comparison is with other investments, such as irrigation, soil conservation, and farm subsidies, or with investments in other rural areas, such as health, education, and roads (Diaz-Bonilla et al., 2014; Mogues, 2015 as cited in Nin-Pratt and Stads, 2023).

The study by Nin-Pratt and Stads (2023) showed a positive correlation between the development of food systems and a country's capacity to innovate, which is a function of several factors, namely quality of human capital and research capacity, the innovation environment, innovation policies, and institutions. Additionally, they found out that R&D activities producing new technologies and innovation are a crucial factor driving TFP. Hence, prioritizing agricultural research investments will undoubtedly develop the country's food systems.

E. Weak State of the Agriculture and Fishery Sector's R4D

In the 2022 Global Innovation Index (GII), the Philippines declined in global ranking from 51st to 59th place. Furthermore, the country's rank in innovation inputs fell from 72nd in 2021 to 76th in 2022. The reduction in innovation outputs, dropping from 40th in 2021 to 51st

in 2022, is primarily attributed to decreased performance scores in knowledge and technology outputs, driven by factors such as knowledge creation, knowledge impact, and knowledge diffusion.

At the core of the weak performance scores in the generation and dissemination of knowledge solutions were the institutions, such as the R&D for the AF sectors. The organization of agricultural R&D in the Philippines is complex with a multi-level institutional structure. Three departments (DOST, DA, DENR) play roles in technology creation within the agricultural sector. The main body is the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), under DOST, serves as the central coordinating body, offering support to 132 R&D agencies, collectively known as the National Agriculture and Resources Research and Development Network, along with 14 region-based consortia. The primary responsibilities of PCAARRD include policy formulation, development of research topics, and allocation of state funds for R&D. Complexities in the country's R&D governance have allowed the persistence of overlaps in research functions among mandated agencies resulting in research fragmentation, even post-AFMA. With this, the overall impact and attribution of agricultural R&D to national goals have been difficult to assess (Briones, 2022).

The Agriculture and Fisheries Modernization Act (AFMA) emphasizing the importance of the strengthened role of DA in agricultural R&D, has established the Council for Extension, Research, and Development in Agriculture and Fisheries (CERDAF) to provide an effective linkage between research and extension. Briones (2022) points out that CERDAF is still yet to be functional. AFMA ensured the involvement of farmers and the private sector in adopting a multidisciplinary approach to R&D. Also it strengthened the role of national government agencies as enablers of the LGU extension system. However, AFMA was unable to address the complex bureaucracy of public agricultural R&D owing to its inadequate funding and low prioritization in government operations. Moreover, LGUs now serve as the frontliners for extension services. In the past, extension was the operational conduit of concerned departments and agencies in bringing down their R&D outputs at the ground level, validating and testing the veracity of R&D technologies, and their eventual widespread use. With this inextricable link of R&D being severed as the LGUs takeover the management of extension in their respective political jurisdictions, the effective link of R&D to extension hinges on the prioritization, outreach, and the extension funding support of LGUs; it has been observed that extension services by LGUs are not being optimized.

In addition, the National Information Network (NIN) which seeks to provide easy access to agriculture and fisheries related information and marketing services, is also yet to be fully implemented. This network is also stipulated under AFMA to be set up by DA, down to the municipality level, as a linkage of all offices and levels of the department with various research institutions and local end-users. The absence of these crucial networks deterred the potential of a more coordinated agricultural R&D system in the country (Briones, 2022).

More than half of the research agencies in the Philippines, focusing on agriculture, are dedicated to researching crops, with a privileged emphasis on rice. The Philippine Rice Research Institute (PhilRice), established in 1985, is a government-owned and controlled research center focused on developing rice technologies and innovations to address specific production problems in the Philippines. PhilRice leads the national R&D program for rice and rice-based farming systems in close collaboration with International Rice Research Institute (IRRI), the oldest and largest international agricultural research institute in Asia. Rice R&D activities are implemented through the network of 57 agencies composed of PhilRice experiment stations, regional agricultural research centers, and state universities. While

IRRI's global mandate is financed by foreign governments, development agencies, and foundations, its research efforts extend beyond the specific technology needs of the Philippines. Consequently, PhilRice adapts many of IRRI's innovations to suit local conditions. Although by number of researchers, the Philippines has one of the largest agricultural research systems in Asia, budgetary expenditures on agricultural research have been low, particularly during the 1990s and 2000s. In 1997, AFMA stipulated that R&D should receive 10% of the annual budget for agriculture, but actual spending averaged around 4% until the end of the2000s. Since 2010, government expenditure on agricultural R&D has increased substantially in absolute terms: PCAARRD and BAR received significant increases in their budgets during 2010-13. PCAARRD expanded its budget for R&D and technology delivery services, while BAR increased funding for national programs on rice, maize, high-value commercial crops and the promotion and development of organic agriculture (Aquino et al., 2013). However, expenditure on R&D as a share of total budgetary expenditure on agriculture decreased to 3% over 2010-15, well below the 10% target.
In Table 9, the DA and DOST R&D investment is presented relative to AFF GVA for 2018 to 2022. The already dismal percentage of R&D investment intensity even decreased further from 2018 (0.29%) to 2022 (0.21%). This affirms scant support in AF R&D wherein the required 1% of annual AFF GVA funding, as stipulated under AFMA, is still to be implemented.

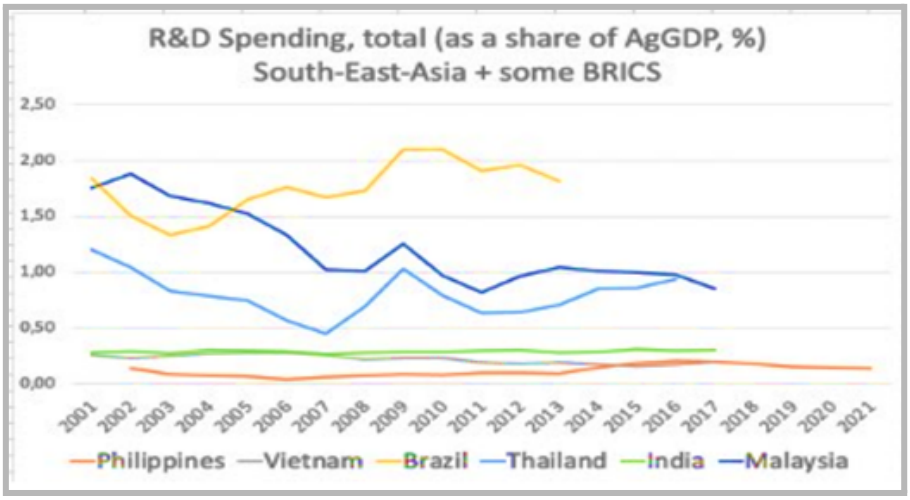
Table 9. DA and DOST R&D Investments and PH GDP, AFF GVA (in PHP million), 2018-2022

GDP Current price	2018	2019	2020	2021	2022
GDP Philippines (millions)	18 265 190	19 517 863	17 951 574	19 410 614	22 024 515
AFF GVA (millions)	1 762 616	1 721 539	1 828 424	1 954 345	2 103 198
DA's AF R&D (millions)	3 933	3 172	3 386	3 125	3 134
AF R&DE Budget Dost-PCAARD (millions)	1 196	1 096	1 121	1 333	1 285
Total R&D of DA and PCARRD	5 129	4 268	4 507	4 458	4 419
Intensity R&D Investments from DA and DOST	0,29%	0,25%	0,25%	0,23%	0,21%
% share of DA R4D investment to the total AFF GVA					

DA=Department of Agriculture
DOST=Department of Science and Technology
R&D=Research and Development
GDP=Gross Domestic Product
AFF=Agriculture, Forestry, and Fishery
GVA=Gross Value Added
Source: DA and DOST as cited in UPLB-CIRAD presentation (2024)

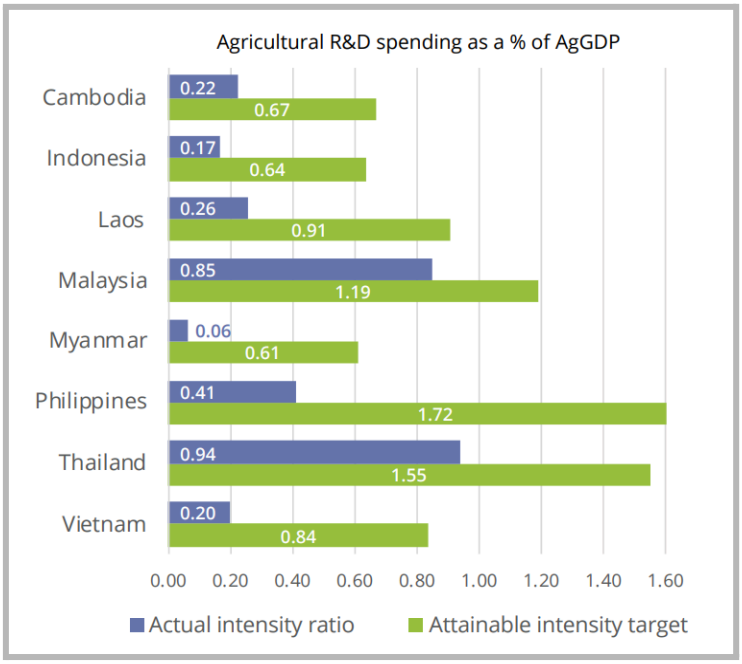
In comparison with neighboring countries in South East Asia and some BRICS, Philippines has consistently placed lowest in total R&D spending relative to agricultural GDP for 2001-2011 (Figure 14). Additionally in 2017, the Philippines only reached 0.41% actual intensity ratio compared to its 1.72% attainable intensity target (Figure 15). This means the Philippines is still yet to maximize the crucial role of R&D in the development of AF food systems.

Figure 14. Total R&D Spending (as a share of AgGDP, %). SEA + some BRICS, 2001-2011



R&D=Research and Development
AgGDP=Agricultural Gross Domestic Product
SEA=Southeast Asia
BRICS=Brazil, Russia, India, China, and South Africa
Source of data: ASTI: and OECD (2022) as cited in UPLB-CIRAD presentation (2024)

Figure 15. Agriculture research intensity ratios & attainable targets in 2017 for different countries of South-East-Asia

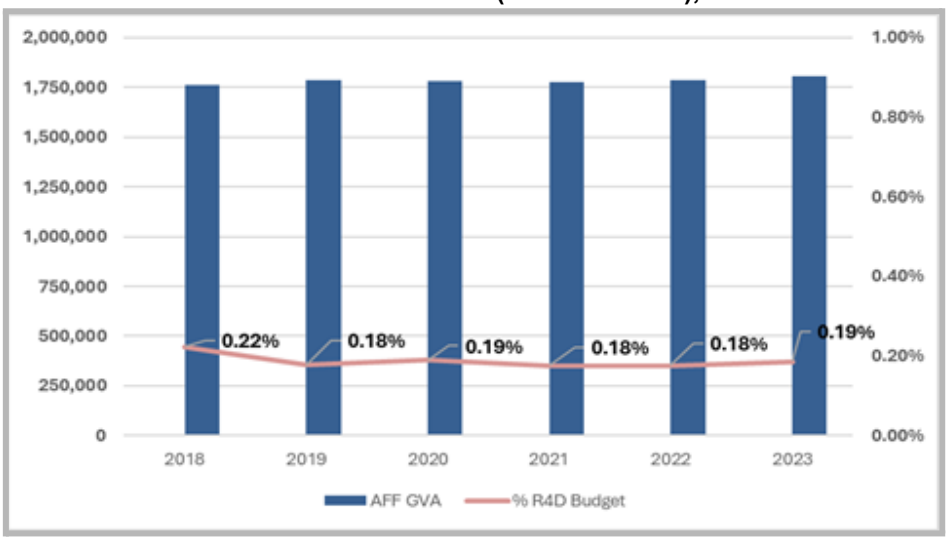


Sources of data: ASTI and Nin Pratt and Stads G.J. & al. (2020) as cited in UPLB-CIRAD presentation (2024)

Looking specifically at the R&D investments of the Department of Agriculture, from 2018 to 2023, the annual investments averaged at only 0.19% (PHP 3.3B) of the total AFF GVA (PHP 1.78T). The data covers all offices under DA including bureaus, attached agencies,

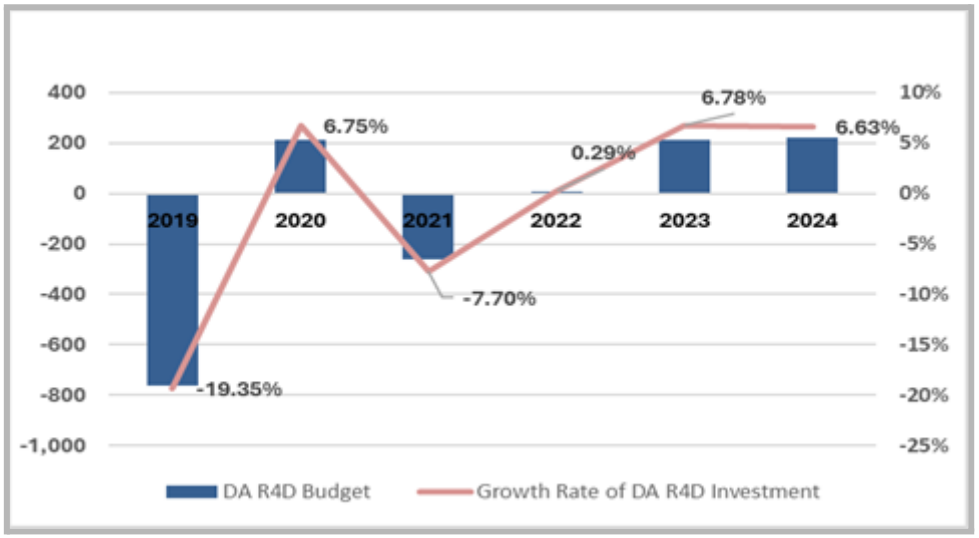
attached corporations and regional field offices. Figure 16 shows the trend of percent allocation which has relatively remained unchanged over the six-year period.

Figure 16. DA R4D Investment vis-à-vis AFF GVA (in PHP million), 2018-2023



DA R4D=Department of Agriculture Research for Development; AFF=Agriculture, Fisheries, and Forestry; GVA=Goss Value Added; PHP=Philippine Peso Source: DA-BAR (2023)

Figure 17. Growth Rate of DA R4D Investment (in PHP million), 2019-2024



DA=Department of Agriculture; R4D=Research for Development; PHP=Philippine Peso
Source: DA-BAR (2023)

Figure 17 presents an erratic growth trend on allocating agriculture R4D funds in the DA. In 2019, the department cut down its allocation by 19.35% or almost a reduction of PHP 800 million. The funds slightly increased by 6.75% during the pandemic but in 2021, priorities shifted at the expense of R4D funds. In 2023, the funding increased for two consecutive

years with approximately PHP200 million or about 7% annually. Chapter 9 of this plan further discusses in detail the financing state of agricultural R&D in the country.

In terms of climate related agricultural R&D investments, there is no readily available data from the DA. Partial information has been gathered from DA agencies on climate related projects from 2020 to 2023. From the list of over 1500 supported projects, about a third were geared towards climate resilience. While a number of efforts are being conducted by various institutions, a complete inventory of R&D initiatives are still to be consolidated and assessed. More details on the climate related R&D investments are discussed in Chapter 9.

F. Urgent call: A climate responsive R4D for AF and increased funding support

Factoring in the challenge of climate change and its projected disastrous consequences to the AF sector and economy in general, it is imperative to bolster the R&D system to generate long term benefits and usher a sound modernization pathway. It is paramount to implement modernization policies and programs that are anticipatory in nature and addressing the increasing and emerging risks to ensure responsive, sustainable and resilient food systems. Currently available data suggests a call for increasing investments in agriculture and fisheries R4D. Investing in the development of the R4D system will foster an environment that is conducive for innovation, knowledge generation, and will effectively bring forth productivity growth. Lastly, collective advocacy is necessary for coordinated R4D activities among key institutions in both public and private to generate wider and long-lasting impact for the agricultural sector.

Chapter III

SOWING R4D FOR A MODERN CLIMATE-RESILIENT AGRICULTURE TO A FOOD- AND NUTRITION-SECURE HORIZON

This chapter puts into perspective the catalytic role of research for development (R4D) for the agriculture and fishery (AF) sector. The first three sections of this chapter discuss the espoused modernization pathway for the AF sector. The last section links the AF modernization pathway to the nutrition strategy and lays the AF's R4D agenda in the context of contributing to the Philippine food and nutrition security.

A. Legal Foundations for the AF's Modernization Pathway

The legal basis for the Philippine agriculture modernization pathway is enshrined in the Philippine constitution. Article XII of the 1987 Philippine Constitution puts "agriculture modernization" in the context of industrialization:

> *The State shall promote industrialization and full employment based on **sound agricultural development and agrarian reform**, through industries that make full and efficient use of human and natural resources, and which are competitive in both domestic and foreign markets.*

To put this Constitutional mandate into action, Congress enacted in 1997 the Republic Act No 8435, otherwise known as the Agriculture and Fisheries Modernization Act in 1997, or AFMA. Agriculture modernization as a "sound agriculture development and agrarian reform" was defined as "the process of transforming agriculture and fisheries sectors from one that is resource-based into one that is dynamic, technologically advanced and competitive yet centered on human development, guided by the sound practices of sustainability and the principles of social justice." The law specified several impact areas for the agriculture modernization pathway, the most important being: (i) achieving food security, (ii) poverty reduction through increased livelihood and jobs, (iii) income enhancement and profitability through improved productivity especially at the farm and fishery production, and (iv) environmental sustainability.

AFMA espoused twofold approaches to achieve a modernized state for the agriculture sector: (i) market-driven as a basis for harnessing competitiveness and efficient use of resources, and (ii) value chain development as opposed to viewing the AF sector from the lens of farm, livestock, and fish production. The objectives in the AFMA law list the key features of a modernized agriculture: (i) efficient use of resources based on competitive

advantage and increasingly more reliance on technology and knowledge to accelerate the sector's modernization: (ii) increased income sources of small-scale farmers and fisherfolk generated through continual improvement in productivity and with cost efficient use of natural resources, diversification of farm-based livelihoods and value chain enhancements and closer integration vertically and horizontally through better and more empowered organizations, and opportunities for incomes and jobs to rural industrial development, non-rural jobs, and (iii) sustainable environmental sustainability. A gamut of public goods and services in the form of policy, infrastructure and institutional measures was laid out to accelerate the modernization of the AF sector (Table 10). One of the major public goods is research and development, which is inextricably linked with extension services.

Table 10. AFMA: Public good and services intervention modalities, value chains, and impact

Modalities of Public goods Interventions	Public good Activities	Transformational change	Value Chains	Impact
Production & marketing support services	SAFDZs, Credit, Irrigation, Info & marketing services, Other infra - R&D (e.g. farm labs, demo farms)	→	Resources/Inputs ↓ Farm/fishery/Livestock production ↓ Processing ↓ Marketing ↓ Distribution	Food security Increased incomes thru improved productivity and value chain ascendancy Environmental sustainability
Human resource development	Education & training			
R&D	**NaRDSAF Fund - multi-year, 1%GVA of AFF; Communication of Research Results; Research-Extension Linkage thru a NIN**			
Extension	Extension services: training, business advisories, demonstration services, information & communication services; NESAF Fund - 1% of GVA AFF			
Rural non-farm employment	Basic needs program Rural industrialization & industry dispersal program Training of workers			
Trade & fiscal incentives	Policy measures			

AFMA=Agriculture & Fisheries Modernization Act
SAFDZ = Strategic Agriculture and Fishery Development Zones
NaRDSAF = National Research and Development System in Agriculture and Fisheries
NIN = National Information Network
NESAF = National Extension System for Agriculture and Fisheries

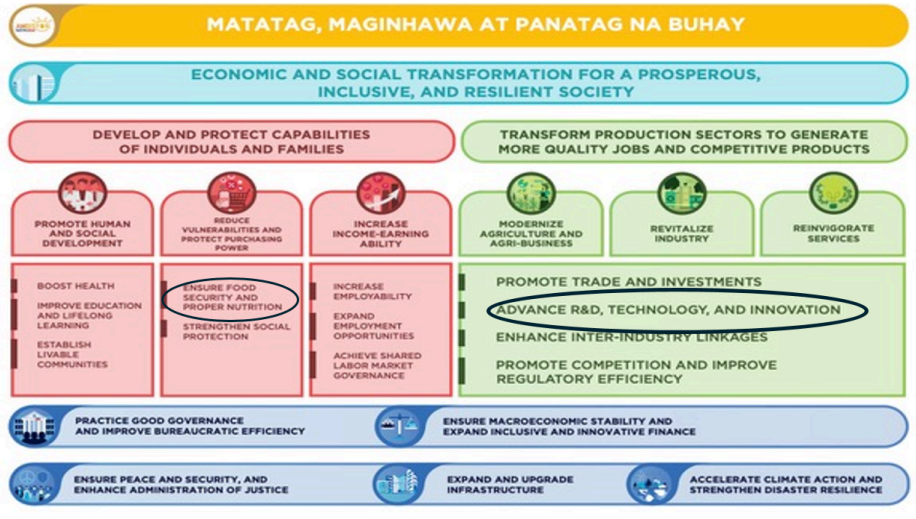
B. Philippine Development Plan 2023-2028: The Macro View of Agriculture Modernization

The recent assessment of AFMA showed that after a quarter of century of the law's implementation, the AF sector is not on track to its espoused modernization trajectory

(Briones, 2023). Achieving the AF sector's modernization pathway was made more challenging with the sector's vulnerability to global risks, such as to health-related pandemics such as the COVID-19, geopolitical conflicts, and most especially to climate-related hazards due to climate change.

Just recovering from the deleterious effects of the Covid-19 and factoring in climate change and the uncertain global geopolitical conflicts, the Philippine government in its Philippine Development Plan for 2023 to 2028 renewed its push for the economic and social transformation of the economy to achieve a prosperous, inclusive and sustainable societal development (Figure 18). A twofold strategy was forwarded: one is to transform the three production sectors (agriculture, industry, and services) so as to generate more quality jobs and competitive products; and the second is to develop and protect capabilities of individuals and families. Following the tenets of AFMA, modernizing agriculture and agribusiness was again the transformational push for the AF with a market-based approach premised on competition, efficient regulation, and promotion of trade and investments as the policy guideposts. One important difference with that of the AFMA is the stress on advancing research and development (R&D), technology and innovation. At the same time, on the strategic component of developing and protecting the capabilities of individuals and families, ensuring food security, an equally important impact objective of modernizing AF, was emphasized.

Figure 18. Strategic Framework of the Economic and the Social Transformation Components for achieving the Goal of a prosperous, inclusive and sustainable societal development



Source: Figure 1.1 PDP 2023-2028

Attaining food security in a transitional phase where A/F sector is slowly moving back on the track of its modernization pathway - is accorded prime significance in the PDP providing it with its own strategic framework in the PDP; more significantly, food security is linked with nutrition security (Figure 19). Note that the three mentioned outputs: (i) sufficient and stable supply of food commodities attained, (ii) access of consumers to affordable, safe, nutrition food expanded, and (iii) nutrition access for all ages – are potential areas for R&D in the modernizing pathway of the AF sector.

Figure 19. Strategy Framework to Ensure Food Security and Proper Nutrition

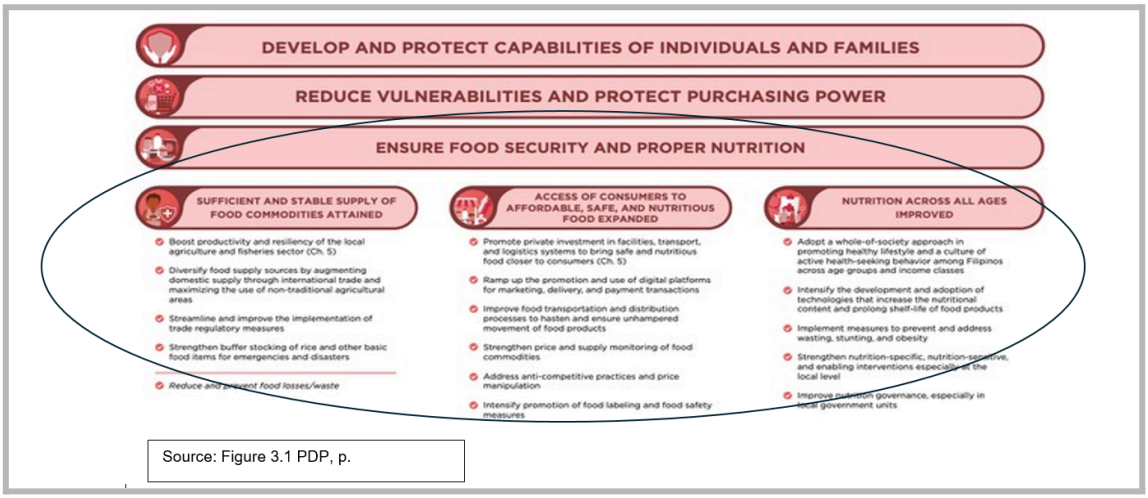
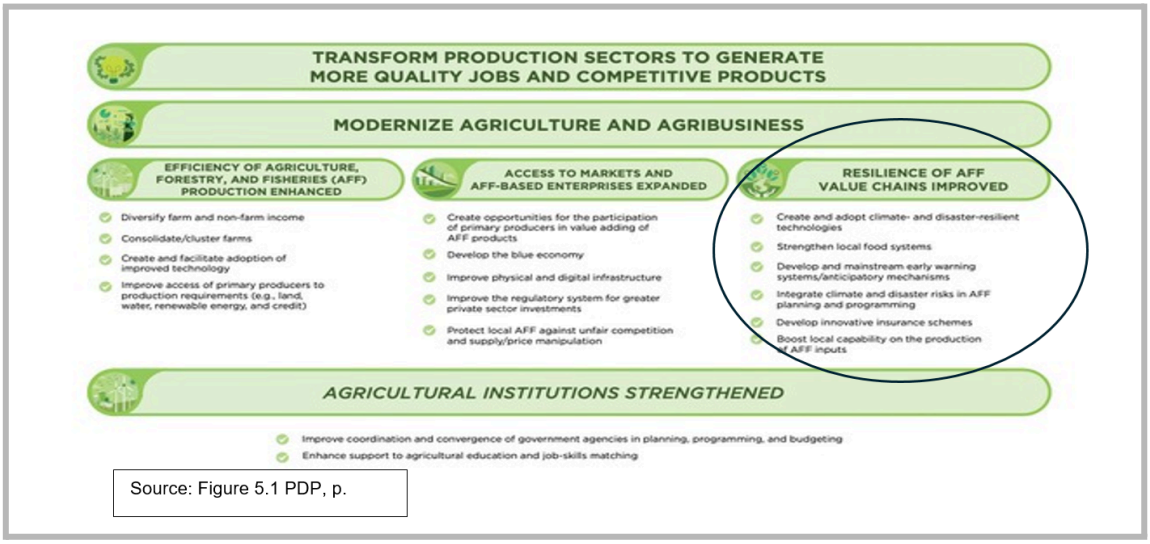


Figure 20 provides the strategic framework for modernizing the AF pathway with three outputs that provide areas for the R&D strategy. An important value addition in the PDP's view of the modernization of the AF sector is that in contrast to the AFMA, the PDP for agriculture modernization puts equal stress on the need to ensure resilience to value chain developments of the AF sector. Being proactive to climate change events is accorded prominence because of the Philippines' high exposure to climate shocks, the rural population's climate vulnerability, and the prominence of the agricultural sector in the national economy (refer to Chapter 2).

Figure 20. Strategic Framework for modernizing AFF to generate more quality jobs and competitive products.



AFF=Agriculture, Fisheries, and Forestry

C. The National Agricultural and Fisheries Modernization Industrialization Plan (NAFMIP) 2021-2030: The Sector-Wide Perspective

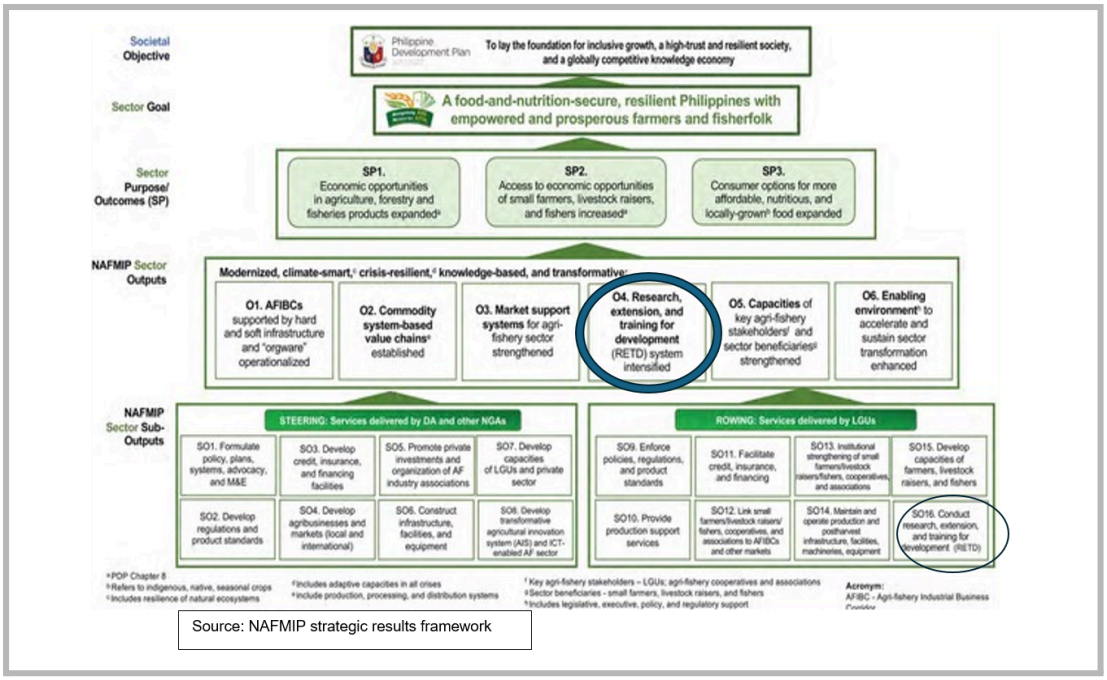
The NAFMIP for 2021-2030, a directional plan for the agricultural modernization pathway of the Department of Agriculture (DA), laid out in more detail the PDP's strategic framework for the AF modernization, the public goods and services that it will provide, and its steering role while the LGUs perform the rowing role. Enforced efficiently and effectively, the AF sector will contribute to the overall economy's goal of a prosperous, inclusive, and resilient Philippine society (Figure 21). Because of the sector's increasing vulnerability to climate-related hazards, it also redefined the modernization pathway as "modernized, climate-smart, climate resilient, and transformative."

Research, extension and training for development (RETD) is one of the 6 strategic public goods that the DA will provide and deliver in accelerating the AF sector's modernization pathway for a "food and nutrition secure, resilient Philippines with empowered and prosperous farmers and fisherfolk." The RETD output will incorporate a climate resilient perspective.

Note that while the DA has jurisdiction over the R4D component, much of the rowing responsibility through extension services or delivery of the R4D at the ground level is performed by the LGUs. This implies that robust, strong, and synergistic relationship

between the DA (mainly the Bureau of Agricultural Research (BAR), the office whose mandate is for the knowledge-creation, technology and innovation aspects of R4D), Local Government Units (LGUs), other key stakeholders and potential partners will need to be forged, fostered, and nurtured.

Figure 21. NAFMIP and the strategic framework for AF sector's modernization pathway



Source: NAFMIP strategic results framework

NAFMIP=National Agriculture and Fisheries Modernization and Industrialization Plan
AF=Agriculture andFisheries

D. Philippine Plan of Action for Nutrition (PPAN) 2023-2028: Nutrition Security

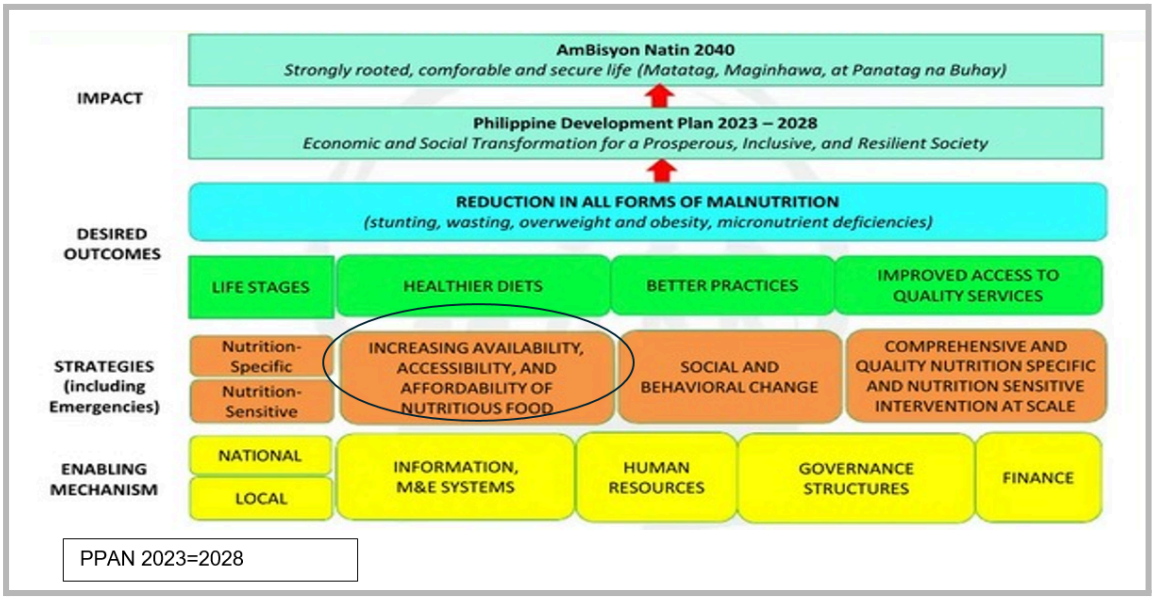
The strategic framework of PPAN for 2023-2028 shows the link between food and nutrition security, specifically in terms of achieving one of its three core strategies, which is "increasing the availability, accessibility, and affordability of nutrition food". Together with the other two strategies, it will achieve the desired outcome of partly, resulting to (i) a healthier diet, where Filipinos consume and demand for adequate, and appropriate, nutrient-dense, diverse, affordable, safe and sustainable food (e.g., fortified food), and partly (ii) a reduction in all forms of malnutrition.

The context of food and nutrition security is lodged at addressing head on the appalling food insecurity situation and the huge problems on undernutrition and overnutrition of the country. According to the PPAN food and nutrition situation is quite dire:

- 33.4% of the population was moderate or severely food insecure, and 2.0% were severely food insecure. One in 10 households were food insecure. BARMM had the highest food insecurity of more than 30%; second and third food insecure provinces were Eastern Visayas and SOCSARGEN, respectively.
- About a quarter of agricultural households are food insecure, compared to only 9 percent for non-agricultural households. As more agricultural households reported reduced incomes, they are more likely to resort to coping strategies to address food insecurity.
- Filipino households experienced involuntary hunger in the second quarter of 2023 (Metro Manila- 15.7%, Luzon outside of Metro Manila- 11.3%, Visayas – 9.3%, and Mindanao – 6.3%)
- Undernutrition indices include: (i) One in three children aged 5 years old and below suffer stunting (2019, NFRDI). For nearly 30 years, there have been almost no improvements in the prevalence of undernutrition in the Philippine; (ii) 19% were underweight for their age, and 6% of children below five years old were classified as "wasted," being underweight for their height; (iii) micronutrient deficiency: 38% among infants six to 11 months old; 26% among children 12–23 months; and 20% of pregnant women are anemic. Nearly 17% of children aged 6–59 months suffered from vitamin A deficiency (2018), of which children aged 12–24 months had the highest prevalence (22%) followed by children aged six to 12 months (18%). (World Bank, 2019). Micronutrient deficiencies also persist, with an estimated 70 to 80% of adults not meeting the recommended nutrient intakes for many vital micronutrients, including iron, calcium, and vitamin A.
- By region, the highest stunting was observed in BARMM (45.2%), followed by MIMAROPA (40.9%), then Bicol region (40.2%), and SOCSARGEN (40.0%).
- Poverty is linked to undernutrition: **42.4% of children from households in the poorest income quintile are stunted.**
- Considering consumption and diet quality, majority of Filipino households especially in the low income rung, are not consuming the recommended amounts of food, specifically for vegetables, fruit, eggs, and milk and milk product
- Overnutrition (e.g. overweight, obesity, and diet-related non-communicable diseases) estimates are that approximately one third of adults are overweight or obese.

The strategic framework of PPAN has a threefold strategy, one of which is inextricably linked to achieving food security: *"increasing availability, access, and affordability of nutritious food"* (Figure 22).

Figure 22. Strategic Framework of the Philippine Plan for Action on Nutrition, 2023-2028



E. Conclusion

This chapter puts the R4D for the AF sector in the context of the modernization pathway and strategy. The macro view, PDP for 2023-2028, highlights that the modernization pathway for the sector will be a " process of transforming agriculture and fisheries sectors from one that is resource-based into one that is dynamic, technologically advanced and competitive yet centered on human development, guided by the sound practices of sustainability and the principles of social justice" (AFMA). The more detailed but focused direction of the modernization transformational process is laid out in the NAFMIP. It stresses that the provision and delivery of the public goods outputs by the Department of Agriculture, such as the RETD, will contribute to a "modernized, climate smart, climate resilient, and transformative" trajectory. The PDP strategy at the macro level, the agriculture sector-specific component of the PDP plan bolstered by the NAFMIP puts the modernization pathway in a climate change lens. The PDP, NAFMIP, and PPAN all aim for food and nutrition security.

The next chapter discusses the climate resilient-themed R4D for the AF sector as an essential component of the modernization pathway. The modernization pathway is focused on contributing to the attainment of the food and nutrition security objective.

Chapter IV

CULTIVATING A SUSTAINABLE FUTURE: FRAMEWORK FOR AGRICULTURE MODERNIZATION AND CLIMATE-RESILIENT INNOVATION

Both the macro and sector-wide strategies for modernizing the Philippine AF sector underscored the imperative of a climate resilient AF sector pathway, while the PPAN highlighted the importance of R4D in AF to focus on both food and nutrition security.

The numerous scientific climate change-related projections, economic impact modeling and policy analyses as well as the Global climate risk and World Risk indices all indicated the Philippines' acute vulnerability to climate risks. These will need to be addressed head on. According to a World Bank report (2022), increasing intensity and frequency of extreme events will translate to huge economic damages that range from 3.2% to 7.6% by 2030; without aggressive climate actions, the costs could balloon to 13.6% of the country's GDP by 2040. FAO (2022) estimates that as much as 84% of the economic costs due to drought fall on the agriculture sector.[6] The World Bank (2022) noted however, that with adaptation measures, GDP relative to the no-adaptation case would sharply increase, and the adaptation measures would reduce the mean impact of damages in 2030 from 3.7 percent of GDP to 1.2 percent in response. Thus, for a nation that is perennially at the crossroads of climatic upheavals and weather-induced perils, a climate resilient pathway in modernizing agriculture and agribusiness is therefore not just strategic—it is existential.

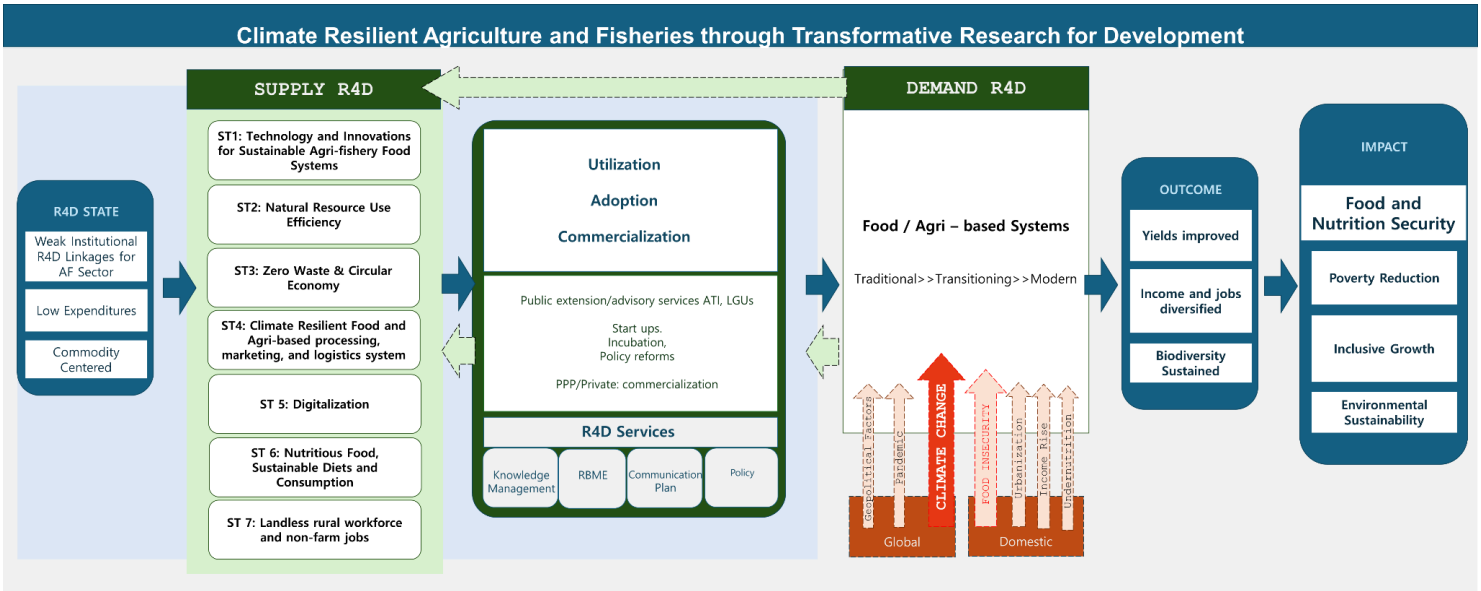
It is for this reason that the Bureau of Agriculture Research (BAR), the lead bureau of the DA that provides and delivers the pivotal public good – R4D for the AF sector – has taken a proactive stance. **Specifically, it will anchor its R&D agenda for the years 2024 to 2028 on science-based climate resilient technologies, practices, innovation, and enabling policies for the AF sector.** The climate resilient themed AF R4D agenda will address the increasing vulnerability of the AF sector to climate-induced hazards, while also being cognizant of the global uncertainties arising from geopolitical and health-induced concerns as these impact on the AF sector. The climate resilient AF R4D agenda aims at R4D projects that will enable the AF sector to adapt to the uncertain and continually variable “new normal” scenarios; provide the conditioners (such as early warning systems) for the AF sector to

[6] *This estimate is corroborated by the first quarter estimates of agriculture losses in the first quarter of 2024. The onslaught of the El Nino (hotter and drier conditions) has already cost Philippine agriculture a total of PhP5.9B in terms of crop damages, with the rice subsector taking the brunt of the drought effect (https://www.pna.gov.ph/articles/1223901), and close to a million families are already facing food insecure situations (https://reliefweb.int/report/philippines/dswd-dromic-report-60-effects-el-nino-11-may-2024-6pm).*

anticipate and be prepared for the increasing frequency and more intense climate variability situations; mitigate the AF sector's contribution to greenhouse gas emissions; and protect, conserve and nurture its natural capital and its terrestrial and water ecosystems. The focused climate resilient R4D agenda will contribute in transitioning the AF sector to a resilient, prosperous, and inclusive AF modernization trajectory. The aim of AF R4D with a climate lens is to ensure that both food and nutrition security is attained.

Figure 23 encapsulates the catalytic function of the climate resilient themed AF R4D agenda. Applying a supply of and demand framework for AF R4D as a starting point, the supply side focuses on BAR (mainly but note that there are other providers of R&D) and its provisioning role in delivering R4D projects for the AF sector.

Figure 23. Framework for Climate-Resilient R4D Agenda as Catalyst for Transformational Change



R4D=Research for Development

1. Demand side

BAR's climate-themed R4D programs, projects, and activities will respond to the perceived needs of its clients who represent the demand side with regard to their R4D requirements in tackling climate-related hazards. The actors comprise those engaged in the food and agri-based systems, including the input suppliers, farm, livestock and fishery producers, processors, logistics providers, wholesalers and retailers, food and agri-based users in the manufacturing and other industries, food and market outlets, traders, civic groups and agribusinesses, government agencies like DSWD and local governments, etc. These actors

comprise those who are engaged in the “dendritic” or the composite of intertwined or interconnected value chains in the food -and agri-based systems (Box 1). Their perceived needs for climate resilient R4D are in turn, influenced by the complex interplay of external and internal or domestic forces. Demand for climate resilient R4D drivers with increasing intensity and frequency of unpredictable climate-related hazards, cognizant of geo-political/pandemic factors, and international trade policies.) and internal forces. For food-based agri systems, demand for climate resilient R4D would need to take into account (i) rising incomes that would result to less share of food expenditures but preference for more diverse and higher quality foods; (ii) urbanization where urban residents would go for ready-to-eat, convenient and processed/long-shelfed foods; and (ii) degree of food insecurity and extent of undernutrition and overnutrition of the populace. Trade-offs for climate resilient R4D and R4D for unsustainably produced foods may emerge.

Global and Domestic Factors. The impact of climate change and demand for climate resilient R4D also depends on the modernization pathway of the agri-based and agrifood systems. Traditional supply chains would be most vulnerable to climate shocks as these have the least coping mechanisms and have limited financial and technical leverage to anticipate and prepare for climate hazards such as expenditures for climate resilient R4D. Low-income farmers, fisherfolk, livestock producers and landless rural workers with short supply chains comprise the major production side of traditional agri-based food systems. Transitioning or semi-commercialized supply chains would be less vulnerable, although disastrous climate-related perils can also warrant the demise of their business ventures. The modern supply chains are those that would have more resources to cope and quickly recover and would likely invest in climate resilient R4D. In the Philippines, the three modalities of agri-food/agri-based systems co-exist. Conceptually, climate related concerns by these complex food-and agri-based systems should be raised to the R4D and extension community; however, the reality is that communication and feedback platforms linking the providers of R4D and extension are weak. BAR may need to provide the platform or venues for these issues and concerns to be raised and addressed effectively and efficiently.

Box 1. Dendritic food and agri-based Systems

The demand side is lumped as dendritic agri- and food-based systems. Or a composite of intertwined and interconnected value chains. Each system (for example, rice value chain) comprises the core supply chain; this is the supply of the output (e.g., rice)- from "palay" farm production down to processing (milled rice), marketing, and consumption of different varieties and quality of rice. The second value chain of the system is the upstream "feeder" or the input supply chains, wherein each input has its own corresponding supply chain/s that also comprise a gamut of supply chains (e.g., fertilizers, fuel). Another "feeder" supply chain involves the logistics for transport of agri products (e.g., trucks, ships) to the processing and wholesale and retail markets and those transport required by the input supply chains. Reardon and Timmer (2007) classified the state of these supply chains as "traditional" (dominated by small-scale farm and fishery actors who barely make a profit (Schultz described them as "efficient but poor") and micro-small enterprises that do simple processing and marketing activities); "transitioning" or those that are semi-commercialized; and those that are "modernized" (described in AFMA as technology- and knowledge driven AF value chains. In the Philippines, a combination of these three modalities co-exist. The fourth "feeder" is the finance sector whether these are formal and informal types that provide financial needs for the various supply chains. The fifth "feeder" supply chain is a broad set of public assets such as infrastructure, police protection, and court systems for contract enforcement. The sixth set of "feeders" is the R&D supply chains which supply technology and product innovations. These include public institutions like BAR, other government-related institutions which also provide R&D, state colleges and universities, civil and private groups with R&D components.

Source: Reardon, et. al. 2023.

2. Supply side

AF R4D landscape. As a public good provider of climate resilient R4D, BAR is constrained (refer to Chapter 2) by: (i) the weak state of the AF R4D landscape, which is characterized by the numerous, fragmented, and uncoordinated public-run R&D institutions and centers, providing piecemeal and small-scale short-term R&D funding support; (ii) the focus of AF R4D on commodity production particularly on rice and not on an agri-based and agrifood system lens; (iii) the low investments for and skewed expenditure on rice for AF R4D, and (iv) the declining number of scientists and other professionals engaged in AF R4D. Moreover, there are international R4D organizations, the private sector and nongovernment organizations that perform R4D functions. These chokepoints constrain the ability and capacity of BAR to become an effective catalyst for transformational change in the AF sector.

3. Linking Supply and Demand

Delivery system to transfer, adopt, scale up, and scale-out, commercialize. For BAR to effectively deliver the potential positive outcomes and impact of the R4D, it needs a stronger link with the delivery mechanisms that transfer, ensure the adoption through scale-up and

scale-out approaches[7] , and provide feedback mechanisms on the R4D. Presently, the LGUs are the frontliners of extension services. BAR will thus need to address these constraints through more collaborative measures with co-providers of R4D and extension and provide a stronger advocacy voice for larger investments especially in climate resilient R4D for AF sector.

Worth noting is the array of R4D services that BAR can provide aside from the provision and delivery of the 7 sub-themed technologies, practices, and other innovations the following: policy, protocol and regulatory measures; knowledge management; results-based monitoring and evaluation system; and a communication plan.

4. Outcomes

A climate resilient R4D for the AF sector if adopted and up- and out-scaled will: (i) improve yields of crops, fishery and livestock farms; (ii) improve the efficiency in the use and allocation especially of natural based resources to; (iii) sustain biodiversity and environmental health; (iv) increase and diversify the supply of outputs and inputs of agri- and food-based systems; (v) mitigate the carbon emissions of agri- and food-based systems; (vi) increase incomes and diversify income sources; and (vii) generate more and better quality jobs.

5. Impact areas

The positive outcomes derived from climate resilient themed R4D and their adoption will impact the AF sector and the whole economy in two ways. First, R4D for the AF sector will contribute to the AF modernization pathway by developing agri- and food-based systems that are productive, profitable, climate resilient, and inclusive and environmentally sustainable. And second, this track of AF modernization will ultimately contribute to achieving the higher level of societal impact, which is achieving food and nutrition security especially among the vulnerable in society who will find it most challenging to cope and recover in highly volatile and uncertain changing climate, the situation of which is made more complicated by the rise of global geo-political conflicts, the potential emergence of other health related pandemic, and by local-specific effects of climate change as these impact differential domestic socio-economic-political landscapes. Achieving food and nutrition security is the priority objective espoused by the PDP Plan period (2023-2028) for the AF

[7] Scale-out is a horizontal spread of technology diffusion (e.g., adoption of the technology by various farmer groups, cooperatives, or associations) while scale-up is a vertical spread of adoption involving difference segments of the agri-based value system.

sector as it journeys the modernization pathway. In contributing to this societal impact, the climate resilient R4D for the AF sector will also aim at keeping food prices affordable and stable as high food prices fuel inflation, which will impact adversely the poor and the vulnerable segments of the population.[8] Achieving these inter-linked impact areas will ultimately result to reduction of poverty in all its forms and provide the basis for an inclusive and sustainable industrialization growth pathway of the Philippine economy.

A. The Climate Resilient R4D Strategy for the AF Sector

1. Straddling between incremental adaptation and transformative adaptation

The International Panel on Climate Change (IPCC) defines resilience as *"The capacity of social, economic and environmental systems to cope with a hazardous event, trend or disturbance, by responding or re-organizing in ways that maintain systems' essential function, identity, and structure while also maintaining the capacity for adaptation, learning and transformation.*" (IPCC, 2014).

Climate resilience of the AF sector means the capacity and capability of the rural communities, the natural systems integral to the operations of the AF sector (comprising the environment, biodiversity, and ecosystems), and the associated agri-and food-based systems to prepare for, respond to, withstand and recover from the adverse impacts of climate change. Resilience response comes at three levels or phases in managing climate risks. The first is a ***reactive response*** that is characterized as shock absorbing and coping mechanism. The second form is one of ***adaptation*** to hazardous events; and the third, is a ***proactive response*** wherein the concerted adoption of adaptation measures serves as the transforming impetus for change.

A key component in building and strengthening the climate resilience of the AF sector is to provide a suite of R4D interventions. These measures undergo the rigors of science and iterative evaluations of evidence. Moreover, socio-economic-political analysis are also often done to provide a good understanding of the local conditions where the climate risks occur. The proposed measures enable the rural communities, the environmental landscape and the agri-based and agrifood systems not just to cope but to manage climate risks[9] through

[8] The PDP plan pegs food and overall inflation within 2.0% to 4.0%. At these inflation rates, subsistence incidence can be reduced to 2.5 to 3.5 percent.
[9] Climate risk is a function of vulnerability and threat. In turn, vulnerability is determined by sensitivity, exposure and adaptive capacity of a the communities, natural resource systems, and the economic

(i) adaptation actions that prepare for and adjust to current and anticipated impacts of climate change in specific areas of concern, (ii) mitigation actions that reduce or prevent greenhouse gas emissions from human activities, and (iii) actions that combine the co-benefits of adaptation and mitigation. These proposed R4D interventions comprise of climate resilient technologies, innovations, and practices as well as the institutional and policy reforms, and infrastructure. They can initially be described as "incremental adaptation" remedies, which respond to a particular event or have a preventive effect. It is envisaged however, that an amalgamation of these climate resilient R4D measures when adopted in a concerted manner can serve as the impetus for a "transformational adaptation" platform or the building blocks for a prosperous, inclusive, environmentally sustainable and resilient modernization pathway of the AF sector. The multiplier effects of the societal gains obtained from the modernizing AF sector can contribute to achieving the nation-wide impact areas, specifically poverty reduction, food and nutrition sector, environmental sustainability, and social inclusion.

2. Climate Resilient R4D Sub-themes

For 2024 to 2028, BAR will focus on a climate resilient R4D strategy for the AF sector. Specifically, the strategy comprises seven sub-themes (ST); each sub-theme will have a suite of R4D action agenda (which are elaborated in the next chapter). The seven sub-themes for a climate resilient R4D for the AF sector are:

ST1: Technology and Innovations for sustainable agriculture, fisheries, and livestock
ST2: Natural Resource Use Efficiency
ST3: Zero waste, recycling, and circular economy
ST4: Climate resilient food- and agri-based processing, marketing, and logistics systems
ST5: Digitalization
ST6: Nutritious food, sustainable diets, and consumption
ST 7: Landless rural workforce and non-farm jobs

The selection of these sub-themes and the associated R4D actions were guided by the following principles, specifically that they:

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systems such as the agro-and food-based systems (https://www.c2es.org/wp-content/uploads/2019/04/what-is-climate-resilience.pdf).

- Deliver at least two outcomes (key outcomes are: boosting productivity, diversifying incomes and jobs, adapting to climate change, ensuring sustainable environment and biodiversity, and reducing greenhouse emissions);
- Shift away from merely the lens of productivity enhancement of specific crops, livestock fishery to a commodity systems perspective that take into account the entire agri-based and agrifood value chains. The value chained commodity systems discussed in NAFMIP will be taken into account: (i) rice-based, (ii) livestock and poultry, (iii) coconut-based, (iv) fishery-based, and (v) geographically specialized (e.g., the pili commodity system of the Bicol region);
- Are demand-driven R4D, meaning the forging of stronger and more strategic collaborations among stakeholders to identify in participatory manner the R4D needs;
- Rely on robust science-based data collection and parameters in identifying suitable commodity systems and implementing sustainable intensification;
- Preserve the ecosystems and biodiversity while improving agri-based and agrifood commodity systems;
- Call for a holistic and systems-based approach that recognizes not only (i) the interconnection on the health of humans, animals, plants and the environment in ensuring food and nutrition security, but also (ii) the synergies and trade-offs of multiple objectives like land consolidation & small-scale farming tenurial rights; and
- Take a multidisciplinary approach.

There are also action agenda that cuts across the sub-themes and will need to be taken into account when tackling action areas per sub-theme. These are:

- Policy measures (including protocols and regulatory measures such as intellectual property rights)
- Finance, and
- Gender inclusiveness and social empowerment

Each project will take into account these cross-cutting themes.

3. Sub-themes: challenges and opportunities, and multiple outcomes

Each sub-theme faces a complex set of challenges. Understanding these could serve as the ground for harnessing the opportunities through implementation of strategic action areas. Table 11 highlights these challenges and opportunities for transformative adaption measures

that can achieve a multiple number of outcomes benefitting the economy and society. Note that each sub-theme is not mutually exclusive; rather, each sub-theme is inextricably linked to each other. In turn, their inter-connectedness contributes to the attainment of multiple outcomes, which synergize and bolster the realization of (i) a prosperous, inclusive, and sustainably modernized agriculture and agri-industry pathway, and subsequently which (ii) paves the solid grounds for achieving the overall impacts of food and nutrition security, inclusive growth, environmental sustainability, and poverty reduction. Achieving these impacts provide the basis for a sustainable industrialization pathway for the country.

Table 11. Sub-themes, indicative R4D areas, and possible outcomes: 2024-2028

ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Balancing the need for increased food production with environmental protection	· Adopting innovative technologies and practices: integrating advanced technologies like precision agriculture, biotechnology, and digital platforms to enhance productivity and sustainability	· Genetic improvements for excellence in agronomy, including plant and animal breeding innovations · Sustainable intensification initiatives	· Helps keep food prices within the reach of every Filipino. - Enhances productivity and resiliency of the agriculture and fisheries sector
· Dealing with climate change impacts such as altered precipitation patterns, temperature changes, and extreme weather events	· Promoting sustainable consumption and production patterns: encouraging practices that minimize waste, reduce resource use, and lower the carbon footprint of food production	· Responses to crop, fishery and livestock diseases and alternative sustainable methods and practices of pest and disease control · Sustainable productivity of crops, livestock, fisheries	· Increased food production capacities with active environmental protection · Enhanced competitiveness of enterprises in domestic and international markets
· Minimizing waste and inefficiency throughout the food production and supply chain	· Investing in research and education: supporting research initiatives that develop new methods and technologies for sustainable agriculture and educating farmers and stakeholders on best practices	· Managing the plant microbiome · Research studies on the impacts of climate change on fish and fishery concerns & climate-smart solutions: (a) changes in migratory routes of fishery resources; (b) alterations of fish reproduction and stress responses; (c) Increased risks of speciation, low survival, and immobility; and (d) habitat disruptions.	. · Diversified food supply and income sources, strengthen buffer stocks mechanism for emergencies, optimize digital platforms for the marketing and delivery of food, and proactively monitor the supply and demand for key commodities for better-informed decision making
· Addressing social and economic inequalities within the sector, ensuring fair access to resources and opportunities	· Engaging stakeholders in collaborative decision-making processes: building partnerships among farmers, researchers, policymakers, and communities to co-create solutions that are locally relevant and sustainable	· Complex crop/farming systems research, multiple commodity-wide value chains (diversification), natural resource management & embracing technology (e.g. crop rotation, intercropping, organic farming) · Livestock management strategies · Fishery management strategies · Innovations in buffer stocking for emergencies and natural disaster preparedness	

ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
		· Agroecology research, managing whole systems and landscapes · Reducing or eliminating crop tillage · Promoting biodiversity · Development and utilization of renewable energy sources in agriculture (e.g., solar-powered irrigation systems). · Soil health improvement through regenerative agricultural practices. · Integrated pest management strategies. · Circular economy models in agriculture to reduce waste and enhance resource efficiency. · Utilization of big data and AI for precision farming. · Climate-resilient crop varieties and livestock breeds. · Enhancement of urban agriculture and vertical farming techniques. · Strengthening community-based fisheries management. · Improving supply chain transparency and traceability. · Promoting sustainable aquaculture practices. · Water conservation and management strategies. · Enhancing ecosystem services through agroforestry and silvopasture systems	

ST 2: Natural Resource Use Efficiency			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Competition for resources, such as land, water, and energy, lead to depletion of natural resources	· Ensuring positive food and nutrition security: by recognizing the interdependence and interconnectedness of land use, water resources, and energy production we can develop integrated approaches to manage these resources sustainably and efficiently, ensuring adequate food production and access to nutritious food for all	· Sustainable intensification by producing more through resource use efficiencies: better water, energy, and land management technologies and practices · Low-water use technology to mitigate the impact of weather phenomena on farmers	· Resource use efficiency enhanced · Sustained production influence sufficient supply of products and helps stable food prices · Improved sustainability and efficiency of land, water, and energy use in food production
· Environmental degradation resulting from unsustainable resource use and agricultural practices	· Promoting sustainable intensification: by producing more with less through improved resource use efficiencies, better management technologies, and practices, we can enhance productivity while minimizing environmental impacts	· Land, water, energy technologies and practices that increase production, lower production costs, while enhancing biodiversity services · Precision farming, fishing, livestock production · Development and utilization of import substitute inputs (fertilizers, etc.)	· Enhanced competitiveness and resilience of agricultural and food systems
· Climate change impacts including altered precipitation patterns, temperature changes, and extreme weather events, which affect food production and resource availability	· Investing in innovation and research: developing and implementing low-water use technologies, precision farming techniques, and circular economy models can increase production and reduce costs while enhancing biodiversity services and resource efficiency	· Economies of scale through land consolidation, clustering, AMIA, agribusiness industrial hubs	
	· Engaging stakeholders: collaborative decision-making processes involving farmers, researchers, policymakers, and communities can ensure that solutions are locally relevant and sustainable	· Modern basic needs clustering for food security and covers for agro-industrial sectors including coffee, cacao, coconut, fruits and nuts, tropical fibers, rubber and other high value crops, fishing, blue economy · Promotion of sectors that foster economic resilience such as energy efficiency, renewable energy, and goods that improve the quality of life while minimizing the use of resources and inputs	

ST 2: Natural Resource Use Efficiency			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
		· Investing in farmers' ability to promote soil health and thrive in the face of 21st-century challenges such as climate change · Enhancing ecosystem services through agroforestry and silvopasture systems · Plant and animal breeding innovations that require less use of resources but higher yields	

ST 3. Zero waste, recycling, and circular economy			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Lack of efficient recycling technologies to handle diverse waste streams	· Redesigning materials and products for circular use would also boost innovation across different sectors of the economy.	· Production of biobased fertilizers, pesticides, and nature based packaging materials for manufacturing industries; serve as import substitutes of inputs	· Economies of scale achieved with consolidated small-scale farm units
· Fear of losing recurrent customers due to changes in product design or business models	· Consumers will be provided with more durable and innovative products that will increase the quality of life and save them money in the long term.	· Import substitutes of local seeds, environmentally based propagating materials, tools, and machinery	· Production efficiency improved through farm clustering or consolidation, adoption of improved technology, and access to inputs
· Poor implementation of localized regulations that support recycling and circular economy practices	· Redefining products and services to design waste out while minimizing negative impacts, such as through long-lasting design, maintenance, repair, reuse, re-manufacturing, refurbishing, and recycling.	· Integration of waste-to-energy technologies · Expansion of community recycling programs	· Enhanced recycling rates and reduced waste generation
· Insufficient understanding of emerging business models focused on circular economy principles	· Promotion of circular business models by encouraging businesses to adopt practices that minimize waste and maximize resource use efficiency can create new economic opportunities and enhance sustainability.	· Development of infrastructure for large-scale - composting and bioenergy production	· Improved economic resilience and job creation in recycling and waste management sectors
· High investment costs for adopting circular economy practices and technologies		· Promotion of extended producer responsibility programs	· Greater consumer awareness and adoption of sustainable products and practices

ST 3. Zero waste, recycling, and circular economy			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
		· Implementation of product life-cycle assessments to reduce waste and improve recycling processes · Incentivizing circular business models and green investments · Use of microbial biotechnology for zero-waste, recycling and the circular economy Recirculating Aquaculture Systems	

ST 4: Climate resilient food- and agri-based processing, marketing, and logistics systems			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Large population and still growing: Population in 2023 is 117M (with growth rate of 1.7%[1]); 47% live in urban areas	· Peri-urban & urban farming has an edge over rural farming because of their proximity to large urban centers	· R4D on appropriate, affordable, & accessible green technology	· Building urban resilience thru food & nutrition security; reduced vulnerabilities and assured sufficient and stable supply of food primarily through improved productivity of agri-food systems, including storage, transport, and logistics
· Micro, small & medium enterprises (MSMEs) dominate post farm production: In 2021, there were a 1.08 M MSMEs of which 90% are micro & small; 50% of MSMEs were involved in wholesale & retail. In 2019, 43% of food services were street food vendors, kiosk, & small stalls)	· Economic competitiveness vis-a-vis conventional rural farming that can achieve higher yield with less unit of land & water use · Developing peri-urban & urban farming supported with shorter supply chain infrastructure & services that are affordable, suitable & competitive technology	· R4D local planning to incorporate green spaces & supply chain facility needs for agriculture production in peri-urban/urban centers (hydroponics, rooftop farming, ground level farming, greenhouses, community-supported agriculture & other novel farming & aquaculture systems	· Improved incomes and jobs for low-income in peri-urban areas · Food & nutrition secure for the low-income and vulnerable groups in increasing urban populaction
· About 30% of food waste like vegetables was due to poor logistics, resulting to 12%-17% wastage in rice for example[2]	· Development of green technology in peri-urban & urban AF by MSMEs (vertical farming, aquaponics, use of rainwater harvesting system	· R4D on institutional arrangements and practices that improve product quality and services of micro- and small enterprises that serve the AF sector, as more than 3/4 of food manufacturing & services relate to AF	

ST 4: Climate resilient food- and agri-based processing, marketing, and logistics systems			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Post farm impacted adversely by climate change & extreme weather events thus aggravating further the poor state of post farm logistics	· Marketing & logistics facilities for short supply chains	· Collaboration arrangements with private sector, local government units, state colleges & universities for organic agriculture	· Improved connectivity by linking markets to each other, connecting urban centers to rural areas
· Growing competition and scarcity of land, water and energy for food production leading to over exploitation of the wild fisheries that will affect our ability to produce food	· Inclusive business provide market opportunities to enterprises; provide above market-rate income opportunities and access to affordable essential goods and services for low income and marginalized groups; and help governments deliver affordable goods and services and lift people out of poverty at scale.	· R4D on inclusive agribusiness defined by efficiency, productivity, sustainability & resilience · Land policies for idle urban lands, food certification & safety policies	· Sustainable communities & cities
· Climate crisis that is changing weather patterns and increasing the chances of extreme events such as floods, and droughts	· Viable farm businesses build stronger local and regional communities and economies, encourage the broad use of sustainable and ecological production practices, facilitate equitable food access, and increase wealth for socially disadvantaged populations. All of these effects drive increased food-system resilience.	· Improving the “last mile” of R4D technology delivery; i.e., final stages of the process of getting new technologies, innovations, or research findings into the hands of end-users · R4D on improving the interconnectedness of multimodal transport and logistics, particularly for perishable products	· Increased income and livelihood opportunities for smallholder farmers and other stakeholders
· Disruptions in the food chain due to various factors, including climate change, economic instability, and pandemics		· Research and advisory services/technical capacity upgrading that will improve capacity of primary producers to process raw materials, understand markets, and ensure that food safety and quality standards are met · Use of mobile platforms and channels that encourage marketing, payment, insurance, and product delivery; optimizing digital platforms for the marketing and delivery of food · Development of cold chain logistics to maintain the quality and safety of perishable goods	

ST 4: Climate resilient food- and agri-based processing, marketing, and logistics systems			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
		· Enhancement of public-private partnerships to improve infrastructure and logistics services · Research on innovative packaging solutions to extend shelf life and reduce waste · Strengthening of regional and local food hubs to facilitate aggregation, distribution, and marketing of locally produced food · Mobile financing	

ST 5. Digitalization			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Social isolation and decreased interpersonal skills as some of the consequences of excessive use of digital technology	· If brought to scale, digital technologies could reduce emissions by 20% by 2050 in the three hard-to-abate sectors: energy, materials, and mobility. These industries can already reduce emissions by 4-10% by 2030 by accelerating the adoption of digital technologies.	· Ensuring availability of subnational, ethnicity-disaggregated nutrition and nutrition-related data for targeted policy advice and interventions	· Improved resource management · Data-driven planning and decision-making:
· Financial constraints, inadequate personnel in the projects, poor handling of original documents, and material and inadequate resources and infrastructure for digitization	· Digitalization of all business including farming operations can lead to increased productivity, more efficient resource management, & encourages knowledge sharing and collaboration across departments.	· Providing farmers with digital solutions for real-time data they need to make smart, data-driven choices. Use of precision agriculture	
· Digital divide between urban and rural areas, limiting access to technology for smallholder farmers	Improved data analytics for better decision-making and policy development.	· Use of affordable drones and sensors for keeping an eye on crops and finding diseases early, which lets farmers target their efforts and lower production losses.	
· Data privacy and security concerns with the increased use of digital tools	· Digital platforms can enhance access to information and education for farmers and stakeholders, empowering them with the	· Blockchain technology makes it possible to track crops, which improves food safety and quality control and helps farmers adjust to changing weather conditions	

ST 5. Digitalization			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
	knowledge and tools needed to improve their practices and adapt to changing conditions.		
· Lack of digital literacy among farmers and stakeholders	· Digital technologies facilitate the adoption of precision agriculture and smart farming techniques, optimizing inputs and increasing yields.	· Coordinated, inclusive and technology-enabled emergency preparedness, science-based anticipatory action, response, and social protection that are responsive to extreme natural- and human-induced disasters.	
· Resistance to change and adoption of new technologies	· Development of digital platforms that provide real-time market and weather information, help farmers make informed decisions and reduce risks. · Digital tools enable remote monitoring and management of agricultural activities, increasing efficiency and reducing labor costs. · Digital technology is also very important for rural development as it helps rural communities get training, education, and knowledge, which makes their lives better.	· Improving DRR management practices through capacitating public institutions to develop specific and anticipatory work plans, including one-health approach. · Digital systems that better analyze climate, temperature, rainfall, zoonotic and other risk data · Establish warning mechanism for early actions; and putting in place inclusive and risk-informed SRSP systems (e.g., risk insurance and digital financing). · Creating a portal of climate smart technology and market intelligence to provide informed knowledge of needs of actors in the food and agri-based sectors for R&D · Supporting the conduct of primary data collection that can capture relevant market data, such as customer needs and preferences, competitors, customer demographics, market trends, market price, and potential marketing processes. These can be used to guide or inform the R&D process and aid in the generation of technology and innovation.	

ST 5. Digitalization			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
		Early warning systems and other climate information services like climate resilient vulnerability assessments · Proactively monitoring of supply and demand of key commodities through the integration of various digital technologies, such as remote sensing, Internet of Things (IoT) devices, and advanced data analytics. · Enhanced marketing and delivery of food through online platforms, mobile applications, and data-driven supply chain management. · Enhanced digital financing and insurance mechanisms for farmers by leveraging data from precision farming technologies, remote sensing, and digital records.	

ST 6: Nutritious food, sustainable diets, and consumption			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Food insecurity, lack of education about nutrition, and high costs of healthy food options contributing to inadequate nutrition and health disparities among different population segments.	· Invest in local food systems · Instituting supportive policies: Encouraging investments in growing, processing, marketing, and consuming nutritious and safe foods.	· Food data central database: what we eat and nutrient content · Traceability systems for food safety · Improved production and enhanced consumption of legumes, pulses, millet, sorghum and its processed products	· Increased availability, affordability and accessibility of healthy & safe foods · Reduced incidence of diet-related diseases · Improved public health outcomes
· High stunting & wasting due to undernutrition; rising malnutrition · High availability of low-cost ultra-processed foods and beverages; Very powerful food marketing	· Food fortification and supplementation programs: Address nutrient deficiencies and improve public health. · Developing traceability systems: Ensure food safety and quality throughout the supply chain.	Food supplements, food fortified products Food heritage products · RDE on indigenous species and varieties of plants and breeds of animals that promote traditional food Policies to encourage investments in growing, processing, marketing (domestic and international), and consuming nutritious and safe local dishes.	- Improved environmental health

ST 6: Nutritious food, sustainable diets, and consumption			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Nutritious foods are inaccessible for certain segments of the population: Lead to health disparities and increased incidence of diet-related diseases. · Increasing incidence of diet-related diseases: obesity, diabetes, and heart disease Nutritional information that is difficult to understand and apply.	· Leveraging digital technologies: Improve access to nutrition information and healthy food options. · Increasing consumer awareness: About healthy eating through targeted education campaigns. · Development and use of foods from plant and animal breeding innovations that cater to specific consumer needs and preferences.	· Community-based nutrition education programs; promote urban agriculture initiatives · School feeding programs with nutrient-dense foods · PPPs for healthy food options · ICT for responsible food production and consumption · Inclusive distribution of nutritious food · Use of plant and animal breeding innovations for more healthy food-based traits	

ST 7: Landless rural workforce and non-farm jobs			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· While the GDP share of agriculture is down to single digit, workforce share of the sector is high at 23% · According to the PCIC's Automated Business System RSBSA, there were 10.9 M farmers & fisherfolk of whom 51% were farmers, 13% are fishermen, and 38% are landless rural workers.	· Shift from monocrop (non-resilient approach) to diversified farming-fish-livestock & organic farming (resilient approach) · Opportunity for rural industrialization & industry dispersal: start up in peri-urban areas; encouraging investments in rural infrastructure and services: Developing rural infrastructure can create jobs and improve living standards	· Diversified farming in highly vulnerable & poverty-stricken areas & job creation · Rural industrial convergence in peri-urban areas · Upgrading skills & on the job training as capacity building service of local governments ·Rural employment schemes and social protection programs	· Creation of more and better-quality jobs, reducing unemployment rates. · Diversified rural incomes, improved income levels, working conditions, and overall well-being of landless rural workers

ST 7: Landless rural workforce and non-farm jobs			
Challenges	**Opportunities**	**Potential R4D Areas**	**Outcomes**
· Landless rural workers migrate to cities for jobs; they end up mostly in low-skilled and low paying jobs largely in the informal sector. Urbanization rate in 2022 was 48%; projected to up to 57% by 250. They are most hit without pay when extreme weather strikes.	· Rural industrial convergence in peri-urban areas · Proving better education facilities for their children: Ensuring access to quality education for their children can break the cycle of poverty.	· Promotion of cooperative and collective farming models · Creation of community-based enterprises and agro-processing units · Access to education and vocational training	· Reduced poverty levels and increased food security in rural areas
· Farmers are also getting old averaging at 57 years but parents don't want kids to do farming	· Empowering workers through skills upgrading and on-the-job training programs: Enhancing skills can lead to better job opportunities and career advancement	· Support microfinance initiatives and access to credit for entrepreneurial start ups · PPP for inclusive peri-urban development	· Enhanced skills and career advancement opportunities for workers for better better job opportunities.
· Many are unable to afford or access their own land for farming. This lack of access to land hinders their ability to improve their livelihoods and escape poverty.	· Facilitating access to microfinance and credit facilities: Providing financial support can help landless workers start their own ventures or invest in productive activities		· Build urban resilience
· Limited opportunities for skills development and career advancement.			

Chapter V

CLIMATE RESILIENT AGRICULTURE AND FISHERIES THROUGH TRANSFORMATIVE RESEARCH FOR DEVELOPMENT (CRAFT R4D): 2024-2028

This chapter elaborates on the Climate Resilient Agriculture and Fisheries through transformative research for development (herein referred to as CRAFT R4D) from 2024 to 2028. It starts off with the statement of the envisaged impact and the expected outcomes. The strategic framework applied by CRAFT R4D provides an overview of CRAFT R4D's action agenda for the immediate- (2024), short- (2025), and medium-term (2026-2028). The discussion of the agenda is based on the seven sub-theme classification of the climate themed R4D for the AF sector. The chapter ends with a reiteration of the imperative for a CRAFT R4D.

A. Impact

The CRAFT R4D agenda for action envisions to contribute to the modernization of the AF sector. The primary impact of this action agenda is a climate-resilient AF sector that ensures **food security and nutrition** by minimizing the effects of climate change on the productivity and income of farmers and fishers while maintaining the long-term sustainability of the AF resource base with increased R4DE budget/funding. Ensuring a stable and diversified supply of nutritious food is targeted particularly for the vulnerable populations.

The implementation of CRAFT R4D is expected to yield significant positive multiplier impacts across various aspects of the Philippine agriculture and fisheries sectors. Improving agricultural yields and diversifying incomes and job opportunities will elevate the economic status of farmers and fisherfolk, leading to substantial poverty reduction. Enhanced productivity and profitability will drive economic growth and uplift rural communities. The action agenda provides opportunities for marginalized groups, including landless rural workers, women, and youth, granting them access to resources, training, and market opportunities, promoting social equity, and bridging social inequalities. Sustainable farming practices will conserve natural resources, reduce degradation, and preserve biodiversity, ensuring the long-term sustainability of agricultural landscapes.

B. Expected Outcomes

The CRAFT R4D action agenda focuses on achieving the following key outcomes: improving agriculture and fisheries yields, diversifying incomes and jobs, and sustaining biodiversity.

The adoption of climate-resilient technologies and practices is expected to enhance the productivity of crops, livestock, and fisheries. The action agenda aims to create diverse income opportunities and quality jobs for farmers and fisherfolk, supporting agribusiness development and fostering entrepreneurship, leading to higher incomes and better employment prospects at on-farm, off-farm, and non-farm levels. It will also facilitate the traditional food supply chains to move up the value chain ladder. The implementation of sustainable agricultural practices will help conserve and enhance biodiversity by protecting natural ecosystems, promoting agroecological approaches, and encouraging the responsible use of natural resources.

C. Strategic Framework and the Priority Climate Resilient Sub-Themes

Overall, CRAFT R4D takes a programmatic approach to incorporating climate resilient pathway of the AF sector. It focuses on three main areas of reform: (1) Enhancing Resilience to Climate Impacts: This area aims to develop and disseminate climate-resilient technologies, practices, facilities, infrastructure, policies, and protocols that enhance the transformative adaptive capacities of the agriculture and fisheries sector and its stakeholders. The focus is on poor men and women farmers, fisherfolk, livestock producers, landless rural workers, and small and micro-enterprises directly involved in the agri-based and agri-food systems. (2) Strengthening Institutional Linkages for Climate Action: This area aims to enhance coordination among R4D partners and funding mechanisms to support the wide-scale transfer, replication, adoption, commercialization, and sustained development of climate-smart technologies and practices. These technologies and practices are science-based, tailor-fit to local conditions, and are environmentally sound. (3) Bolstering Agri-Food Value Chains: This area promotes forward and backward linkages and develops midstream and downstream nodes of agri-based and agri-food systems. The goal is to establish robust private-run systems capable of effectively managing and directing resources towards climate resilience. This includes promoting nature-based solutions, improving agricultural practices, and building resilient infrastructure to safeguard against climate-related disasters through novel and digitalized approaches.

From 2024 to 2028, DA-BAR will prioritize a climate-resilient R4D strategy for the AF sector adopting a systems-based (value chain) perspective and ensuring sustainable environment and biodiversity. The suite of R4D projects is organized into 7 sub-themes (ST): ST1-Technology and innovation for sustainable agriculture, fisheries, and livestock; ST2-Nature resource use efficiency; ST3- Zero waste, recycling and circular economy; ST4- Climate

resilient agri-based and agrifood processing, marketing, and logistics systems; ST5- Digitalization; ST6- Nutritious food, sustainable diets, and consumption; and ST7- Landless rural workers and off-farm and non-farm jobs.

The discussion of R4D projects by sub-themes is by time frames: (i) Immediate-Term (2024), (ii) Short-Term (2025-2026), and (iii) Medium-Term (2026-2028). The R4D projects for 2024 and 2025 are firm, meaning that these have allotted or earmarked funding, while those for 2026 to 2028 are listed as indicative project areas and will be evaluated and assessed by beginning the second quarter of 2024; the early planning of R4D projects is to ensure a suite of R4D projects within a 2-year rolling time for financial management purposes.

Type of climate resilient R4D projects. The R4D projects will include climate resilient/climate smart technologies, practices, and innovations (for creation and development, land and water saving, and renewable energy for incubation, replication, out-scaling, up-scaling, commercialization); digitalization systems and applications; development of protocols, standardized or harmonized regulations for accessible safe and nutritious food; analytical multidisciplinary researches for expanding climate resilient R4D financing; climate resilient inducing policies; upgrade/rehabilitation of climate resilient technology and facilities for production at farm and inputs levels, processing, marketing and logistics; and climate-proofed market and logistics linkaging infrastructure.

The succeeding sections discuss the climate resilient R4D projects by time frames.

D. Immediate-Term R4D Agenda: 2024

For 2024, the following climate resilient projects have been identified, selected, and provided with firm funding from DA-BAR's R4D resources. There are 39 climate resilient R4D projects that are being implemented on first quarter of 2024. The total amount budgeted for these projects is PhP 226M; a brief description of these R4D projects is shown in Table 12. .

About 97% of these projects are adaptation measures, the remaining 3% is for adaptation plus mitigation purposes (Figure 24). By sub-themes, the largest share of projects fall under ST1, which comprise 36% or 14 projects (Figure 25) with PhP 106.6M funding support. Next is ST7 getting 36% of the total with 9 projects and provided with PHP 46M. This is followed by ST5 with 18% (7 projects) with Php 34.5M budgetary requirement. Both ST2 and ST3 have 4 projects (10%) each, getting PhP 22.9M and PhP 11M, respectively.

Figure 24 . Percent distribution of R4D projects by climate resilient measure (2024)

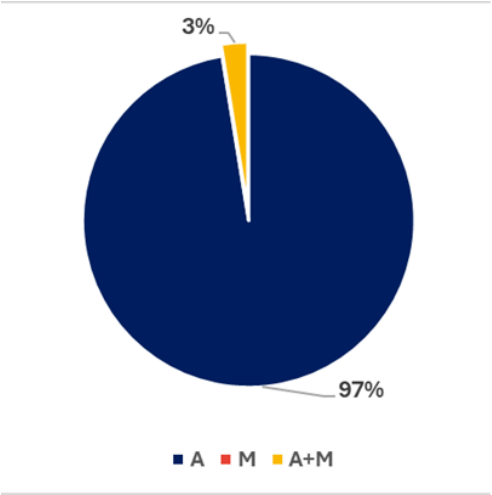
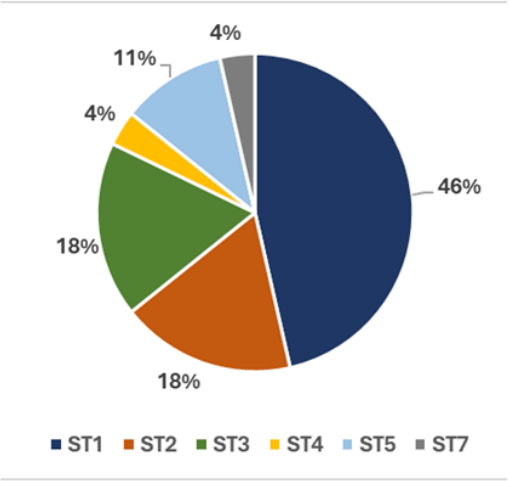


Figure 25. Percent distribution of R4D projects by 7 sub-themes (2024)



R4D=Research for Development

The distribution of projects relatively covers all the sub-themes with the exception of ST6 which is a potential researchable area in the succeeding time frames. It is worth noting that some R4D projects can cut across or also contribute to other sub themes. For instance, one of the funded research projects is on field validation of the Mobile Photovoltaic Irrigation System (MPIS) for technology commercialization which is mainly classified under ST1 but is also contributory to ST5 as a digitalization initiative.

Majority of the projects for 2024 under ST1 and ST2 are focused on field validation, upscaling, or outscaling of already generated technologies that are deemed to have potential for adoption and commercialization. Among these are the validation of balanced fertilization strategies for rice and mango, scaling out of integrated pest management (IPM) for Fall Army worm in infested corn areas, validation of biopesticides to manage arabica coffee, and crop diversification and mechanization. Additionally, genetic studies are ongoing focused on rice, cassava, and water buffalo for improved productivity and mitigation of risks from pests and disease infestation. All of these are toward sustaining the productivity the of the AF sector driven by efficient utilization of natural resources.

Three projects are dedicated towards development and production of biofertilizers which are potential import substitutes and can aid in reducing costs of production. Meanwhile, majority of the digitalization initiatives are focused on Site Specific Nutrient Management (SSNM) Nutrient Expert as a means for improving productivity and profitability. Lastly, outscaling

efforts of off-season technologies, hybrid rice technologies and integrated farming systems (crop-livestock) are conducted in numerous provinces across different regions in the country aiming to diversify production. Successful project results from the immediate term through up and out scaling will have massive potential for farmers, fisherfolk, and livestock producers to benefit from such technologies, innovations, and climate resilient practices in the long run.

Table 12. Climate Resilient Agriculture and Fisheries R4D funded in CY 2024

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries *(of technology demonstrations)*	Local Partner	Fund (PHPM)
ST 1: Technology and Innovation for Sustainable Agriculture, fisheries, and livestock							
1	Field Validation of the Mobile Photovoltaic Irrigation System (MPIS) towards Sustained Technology Commercialization	This project will develop a solar-powered farm tractor for that can be used for hauling, irrigation, pond aerator, and even for post-harvest operation such as paddy-mixer during drying. Another component of the project is the development of a solar-powered hose-reel irrigation system for higher irrigation efficiency. Also, an agrivoltaic system shall be established to optimize land use utilization.	A+M	Ensuring reliable supply of water using solar power	10	Central Luzon State University	4.0
2	OneRicePH: Accelerating Genetic Gain for Improved Productivity and Nutrition for Priority Market Segments (2024)	Targeted breeding/R&D innovations	A	Philippine cultivars improved with genes for priority insect and disease resistance and abiotic stress tolerance		DA PhilRice, UPLB	55.7
3	Technology Validation of Various Balanced Fertilization Strategies for Hybrid Rice Production in Clustered Lowland Irrigated Areas in Zamboanga Del Sur Towards Scaling	This project aims to scale up balanced fertilization strategies for high-yield hybrid rice varieties in clustered irrigated areas to significantly increase rice production in selected regional clustered irrigated areas in Zamboanga del Sur to significantly increase and promote sustainable rice production, improving farmer's livelihoods, and ensure transfer of knowledge and practices to enhance agricultural outcomes.	A	Mechanization and precision farming, pest management, and efficient water management to reduce the environmental impact of rice cultivation (e.g. soil health, water quality, and greenhouse gas emissions)		DA RFO 9	5.0

4	Enhancing the Dry Direct Seeding Package of Technology for Increased Rice Production in Central Luzon	To be implemented under Dry Direct Seeded Rice System will include; Utilizing PhilRice PRISM, GIS and other related soft wares and hard wares to develop database and mapping DDSRS project from soil nutrient, water availability, crop yield, suitable variety, practices and other relevant data that will become basis of future planning and possible policy recommendations other proven technologies to be implemented are aerobic rice production system (ARPS), modified direct seeding (MDS), utilization of mechanical seeder for crop establishment zero and minimum tillage, and drought tolerant varieties.	A	Climate -risk maps and adaptation plans, cost effective systems application of small-scale irrigation for efficient and sustainable soil and water management		BPSU	7.0
5	Upscaling the Production and Utilization of Zinc Solubilizing Inoculant for Corn	Validate and upscale the production of Maizinc and K-SolB in response to the rapidly increasing demand for zinc fertilization	A	Improved production protocol to address biotic and abiotic stresses for corn	6	UPLB	2.2
6	Scaling-Out of the Developed IPM for Fall Armyworm, (Spodoptera frugiperda, JE Smith) in Frequently Infested Corn Areas in Region 2	The technology promotes early detection and timely management application along with cultural practices.The utilization of available bio control agents and the right timing of insecticide application to reduce FAW incidence and damage. Furthermore, the developed IPM reduces the risk of resistance development of FAW to certain insecticides.	A	Pest Management protocols addressing abiotic stresses of corn	100	DA RFO 2	4.2
7	Evaluation of Cassava Genetic Resources in the Philippines Against Major Cassava Diseases	A sustainable cassava seed system in the Philippines through rapid propagation, dissemination, and development of disease-free and quality planting materials	A	Decision support tool for nutrient management	-	UPLB	5.2
8	Integrated Pests Management for Cassava (IPM Cassava): An Inclusive Management Approach for Cassava Witches' Broom Disease (CWD) and Red Spider Mites (RSM) Through Soil Health, Cultural and Biological Strategies	Package of Technology (POT) for cassava is a consolidated protocols/strategies of field validated management systems including cultural and biological approaches for pests and diseases, recommended soil nutrients and varietal response. POT also utilizes the monitoring and prediction models as a proactive approach to the pests and diseases in cassava. This technology	A	Pest Management protocols addressing abiotic stresses of cassava	50	UPLB	4.5

		is a tangible technical support system (IEC materials, seminars, training-workshop, field demo, etc.) that are accessible to cassava growers for the sustainability of pests and disease management in cassava.					
9	Development of Quick Response Strategies to Mitigate Small Hive Beetles (SHB) and Other Bee Pests and Diseases	evaluate and mitigate the damage caused by bee pests and diseases nationwide	A	Quick response protocols to address bee pests and diseases brought about by climate change	100	UPLB	3.8
10	Outscaling of Balanced Fertilization and Pesticide Use Plus Rejuvenation Technology to Enhance Productivity of Mango in Cagayan Valley	Improved production protocol to address biotic and abiotic stresses for mango	A	Improved production protocol to address biotic and abiotic stresses for mango	20	DA RFO 2	2.0
11	Enhancing the Adoption of Off-season Onion Production in Nueva Vizcaya, Cagayan and Quirino Province	Ensuring sustainable availability of onion using off season production technology	A	Ensuring sustainable availability of onion using off season production technology	20	DA RFO 2	3.0
12	Integrated Approaches Toward Sustainable Management of Banana 'Bugtok' Disease in Luzon	Disease management addressing biotic stresses	A	Disease management addressing biotic stresses	20	UPLB	4.5
13	Integrated Disease Management of Onion Using Biological Control Agent (BCA)-Infused Foliar Spray and Mulch in Nueva Ecija	Biological control agent-induced foliar spray for disease management addressing biotic stresses for onion	A	Biological control agent-induced foliar spray for disease management addressing biotic stresses for onion	20	CLSU	2.6
14	Validation of White Muscardine, Beauveria Bassiana, and Beneficial Soil Nematodes as Entomopathogenic - Based Biopesticides to Manage Arabica Coffee Berry Borer, Hypothenemus Hampei	Disease management addressing biotic stresses	A	Disease management addressing biotic stresses	20	BSU	2.9

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries	Local Partner	Fund (PhPM)
ST 2: Natural Resource Use Efficiency							
15	Rice-Based Crop Diversification and Mechanization for Improved Productivity and Efficiency	Cropping calendar and mapping of diversified rice-based cropping systems with best management practices and mechanization option (seeding, fertilizer application, weeder) for rice, corn, mungbean, soybean and other priority crops	A	Using crop diversification approach to buffer the damages that can be brought about by climate hazards		DA PhilRice, UPLB	8.2
16	Development of Integrated Management Strategies for Sustained Garlic Productivity in Ilocos Norte		A	Improved production protocol to address biotic and abiotic stresses for garlic	20	MMSU	3.0
17	Development of Waterlogging Tolerant Population of Tomato: Upscale Evaluation of Waterlogging Tolerant Tomato Varieties, Breeding Lines and Accessions Towards Variety Release and Recommendation for Flood-prone Areas	Improved production protocol to address biotic stresses for tomato	A	Improved production protocol to address biotic stresses for tomato	20	UPLB	3.5
18	Development of a Climate-Smart Water Buffalo Production System: Identification of Heat Stress Indicators and Genetic Screening for Thermotolerance	Production system that will contribute to adaptation to increasing temperature	A	Production system that will contribute to adaptation to increasing temperature	10	DA - Philippine Carabao Center	8.2

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries	Local Partner	Fund (PhPM)
ST 3: Zero waste, recycling, and circular economy							
19	Utilization of Processed Cassava Leaves as Alternative Protein Source for Animal Nutrition	Cassava leaf powder is an ingredient for poultry feeds that is intended as a substitute to costly protein sources such as soybean meal. Processing technology/protocol for production of cassava leaf powder for poultry feeds will be established. In addition, feed formulation of poultry feeds with cassava leaf powder as a protein source will also be optimized.	A	production and utilization of climate resilient, alternative and locally available feed source	32	UPLB	2.5
20	Development of Microencapsulated Microbial Inoculant Formulation for Improved Biofertilizer Technology	Microencapsulated microbial inoculant formulations for improved biofertilizer technologies containing suitable biocompatible microbial formulations in solid, liquid, or granular form using inert materials that are cost-effective and easy to use for increased utilization and acceptability.	A	Adaptation to the emergence of insect pests and diseases brought about by climate change	3	UPLB BIOTECH	3.4
21	Upscaling the Production of NVSU-Developed Bio-Organic Fertilizer	Fortified with effective microorganisms, the product will enhance the nutrient availability for crops, help improve soil fertility, and enhance crop yield. EM consists of a symbiotic mixture of naturally occurring microbes found in healthy soils. The EM products contain a combination of lactic acid bacteria, yeasts, phototrophic bacteria, actinomycetes, and N-fixing bacteria (Boraste et al., 2009). They help inhibit the growth of harmful pathogens by soil pH regulation, decomposing organic matter, producing bioactive substances, and converting harmful ammonia and hydrogen sulfide into odorless gases (Singh, 2007). The bio-organic fertilizer production process would adhere to the organic principles prescribed by the Philippine National Standard (PNS) of the Bureau of Agriculture and Fisheries Standards (BAFS).	A	Adaptation to the emergence of insect pests and diseases brought about by climate change	20	NVSU	2.5

22	Harnessing Rhizobacteria and Actinomycete's Potential as Biofertilizer and Biocontrol Inputs Supportive of Strengthening the Organic Agriculture Industry (HaRBIS – Organic)	Harness potential rhizobacteria and important actinomycetes as biofertilizer and biocontrol input for organic farming.	A	Adaptation to the emergence of insect pests and diseases brought about by climate change	5	USM	2.6

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries	Local Partner	Fund (PhPM)
ST 4: Climate resilient food- and agri-based processing, marketing, and logistics systems							
23	Market Assessment and Field Validation of Rice Wash-Based Probiotics in Region 02	The incorporation of rice-washed probiotics into the diets of small ruminants has the potential to yield immediate advantages, including better gut health and microbial diversity, which can promote nutrient absorption and general health. These advancements will result in immediate benefits including strengthened immunity, less digestive issues, and greater weight gain. Eventually, these benefits will help small ruminant farmers become more productive and spend less on veterinary care. Additionally, using these probiotics increases the survivability of young and susceptible animals, which strengthens the resilience of theherd as a whole. The adoption of rice wash-based probiotics has the potential to have a significant impact on small ruminant farming systems, fostering greater sustainability and livelihood security and livelihood security for farmers by increasing productivity, lowering veterinary expenses, enhancing survivability, and promoting better herd health.	A	Improved gut health in response the climate hazards	100	DA RFO 2	2.6

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries	Local Partner	Fund (PhPM)
ST 5: Digitalization							
24	Development of Innovation System for Climate Smart Pest Management in Rice	Localized surveillance, early warning and forecasting systems for pest outbreaks and epidemics	A	Improved protocols on climate smart pest management in rice		DA PhilRice, DA - BPI	11.5
25	Drones4Rice: Development of standard drone application protocols (UAV-based direct seeding, fertilizer broadcasting, and pesticide/ insecticide spraying) for rice production systems in the Philippines - Cagayan Valley Region	Standard protocols for uniform drone application of seed, fertilizer, and pesticides and comparative analysis of the benefits of using drone-based technologies over current manual practices with respect to cost, efficiency, labor requirements, environment, and productivity. Drone-based field crop monitoring protocols RCMAS module for image-based automated georeferencing of farm lots and updating of the RSBSA	A	protocols on precision and digital tools and technologies for improved advisories/decision support tools and services for rice farmers,		DA RFO 2, DA RFO 4A, DA RFO 5, DA PhilRice	5.5
26	Improving Corn and Cassava Productivity and Profitability in Region 5 Using SSNM Nutrient Expert	SSNM technology is a science-based management of fertilizer in crop production. It entails the proper and effective use of fertilizer to improve crop production. To facilitate SSNM technology, Nutrient Expert for corn and cassava had been developed to serve as guide in the implementation of this technology. On the same side, the technology also promotes optimum and budget dependent use of fertilizers which will be beneficial to improve the livelihood of the producers.	A	Decision support tool for nutrient management	30	DA RFO 5	4.0
27	Improving Corn and Cassava Productivity and Profitability in Region 9 Using SSNM Nutrient Expert	SSNM technology is a science-based management of fertilizer in crop production. It entails the proper and effective use of fertilizer to improve crop production. To facilitate SSNM technology, Nutrient Expert for corn and cassava had been developed to serve as guide in the implementation of this technology. On the same side, the technology also promotes optimum and budget dependent use of fertilizers which will be beneficial to improve the livelihood of the producers.	A	Decision support tool for nutrient management	30	DA RFO 9	3.2

28	Improving Corn and Cassava Productivity and Profitability in Region 12 Using SSNM Nutrient Expert	SSNM technology is a science-based management of fertilizer in crop production. It entails the proper and effective use of fertilizer to improve crop production. To facilitate SSNM technology, Nutrient Expert for corn and cassava had been developed to serve as guide in the implementation of this technology. On the same side, the technology also promotes optimum and budget dependent use of fertilizers which will be beneficial to improve the livelihood of the producers.	A	Decision support tool for nutrient management	30	DA RFO 12	2.8
29	Improving Corn and Cassava Productivity and Profitability in Region 13 Using SSNM Nutrient Expert	SSNM technology is a science-based management of fertilizer in crop production. It entails the proper and effective use of fertilizer to improve crop production. To facilitate SSNM technology, Nutrient Expert for corn and cassava had been developed to serve as guide in the implementation of this technology. On the same side, the technology also promotes optimum and budget dependent use of fertilizers which will be beneficial to improve the livelihood of the producers.	A	Decision support tool for nutrient management	30	DA RFO 13	4.1
30	Deployment of SSNM-NE for corn and cassava through the development of Sustainable Decision Support System	Develop, validate and deploy system support and maintenance processes	A	Decision support tool for nutrient management	30	UPLB	3.4

	Project title	Brief Description	Nature of Climate resilient measure	Envisioned Outcomes	Direct beneficiaries	Local Partner	Fund (PhPM)
ST 7: Landless rural workforce and non-farm jobs							
31	Outscaling of Off-Season Onion Production Technology in the Province of Palawan	Demonstration of off-season onion production in rice areas in the municipality of Narra, Palawan. Protective covering will be provided and good agricultural production management will be employed in onion farming in view of increasing the income of farmers and sustaining a stable supply of onion in the province. Also, onions can be grown even during the rainy season which is normally planted after rice.	A	Ensuring sustainable availability of onion using off season production technology	500	DA RFO 4B	5.0

32	Outscaling of Crop-Livestock Farming System Towards Entrepreneurship and Sustainability in Selected Municipalities of Romblon	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps; priority commodities to be catered in the project includes upland rice, vegetables, arrowroot and cassava.	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards, contributing to the improved climate resilience of the community	30	DA RFO 4B	1.0
33	Scaling Rice Technologies for Hybrid Rice Production in Clustered Irrigated Areas in Region 2	Scaling up hybrid rice production using balanced fertilization strategies in clustered irrigated areas involves the deployment of various agricultural technologies to achieve its objectives of increasing rice production, promoting sustainability, improving farmer livelihoods, and transferring knowledge and practices to enhance agricultural outcomes.	A	Mechanization and precision farming, pest management, and efficient water management to reduce the environmental impact of rice cultivation (e.g. soil health, water quality, and greenhouse gas emissions)		DA RFO 2	5.0
34	Technology Validation of Various Balanced Fertilization Strategies for Hybrid Rice Production in Clustered Lowland Irrigated Areas in Eastern Visayas Towards Scaling	This project aims to scale up balanced fertilization strategies for high-yield hybrid rice varieties in clustered irrigated areas to significantly increase rice production in selected regional clustered irrigated areas in Eastern Visayas to significantly increase and promote sustainable rice production, improving farmer's livelihoods, and ensure transfer of knowledge and practices to enhance agricultural outcomes.	A	Mechanization and precision farming, pest management, and efficient water management to reduce the environmental impact of rice cultivation (e.g. soil health, water quality, and greenhouse gas emissions)		DA RFO 8	5.0
35	Outscaling of Crop-Livestock Farming System Towards Entrepreneurship and Sustainability in Selected Municipalities of Davao Occidental	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps; priority commodities to be catered in the project includes banana, corn, vegetables, and small ruminants	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards, contributing to the improved climate resilience of the community	40	DA RFO 11	6.0

36	Outscaling of Crop-Livestock-Inland Aquaculture Farming System Towards Entrepreneurship and Sustainability in Selected Municipalities of Lanao del Norte	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps for abaca;	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards, contributing to the improved climate resilience of the community	50	DA RFO 10	6.0
37	Outscaling of Integrated Nutrient and Crop Pest Management towards Enhanced Crop Productivity and Sustainable Entrepreneurship in Selected Municipalities of Sarangani Province	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps; priority commodities to be catered in the project includes 1) Crops [Abaca, corn upland rice, banana, cacao, cassava, durian, mango, papaya, vegetables], 2) Livestock (Carabao, cattle, goat, swine), 3) Poultry [Goose, Chicken, Muscovy Duck]	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards, contributing to the improved climate resilience of the community	35	DA RFO 12	6.0
38	Outscaling of Farming Systems for Banana, Sweetpotato and Rice Towards Entrepreneurship and Sustainability in Selected Municipalities of Camarines Sur	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps; priority commodities to be catered in the project includes 1) Crops [Banana, Corn, Rice, Sweetpotato, vegetables], 2) Livestock [Swine, poultry]	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards	30	DA RFO 5	5.0
39	Community-based Soil Health Management and Integrated Farming Systems Towards Entrepreneurship and Sustainability in Selected Municipalities of Dinagat Islands and Agusan del Sur	Transfer of mature technologies through developmental projects and provision of assistance to identified FCAs to improve their practices in terms of production, postharvest and processing and address existing challenges and gaps; priority commodities to be catered in the project includes 1) Crops [corn, rice, banana, cacao, cassava, lowland vegetables, fruits (watermelon)], 2) Livestock (Carabao, cattle, goat, swine), 3) Poultry [Chicken, Muscovy Duck]	A	Using farming systems approach to buffer the damages that can be brought about by climate hazards	90	DA RFO 13	7.0

A=Adaptation, M=Mitigation

E. Short-Term (2025 to spillover to 2026) Climate-Resilient R4D projects

The 2025 R4D climate resilient projects were obtained from the intensive R4D works of NIRAS experts who were funded under the ADB Technical Assistance (TA)[10]. Table 13 provides a summary of these 9 R4D projects and their key features. Subject to the approval of the Department of Budget and Management, these projects are planned for funding in 2025 under the Tier 2 of the budget for programs, projects, and activities of the DA-BAR, amounting to PhP 394M. This shows the firm commitment of DA-BAR in carrying out the plan.

Additionally, 19 projects have been recommended from separate R4D studies of CIRAD and UPLB through AFD funds which supplemented the ADB TA funds for technical support in the achievement of the Subprogram 2 policies of the ADB Policy Based Loan[2], *Climate Change Action Program for the Philippines.* The preliminary list and brief description of these projects are shown in Table 14. Subject to further discussions for external funding and elaboration, these R4D projects are proposed for late 2025 or for 2026.

Almost half of the 28 total projects identified for implementation in the short-term, fall under the ST1 category with 13 projects or 46% of the total, as shown in Figure 26. Next is ST2 and ST3 with 5 projects each (18%), followed by ST5 having 3 projects (11%). Lastly, ST4 and ST7 both have 1 pipelined R4D project each. In terms of the nature of climate measure, majority are still towards enhancing adaptive capacities with 16 projects (57%), followed by adaptation plus mitigation projects with 11 (39%), and finally, only 1 project is focused on mitigation (Figure 27).

The track of action agenda in the short term is still largely focused on generating knowledge and technologies for sustainable AF sector, as presented in the composition of R4D projects. However, it can be equally observed that due focus is also directed towards other thematic concerns to ensure robust R4D initiatives, building on the pathway for modernization in the short term and potentially expanding investments in the course of the medium term.

It is notable that DA-BAR, for 2025, has proposed under its regular budget 214 R4D Projects, Activities and Programs (PAPs) worth a total of PhP 748M. Objectives of the PAPs are to: 1) Expand and improve available AF areas for increase production; 2) Mechanize and modernize AF production systems; 3) Develop and improve post-harvest systems and

[10] https://www.adb.org/projects/documents/phi-55268-002-tar

infrastructure; 4) Science and information-driven decision making through digitalization; and 5) Other cross cutting policies. Despite limited resources, the Bureau is committed in carrying out this action agenda to bolster its contribution to climate resiliency and AF modernization, hence the proposal for increased funding for the 9 R4D proposals packaged through the NIRAS Technical Assistance.

Figure 26. Percent distribution of indicative R4D projects by 7 sub-themes (2025-2026)

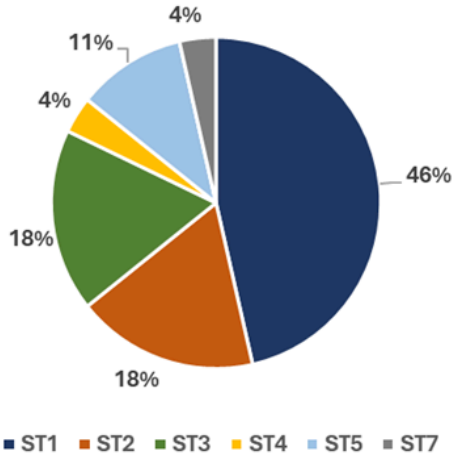
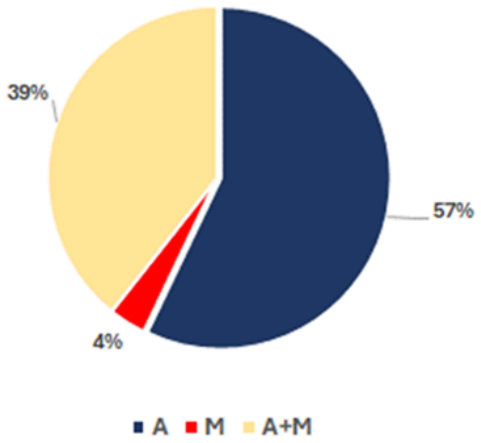


Figure 27. Percent distribution of indicative R4D projects by climate resilient measure (2025-2026)



R4D=Research for Development

Table 13. Climate Resilient Projects for 2025-2026[11]

NO	Project Title	Brief Description	Nature of Climate Resilient Measure	Envisioned Outcome/s	Local Partner	Funds (PHP thousands)
	ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock					
1	Abaca genetic resource conservation: Crop improvement for disease, drought and submergence resistance	This project shall validate the performance of the superior abaca varieties produced through mutation breeding and methylome/chromatin state engineering and test their adaptability across the country	A	to enhance the Philippine abaca genetic resource by improving resistance of abaca disease, drought and submergence	PhilFIDA	7,000.00
2	Towards varietal registration of abaca varieties with tolerance or resistance to biotic and abiotic stresses	To fully address the disease, drought and submergence stresses encountered by abaca, the genetically improved cultivar(s) shall be subjected to multilocational trials. Since abaca growing provinces have varying climate types (Type II, III and IV), the field performance of the test cultivars need to be assessed and validated.	A	yield information on the performance of the developed cultivars against the mentioned biotic and abiotic stresses, as well as information on their suitability for planting in different abaca growing provinces.	PhilFIDA	12,000.00
3	Tropical Seaweed Resilience Center	A tropical seaweed resilience center will be designed, taking the learnings from successful models and applying it to the seaweed sector, where this is much needed. Across these regions in rural and urban communities, a dedicated center could speed up the translation of targeted innovations into the local value chain through partnerships, capacity building on best practices, and technology to facilitate appropriate adoption, maximize impact in the shortest time, and produce substantive benefits for tropical seaweed farmers, producers, and consumers.	A+M	to ensure fundamental research and seed banks remain open source to protect biodiversity and global food security.	UP MSI	48,000.00

[11] Republic of the Philippines: Accelerating Climate Resilience in Agriculture, Natural Resources, and the Environment on abaca, seaweed, livestock and other non-GMO crops

4	Ulva Cultivation Research & Development for Innovations and Sustainable Production Systems (Ulva CRISPS)	Sea-based cultures require a nursery (i.e., tank culture) system to provide sufficient seedstock through reproductive and vegetative propagation. In tank culture, it is easy to control the environmental factors; it also ensures that production meets high quality standards and biosafety for human consumption. The introduction of various cultivation methods include “backyard” Ulva farming. The establishment of a bio-bank for Ulva spp. will be valuable for further expansion of seaweed farming in the Philippines, using “improved” strains that are selected to be better adapted to local conditions.	A	Improved productivity and sustained biodiversity Development of land- and sea-based cultivation technologies	UP MSI	45,774.16
5	Sustainable Production of Indigenous Gamét (SPRING) in Northern Philippines	In this work, we aim to fill in the gap of our knowledge and understanding on the basic biology, ecology, life history and reproduction, and biochemistry of gamét species as well as to benchmark studies supporting the development of the culture technology and valorization of nori/gamét.	A	Build foundational knowledge on the biology, ecology, and natural products chemisty, as well as develop socio-culturally acceptable and economically feasible culture technology and marketable products based on indigenous gamét in northern Philippines	UP MSI	27,940.84
	ST2. Natural Resource Use Efficiency					
6	Innovative and Sustainable Macroalgal Biorefinery System	As a sustainable technology, the R&D program is focused on advancing innovative biorefinery technologies through the utilization of macroalgal biomass. Its goal is to optimize the conversion of macroalgae into value-added products such as biofuels, biochemicals, bioplastics, and other alternative materials. To target economic viability and industrial resilience, process efficiency, waste valorization, and resource optimization of the biorefinery system will further be explored.	A+M	Advancing innovative biorefinery technologies through the utilization of macroalgal biomass	UPLB	43,000.00

7	Bridging Lab to Field: Deployment of LAMParA for Sustainable Abaca Production	The LAMParA kit will be mass produced and will be deployed to all abaca growing regions primarily to quickly and accurately identify viral infections in abaca plants. LAMP deployment will be substantiated with the use of Abaca Detection App (AbaDApp) to develop a comprehensive abaca disease map which is essential in the implementation of appropriate interventions, such as disease management strategies that will prevent the spread of the abaca viruses. Remote sensing technology will also be used to present location and severity of diseases. By effectively managing viral diseases, the overall health and productivity of abaca plantations can be improved, ensuring a sustainable and profitable abaca industry.	A	The Disease Map will become a planning tool for both government and private sector to properly manage diseases .	PhilFIDA	16,000.00
	ST4. Climate resilient food- and agri-based processing, marketing, and logistics systems					
8	Breeding for climate resilient non-GMO crops, livestock and fisheries	Climate resilient crop varieties, trains of livestock and fisheries will be developed through new breeding techniques and speed breeding.	A+M		SUCs	105,000.00
	ST7. Landless rural workforce and non-farm jobs					
9	Climate Change R4D Capacities Enhancement	The program shall develop the scientific manpower with corresponding research facilities to create and innovate climate resilient technologies and solutions. It shall strengthen the capacity of BAR to support research for development and extension.	A+M	Climate resilient crop varieties, strains of livestock and fisheries will be developed through new breeding techniques and speed breeding.	DA BAAs / RFOs / SUCs	90,000.00

A=Adaptation, M=Mitigation

Table 14. Climate Resilient Projects for 2025-2026[12]

No.	Project Title	Brief Description	Nature of Climate Resilient Measure	Envisioned Outcome/s	Local Partner
	ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock				
1	Molecular characterization of resistance genes for TR4, BBTV, BSV pathogens to develop banana tolerant cultivars	Integrated viruses in some Banana genomes such as fungus Fusarium oxysporum tropical race 4 and the banana streak virus (BSV) are reactivated under biotic or abiotic stresses, like climate change are reactivated and develop disease which can lead to the death of the plant in extreme cases. Molecular markers for genotyping the different BSV species have been developed and genome editing tools for deactivating them are under development at CIRAD. This R&D project is a way of adapting to climate change without having to use chemical products.	A	Improved productivity and resiliency of banana	SUCs (e.g. UPLB)
2	Stable and transitory transformation of tropical species for genome editing of agronomical genes of interest		A		
3	Genome editing for developing climate resilient coconuts		A		
4	Germplasm screening and identification of resistance genes against HLB and CTV in citrus		A		

[12] These R4D concept briefs were proposed from the 5 R4D research studies conducted jointly by CIRAD and UPLB and funded by AFD as part of its support to the ADB TA Republic of the Philippines: Accelerating Climate Resilience in Agriculture, Natural Resources, and the Environment on mango, sugar, agri waste products and renewable energy, aquaculture, and genetics.

5	Project on updated genetic programs and valorization of indigenous aquaculture species	Saline Molobicus tilapia: - a product of Philippine National Fisheries Development Center together with the collaboration with Cirad and INRAE. - provide an opportunity for adaptation and mitigation of aquaculture to climate change particularly in the context of sea level rise and salinization of inland waters. - selected for their growth performance providing an opportunity to improve the production systems of Laguna da Bay and Taal lake. Valorization of indigenous species such as Silver perch (Leiopotherapon plumbeus) and freshwater sardine (Sardinella tawilis) and selection toward growth and adaptation to CC, such as increased temperature and salinization, to improve the aquaculture value chain in the Philippines.	A	Sustained biodiversity and increased income	
6	Mango resilience- Impacts of climate change on the mango physiology and yields	The aim here is to conduct research on mango ecophysiology on the main cultivars that will help tropical perennial fruit cropping systems to adapt to climate change and improve their productivity and resilience.The questions to be answered are: What are the effects of climatic factors (CO_2 concentration, temperature, water availability) on the mechanisms underlying the development of mango development, production and fruit quality? What will be the future impact of climate change on the plant and its productivity?	A	Improved productivity	
7	Mango resilience- Agro-ecological control of the cecid flies	Preliminary study has indicated that effective management of pests and diseases in mango orchards can improve yields by about 33%, whereas integrated pest management would reduce the costs of production by 16%, derived from a 75% reduction in chemical control cost (Preciados et al., 2013). The aim of this project will be to reinforce this results to move towards sustainable management of mango pests. Trials on agro-ecological management practices to control pest and disease (especially the cecid fly) will be conducted and tested as based on current practices developed in other areas. the development of new techniques to control the cecid flies would make it possible to reduce the fruit bagging technique, which is costly and time-consuming for the farmers and contractors.	A	Improved productivity, increased income	

8	Sugar cane varietal selection for adaptation to climate change.	This R&D project with Philippine sugarcane sector stakeholders and CIRAD could first of all provide access to the best-performing cane varieties developed by eRcane, a breeder partner in Réunion Island. These varieties are appreciated and in demand in the Philippines, for their good resistance to ratooning after harvesting: 8 to 10 ratoons compared with 2 to 3 at present in the Philippines fields. The latest varieties available on Reunion Island would officially provide better resistance to disease and high temperatures, as well as an opportunity to broaden the genetic base available to Filipino breeders from public and private research centers. The aim is not only to improve the performance of ratooning, but also to increase, in a longer term the capacity of Filipino sugarcane breeding centers to withstand drought and high temperatures in a context of climate change. The introduction of new varieties is an opportunity to steer agricultural practices towards more agroecology, i.e. reduced pesticide use, and greater consideration for soil health and biodiversity.		Improved productivity, Increased income	
	ST2. Natural Resource Use Efficiency				
9	Mango resilience- Modern mango orchard management	- Improvement of mango management practices will enhance production while integrating farmers into low input and integrated orchard management strategies to sustainably manage their orchards while experiencing climate change. This plan will include the evaluation of different practices of fertilization, tree pruning and size maintenance, orchard design (planting density), grafting, and rejuvenation of orchards (planting new trees) ; and selection of new varieties,.	A	Improved productivity Resource use efficiency enhanced	
10	Project of integrated small-scale aquaculture (ricefish, mud crab and mangrove)	Ricefish or associated mangrove aquaculture provide opportunity to increase system production and system efficiency. For ricefish, introduction of fish in paddy field (4,8 Mha in Philippines) provide opportunity to increase rice production of up to 20% and save water for dual production of rice and fish (up to 500 kg/ha). Additionally, the integration helps decreasing the need on chemical inputs such as pesticides and fertilizers. Fish or other organisms such as prawns, crayfish or crabs (for those consumed locally) can be integrated with rice providing an opportunity for diversification of the production system and increasing income for farmers.	A+M	Improved productivity, yields and income diversified	
11	Community-based Forest management & Climate resilient	The project explores and develops the climate change resilience potential of communities and mangroves, using the complementarities between mangrove	A	Sustained biodiversity	

	fisheries and aquaculture systems	forestry, agriculture and fisheries, and paying particular attention to gender and women			
	ST3. Zero waste, recycling, and circular economy				
12	Project on circular economy in the aquaculture value chain	The concept includes new ways to increase resource use efficiency, lower production cost as well as carbon emission and thus the footprint of aquaculture to climate. The concept is developed toward: 1) the reduction of feed inputs through smart diets adapted to fish or shrimp requirements (e.g., species, season) as well as to the environment where they are produced (e.g., pond vs cages); and 2) the recycling of the remaining waste into new commodities such as seaweeds, black soldier fly meal and organic fertilizers. These new commodities can thus be 3) reused in situ by the food web or ex situ into new feed formulations or fertilizers for aquaculture or other crops.	A+M	Enhanced recycling rates and reduced waste generation	
13	Biomass Energy atlas project	The project proposes to update the national map of biomass resources produced 10 years ago, with different biomasses typologized according to the source of waste or agricultural residues. This update is necessary due to the evolution of technologies and the development of applications as energy or as new materials or uses. In addition, the project will specify the limits of the economic viability of each of these biomass resources, for certain valorization scenarios (e.g. energy production in a large city or a medium-sized town), this will allow mapping the logistical costs and GHG emissions linked to the collection of this biomass.	M		
14	Establishment of decentralized rice husk biochar production units in other producing regions	The production of biochar from rice husks has now been technically mastered. It is now a reality in the Philippines with the ALCOM unit in operation. The project will involve studying the feasibility of setting up 1 or more other biochar production units, the sizing and corresponding technology of which will have to be studied in relation to the volume of rice husk resources available (maximum 100 km supply radius).The production of this biochar is fully in line with the Philippines' Climate Plan, as the Intergovernmental Panel on Climate Change (IPCC) has classified it as a "negative emissions" technology, which it considers essential for removing CO2 from the atmosphere.	A+M		
15	Decentralized heat production from rice straw (pellets, briquettes)	The use of rice straw is more problematic than that of rice husks because of the dispersed nature of the resource. For this reason, the proposed project focuses on increasing the energy densification of the rice straw resource through the decentralized production of pellets or briquettes in the main producing regions. A comparative inventory of the main existing devices and	A+M		

		systems will be used to select those best suited to the local socio-economic context.			
16	Establishment of one or more hydrochar production pilots, i.e. using wet waste from vegetable production to produce a product that improves soil	The project will involve studying the technical and economic feasibility of 3 to 5 pilot hydrochar production units using existing technologies, following a preliminary study of the availability of wet lignocellulosic by-products, mainly by-products from market garden production. The preliminary study will determine the choice of sites for the installation of these units, which will have to be optimized according to the distance to the resource.	A+M		
	ST5. Digitalization				
17	Digital tools for climate change adaptation - Quantify the needs for digital tools	the aim is to assess the needs from smallholders and other stakeholders of the value chain regarding climate change issues to develop digital tools of technical advice (weather forecast, water use efficiency, pest and disease detection & warning...) and on-farm performance assessment (farmers communication systems, yield estimates, GHG calculators, mitigate waste, sustainability indicators...) relevant to help them mitigate and adapt to climate change.	A+M	Improved productivity Enhanced decision making and planning	
18	Digital tools for climate change adaptation - Scaling-up of digital tools resulting from the SARAI project (Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines)	Based on the comments of the stakeholders of the SARAI project at the UPLB, some digital solutions developed during the project and that achieved their proof of concepts, lack of human-centered IT deployment and improvements of computer development to ensure successful scaling-up and high adoption rate at national and even regional levels. The aim of this project is to help the adoption and scaling up of the solutions already built within the SARAI project.	A+M	Improved productivity Enhanced decision making and planning	
19	Digital tools for climate change adoption – PixFruit based-digital solution	PixFruit is an expertise currently developed by CIRAD to evaluate fruit yield variables (production, fruit size, maturity, etc.) based on digital tools. The aim of this project will be to assess the development potential of a PixFruit-based tool for evaluation of mango size, color grade and pest & damage levels at harvest. Currently small-scale producers of fruit trees, especially mangoes, have no other means to monitor the quality and damages of their fruits than performing a rough visual estimate at harvest. This project will be setting-up tests and collect calibration data for image analysis tool. The project will also evaluate feasibility and co-design a tool adapted to the mango value chain in the Philippines.	A	Improved Productivity Enhanced decision making and planning	

CIRAD-UPLB=French Agricultural Research Centre for International Development-University of the Philippines Los Baños

F. Medium-Term (2026 to 2028) Indicative Climate Resilient R4D Projects

There are 61 prospective R4D projects earmarked for 2026-2028. These were generated from DA-BAR NAREA 2023-2028, and CC REAP 2016-2022. Table 15 provides a list of these prospective climate resilient R4D topical areas by sub-themes.

By 2025, an assessment of this list of indicative R4D projects will be evaluated. The assessment of R4D projects for 2026 to 2028 will consider the distribution of R4D projects by sub-themes and the shift from specific agriculture and fishery commodities to a more commodity and value chain approach. There will be more emphasis for agri-based and agrifood commodities and products with comparative advantage (for example, more focus on high value crops and nutrition dense and safe food), ensure sustainable agriculture and sustainable intensification as well as employ nature-based solutions and circular economy approaches, emphasis on diversification of income sources, and is inclusive (embeds gender empowerment and social inclusion). The R4D prospective projects will also be assessed in terms of their potential impact on achieving the R4D strategy's outcomes, their innovative proposed financial modalities for funding, and their economic, social and political prospects of being out-scaled, up-scaled, and for being commercialized with active participation of the private sector.

As summarized in Table 15 there are 61 total action agenda categorized under the 7 sub themes. Among which, shown in Figure 28, the largest share of identified projects are under ST1 with almost half or 30 projects comprising 49% of the total. Next to it is ST4 with 15% (9), followed by ST5 with 11% (7), then ST3, ST6 and ST7 with 7% each or 4 per ST. Meanwhile, ST2 has 3 projects or 5% of the total.

Majority of the indicative interventions are focused on adaptation measures covering a large chunk of 75% or 46 projects (Figure 29). Meanwhile 23% (14 projects) is dedicated to adaptation plus mitigation efforts, and the last remaining 1 project aims to contribute to mitigating the effects of climate change. Refer to Annex 1 for the full length table/ detailed list of the indicative projects.

Figure 28. Percent distribution of indicative R4D projects by 7 sub-theme (2026-2028)

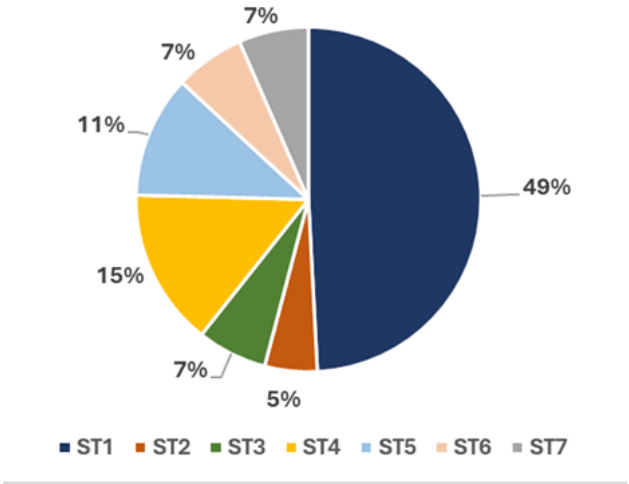
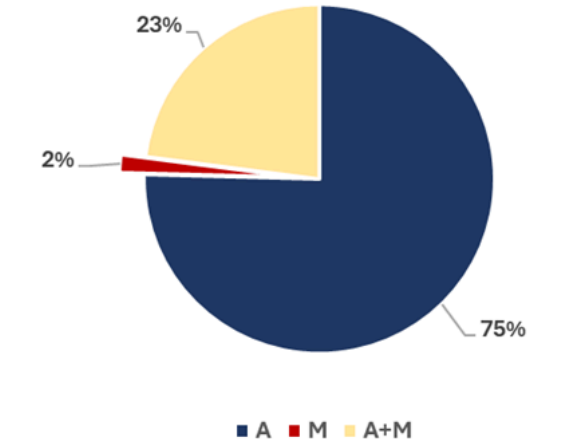


Figure 29. Percent distribution of indicative R4D projects by climate resilient measure (2026-2028)



R4D=Research for Development

Looking at the roadmap of action agenda for the medium term, the array of proposed R4D projects puts emphasis and priority on R4D initiatives focused on the generation of technologies and innovation to ensure a production and productivity through more efficient use of scarce natural resources (land and water) for a sustainable agri-fisheries sector.

Pursuing R4D projects under ST1 and ST2 will continue to bolster the pathway to food security through varietal and genetic development, generation of management protocols, and managing agroecological impacts, among others. To bolster the efficiency of natural resources utilization, there may need to put equal attention on shifting to local resources that can serve as import substitutes to address the increasingly rising prices of imported agri-based inputs. These include fuel and fertilizers. Nature-based renewable energy sources would likewise help reduce fuel costs, a rising share of the farmers and fisherfolk's total costs of farm/fishery production. Additionally, environmentally sustainable innovations such as bio-based fertilizers and other local pest management products that use local resources could help cut the costs of their production while help boost their productivity in an environment-friendly manner. Using more locally-produced inputs will not only help reduce costs at farm production, but as mentioned, contribute in increasing production, thus resulting to higher take-home pay to the farmers and fisherfolk. A steady supply of agrifood products could help mitigate erratic price hikes as what continues to happen due to the uncertain global geopolitical conflicts. In effect, a combination of R4D on ST1, ST2 and ST3 projects can contribute in ensuring food security. Moreover, these new agri-based products also have the potentials of increasing incomes from diversified farm sources, provide more

productive on-farm and off-farm work to the surplus rural landless workers, and ultimately reinforces food security.

In addition, recycling is an important practice and a researchable action agenda that helps not just in the reduction of wastes, but also in the development of innovations that convert these wastes into nutritious food and other agri-based products. It is envisaged in this plan to encourage the conversion of waste products into marketable value-added products (Box 2).

Box 2. From wastes to nutritious food and functional agri-based products

Studies showed that almost all nutrient contents of dragon fruit are found on its peels. With funding from DA-BAR, the Central Luzon State University studied the peels of Hylocereus undatus and Hylocereus polyrhizus (white and red flesh) and found that the former has higher phytochemical properties and antioxidant activity. As a good source of antioxidants and other bioactive agents, the dragon fruit peels were used to develop various value-added products such as granola bar, grenadine syrup, crackers, vitamin gummy, beauty products, and specialty paper. These products are a good source of additional revenue to dragon fruit farmers in the Philippines, in addition to reducing agricultural waste.

Invasive aquatic species (IAS) that are found to be of high risk for freshwater and brackishwater areas in Pampanga are Thai catfish, mudfish, softshell turtle, janitor fish, Asian swamp eel, and blackchin tilapia, that caused huge damage in the aquaculture areas of Pampanga. A DA-BAR funded projected collected IAS in this region and developed IAS as feed, food products, and other agri-related products, namely, mushroom fruiting bags; charcoal briquette; blackchin tilapia-based frymash; smoked blackchin tilapia in a bottle; fermented rice with mudfish; water hyacinth- and water lettuce-based growing medium for hydroponic system

Source: DA-BAR Annual reports 2022, 2023

In congruence, action agenda under ST6 shall promote nutritious and sustainable dietary patterns that may be integrated in the usual meal plans of Filipinos. With the worsening social indicators, especially on nutrition among the young and poor population, it is imperative to provide and produce affordable foods with adequate nutrient content. DA-BAR already has prior investment on this through the PINOY GOURmix which is a mixture of nutritious and locally produced milled rice, white corn grits and Adlay grits which are enriched with malunggay powder, Soybean Texturized Vegetable Protein (TVP), ground Mungbean and yellow ginger turmeric. Development of such and more options for consumers shall cater to different taste preferences and help improve nutrition security (Box 3)

Box 3. Nutritious food anyone?

In 2019, UPLB focused on maximizing the nutritive values of nixtamalized Philippine corn such as proximate content, mineral content, and mineral availability. This is to improve the nutritional quality of two locally available corn, namely IPB Var 6 and Lagkitan, through the process of cooking and steeping in an alkaline solution known as nixtamalization. The nixtamalized Philippine Corn or "PhiNixC" were used in the form of kernels, grits, and flour. PhiNixC products were standardized and are now ready for commercialization. Some of the PhiNixC products developed were pancake/muffin mix, loaf bread, pan de sal, puto, fermented corn beverage, espasol, palitaw, buchi, and ricecorn blend.

To introduce a healthier meat alternative, provide an additional income to farmers of soybeans, and increase the utilization of soybeans, DA-BAR provided research funds to the Benguet State University to develop full-fatted soybean-based food products (ie. burger patty, sweet longganisa, and nuggets). These products were found to have considerable amounts of protein, sodium, potassium, and calcium.

In 2018, DA-Cagayan Valley Research Center developed various mungbean-based food products as a value-adding intervention in support to the mungbean farmers in the region. Under the Mang Bean brand, these products include instant ginisang munggo, instant mungbean noodles and vacuum-fried sprouts. Nutritional analysis showed that these products are high in protein and fiber and are at par with the existing commercial products.

Source: DA-BAR Annual Report, 2022

ST4 R4D initiatives will also be encouraged on fortifying the value chain and logistics systems through upgrading the infrastructure, improving institutional measures and capacities, and implementation of policies that broaden markets. These would ensure inclusive benefits to stakeholders across the food systems (Box 4). This coincides with digitalization efforts under ST5, that aim to contextualize the climate risks and hazards, and provide market intelligence for better decision making and science-based policy recommendations.

Box 4. While in transit, cool them.

To minimize postharvest losses and extend the shelf life of highly perishable high value crops, the UPLB fabricated a one-ton mobile solar-powered precooler prototype. Precooling is the process of removing the field heat (or the difference between the temperature of the crop when harvested and its optimal storage temperature) immediately after harvest. The faster this is executed the greater the chance that the crop reaches the consumer at its maximum quality. The prototype is a polyurethane-insulated walk-in chamber mounted on a trailer that can carry 3.5 t gross weight. Tests showed that the prototype precooled selected high value crops, at partial capacity, in 2-4 hours with weight loss of not more than 2%. With the 2-hp refrigeration system installed, the temperature inside decreased to 10-15°C. The prototype is powered by a solar photovoltaic system with a hybrid off-grid setup with the battery bank as the main power output source charged by solar panels or by utility grid. Results also showed that the fabrication cost of PhP 1,3 million is more than PhP 500,000 cheaper than acquiring a brand new refrigerated truck. The mobile precooler can serve as an alternative cold storage when not in use, especially in remote areas. UPLB will further optimize the prototype as a cold chain facility from precooling to storage and transport of high value perishable crops.

The DA-Cagayan Valley Research Center developed and tested four Zero energy cooling chambers (ZECCs) to provide vegetable farmers in the region with a cheaper alternative to mechanical refrigeration. ZECC is an evaporative cooling system that works akin to how our bodies cool down through perspiration. When water is poured over the walling, the cavity materials absorb the moisture and in time evaporates, resulting in a high relative humidity and lower temperature than outside the chamber. On-station trials revealed that ZECC using charcoal walling extended the shelf life of hot water treated tomatoes to 31 days with fruit weight remaining at 868 kg per ton. DA-Cagayan Valley recommended the ZECC using charcoal walling as its construction cost is cheap. This will be subjected to on-farm trials for the second phase of the project.

Source: DA BAR annual report 2023

Lastly, the thrust under ST7 is to enhance the capacities of rural farmers and fisherfolk by retooling their skills in micro and small agri-based enterprises and eventually enabling them to become agri-entrepreneurs, especially the rural women and, and in the case of scientist inventors provide them the incentives of reaping the fruits of their innovations (Box 5). Where feasible, the upgrade of their skills and their venture to becoming registered small-scale AF businesses will increase and diversify their incomes, especially if the locational targets are in peri-urban areas. For the landless rural workforce, provision of skills trainings in anticipation of increased labor intensity and productivity from diversified farming systems would be important in enabling this surplus agriculture and fisheries workers to diversify their on-farm and off-farm work.

Box 5. Pili Milk-an all women invention

The research team, comprising three women-researcher-entrepreneurs (two are Agricultural and Biosystems Engineers and one Food Technologist. The women team developed pili milk, a way to boost the pili industry in the region and at the same time introduce a healthier alternative option to existing milk products in the market, not to mention the additional income for pili farmers and processor adaptors who would benefit from the technology researchers' innovation of producing plant based milk from pili, making use of the available small-scale processing equipment necessary in the product exploration such as colloid miller and high speed blender. They partnered with a local Barcelona Development Cooperative in Barcelona, Sorsogon, who benefitted from the transfer of the milk processing technology developed by the women researchers. This benefitted their 1,289 total number of members, where 1,048 are women and 241 are men. Knowledge on pili milk processing was provided to the coop as initial assistance. The increased demand for pili production and processing greatly benefit the partner-pili farmers and processors with the additional income from the pili milk processing. The product also benefitted the consumers with nutritious, affordable, less cholesterol, and a satisfying taste that is expected from pili milk.

DA BAR assisted the women researcher-scientists by providing them intellectual property assistance to protect their research outputs from DA-funded R4D programs and projects. Prior to submission for application to the Intellectual Property Office of the Philippines, research outputs are evaluated to assess its IP potential. The DA BAR's assistance also covered compliance with the Intellectual Property Office of the Philippines' examination reports. In 2023, DA-BAR assisted the DA-Bicol Region in drafting claims and online filing for a utility model on the process for producing milk from Pili (Canarium ovatum) kernels. The utility model relates to a process for producing milk from Pili kernels using wet process method.

Source: DA BAR Annual Report 2023, and BAR Digest (March 2024)

Dependent on periodic assessments and the demands from the market, key stakeholders, and policy makers, the action agenda can be recalibrated and reprioritized to ensure that R4D initiatives are responsive to the prevailing challenges of and opportunities offered by AF modernization. All the agenda in Table 15 will be subject to evaluation and may undergo reprioritization, hence, the document is a living document.

Table 15. Indicative Projects for Climate Resilient R4D Projects by subthemes, 2026-2028

	Projects / Activities	Nature of Climate resilient measure			Local Partner
		Adaptation	Mitigation	A +M	
ST1. Technology and Innovations for sustainable agriculture, fisheries, and livestock					
	Studies on genetics (e.g. molecular characterization and germplasm screening of resistance genes, genome editing)	3			SUCs, DA-BPI, DA-RFOs, SEAFDEC, DA-NFRDI, DA-BFAR,

	Varietal/broodstock improvement and development of new commercial varieties	7			DA-BPI, DA-RFOs, SUCs, DA-RDIs, SEAFDEC, CPF, GENOMAR, PhilFIDA and other private sector research institutions
	Agroecological/ impact studies on climate change, agrifisheries commodities and food systems	1		7	SUCs (e.g. UP-MSI), DA-ATI DA-BAAs, DA-RFOs, SEAFDEC, DA-NFRDI, DA-BFAR, DA-SRA
	Development of production management practices, adaptability trials, and improvement and utilization of POTs to advance productivity and efficiency	11			DA-RFOs, SUCs (e.g. UPV, UP-MSI), DA-BAFS, DA-BAI, DA-NFRDI, DA-BFAR, SEAFDEC, LGUs
	Development of management protocols on pests and diseases	1			DA-RFOs, SUCs (e.g. UPLB, VSU)
ST2. Natural Resource Use Efficiency					
	Farm consolidation and clustering, integrated production systems and diversified farming, more efficient irrigation systems and rainwater harvester, Renewable energy systems		1	2	SUCs, DA-CRAO, DA-BFAR, BSWM, DA-BAFE, NIA, DA-RFOs, PhilFIDA
ST3. Zero waste, recycling, and circular economy					
	Reduction of feed inputs, recycling of wastes, eliminating pollution and development of Value added products	2		1	SUCs (e.g. TAU, NWSSU, UNP), DA-ATI, DA-RFOs, DA-NFRDI DA-BAAs
	Nature-based materials			1	SUCs, DA-ATI, DA-RFOs, DA-BAAs
ST4. Climate resilient food- and agri-based processing, marketing, and logistics systems					
	Improving infrastructure and institutional measures and capacities	5		1	DA-BFAR, NFRDI, Phil. Fisheries Biotech Center, DA-RFOs, DA-BAI. PCC, Phil. Animal Biotech Center, DA-CRAO, DA-PRDP, DA-ATI, SUCs, DA-NFRDI, DA-BFAR, DA FDC
	Policies that broaden markets through regional and global trade engagement and pool risks	3			DA-ATI, SUCs, DA-RFOs, PIDS, DA-BAAs
ST5. Digitalization					
	Digital Tools for climate change adaptation and mitigation	1		2	SUCs, DA-ATI, DA-RFOs, DA-BAAs
	Development of tools for market intelligence (e.g. VCA, Supply chian analysis, resource mapping)	4			DA-RFOs. SUCs(e.g. UPV), NGOs, DA-NFRDI. DA-BFAR,
ST6. Nutritious food, sustainable diets, and consumption					
	Promoting and communicating healthy and sustainable dietary patterns	4			DA-ATI; SUCs; DA-RFOs, DA-BAAs
ST7. Landless rural workforce and non-farm jobs					

	Sustainable community based farming, field demos and hands-on training workshops; capacity enhancements	2			DA-ATI; SUCs; DA-RFOs, DA-BAAs
	Policy studies on trade and certifications	2			DA-ATI; SUCs, DA-RFOs, DA-BAAs
	TOTAL	**46**	**1**	**14**	

A=Adaptation, M=Mitigation

G. Digitalization through Development of Dashboards for Knowledge Development and Dissemination

Among the strategies for communication and knowledge management of climate action and agenda, is the development of an interactive **Technology and Innovations Dashboard** dashboards. This digital tool will enhance the access and delivery of information to relevant stakeholders such as the farmer and fisherfolk beneficiaries, academe, other government agencies, NGOs, foreign funding institutions, traders/investors, students, press/mainstream media and the private sector, among others. Likewise, it will serve as an instrument for policy makers to aid in their decision making. The dashboards will capture relevant information and provide the R4D scenario on climate change initiatives for the next medium term.

Figure 30 provides a schematic outline of the dashboard development to be lodged at the DA BAR. The phase of development shall start with the completion and publication of a Compendium of all DA-BAR funded climate smart (CS) research for development (R4D) projects in the last 5 years (2020-2024). The review and inventory of projects and programs are targeted in 2024. This shall also include all currently ongoing climate related R4D initiatives and the policies. The information that will be gathered in this publication are crucial inputs for the establishment of the dashboards. In effect, DA BAR can become the repository of agri-based and agrifood technologies and innovation, which can perform multiple services: (1) recognize their level of use (on trials, for out- or up-scaling, potentials for commercialization) and attract potential investors; (2) policy planning and decision-making on measures to take that could accelerate the agriculture-fisheries modernization; (3) serve as an extension service to other stakeholders who may want to employ these technologies and innovations; and (4) provide stakeholders in the concerned supply chains to explore value chain support.

In subsequent years, the dashboard on climate resilient technologies and practices will be expanded to include those that have been developed from the DA's other bureaus, attached agencies and corporations, and the banner programs. It is also envisaged that those

generated from PCAARRD and state colleges and universities will likewise be included. Where feasible, other R4D projects from the private sector, non-government organizations, etc. will also be gathered and collected and consolidated to provide a comprehensive list with the end-view of informing the policy decision-makers and dabbling them to come up with concrete measures for dissemination, adoption through scale-out or scale up, or commercialization.

In 2025, the establishment of the two proposed dashboards will commence. It is envisioned to develop an Analytics Dashboard and an Indicative R4D Dashboard which will serve as the front end, while regularly updated databases will serve as the back end.

The Analytics Dashboard is the platform that will house available CS technologies and practices in the context of the market, shifting the NAFMIP 2021-2030 five commodity systems into commodity value chains and in the context of the sub-thematic groups indicated in this plan. Inputs will be the readily available information in the compendium added with market-related data such as supply and demand, value chain nodes[13] and factor efficiencies which can be sourced from the PSA, FNRI, World Bank and other relevant publications, among others.

The analytics dashboard will have 3 types:

1. Commodity systems in NAFMIP focused on value chain approach (e.g. Market analysis, supply and demand, cost-benefit analysis)
2. Commodities for Nutritious Food natural resources in a value chain approach
3. Policies dashboard[14]

The analytics dashboard will provide market intelligence and updated scenarios of R4D initiatives through visual tools like pies and graphs. Among the potential topics, information and analysis that can be derived from the Analytics Dashboard are the following:

- The current climate change trends in the Philippines and the state of climate resilient AF R4D initiatives highlighting the available climate smart/resilient technologies, practices, protocols that are ready for dissemination, adoption, upscaling, outscaling, commercialization, among others;
- Disaggregation of developed technologies or innovations into its readiness level, the value chain nodes, commodity systems, and sub-themes as proposed in this plan;

[13] Linked with research results under ST4 and ST5
[14] Mostly linked to ST1 and ST2

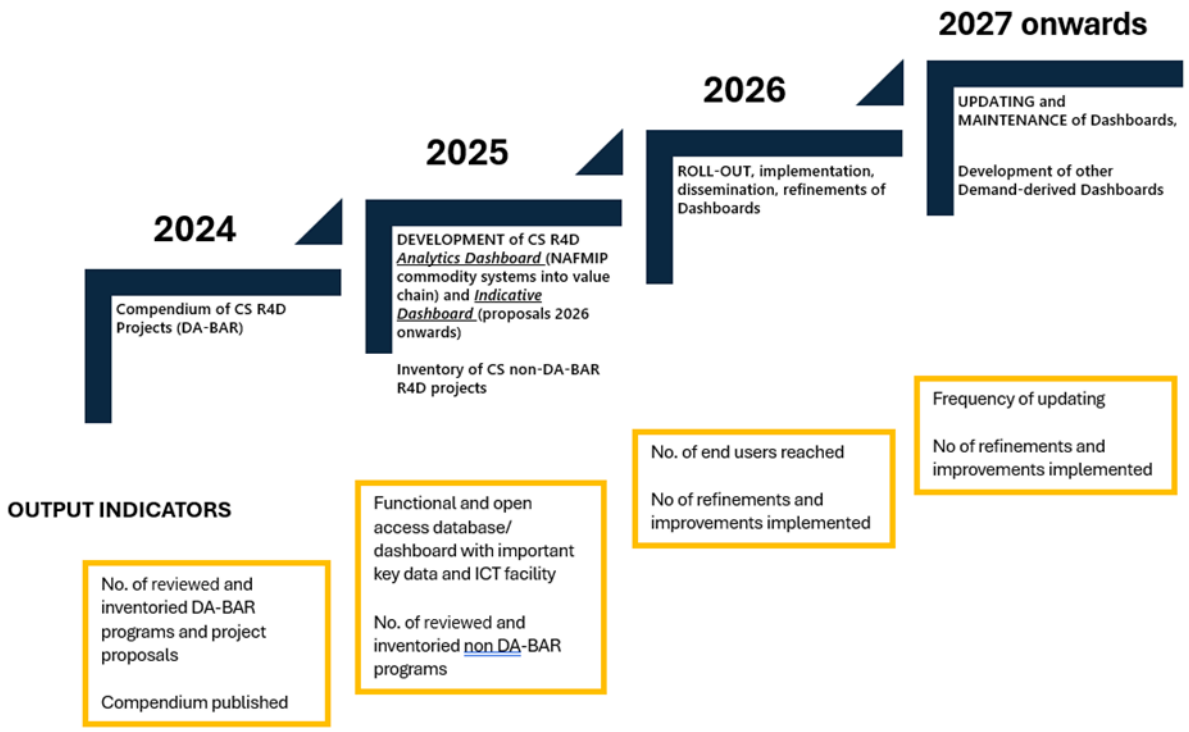
- Distribution of technologies by climate resilient measure (i.e adaptation, mitigation, adaptation + mitigation) and the climate risks addressed;
- Applicable geographical locations (by province, municipality) where technologies and utilized and potential areas where it may be outscaled, and the potential beneficiaries catered;
- Distribution of users/ adopters by gender, age, locations and other socio economic indicators;
- Total investment requirement to utilize the technologies with applicable financial indicators (e.g. ROI, NPV,IRR);
- Salient features of research outputs and its climate resilient attributes;
- Potential contribution of technologies/ innovations to productivity growth if adopted and outscaled vis-a-vis the per capita consumption;
- Market demand for the technologies developed; and
- Contact details of programs/ projects' point persons for future inquiries.

On the other hand, the Indicative Dashboard will serve as a visual roadmap of future investments as espoused in this plan. It will also serve as a repository of R4D proposals and initiatives for the succeeding years. Among the potential topics, information and analysis that can be derived from the Indicative Dashboard are the following:

- Track and timeline of priority action agenda in the current medium term;
- Projected R4D investments (total funding costs) for priority R4D proposals by commodity systems, sub-themes, value chain nodes;
- Distribution of R4D proposals and/or technologies by climate resilient measure (i.e adaptation, mitigation, adaptation + mitigation) and the climate risks addressed;
- Target locations by province, municipality.
- Potential beneficiaries and gender responsiveness
- Expected/potential research outputs and technologies or innovations and expected timeline of development
- Project proposal links.

The development timeline of the DA-BAR commodity systems' climate smart R4D dashboards is illustrated in Figure 30. All information and data requirements for the compendium and dashboards are referenced in Annex 2, 3 ,4.

Figure 30. Development timeline of DA-BAR Commodity Systems Climate Smart (CS) Research for Development (R4D) Dashboards



DA-BAR=Department of Agriculture-Bureau of Agricultural Research

As mentioned earlier CS projects and technologies developed and undertaken by other research institutions are also to be inventoried which will eventually be incorporated in the dashboards to generate more robust and comprehensive information, trends and analyses.

Upon completion of the development phase, the roll out, implementation, and dissemination of the dashboards will be conducted in 2026 to test out the usability. Refinements and improvements shall also be carried out depending on user feedback. Thereafter, in 2027, regular updating and system maintenance will serve as the main activities. The dashboards will undergo evaluation and may be improved and recalibrated depending on the perceived demand and needs of policy makers and stakeholders.

The dashboard platforms add value to the services that DA BAR can provide as it not only generates and fund basic and applied R4D projects but enable other stakeholders in the agri-based and agrifood systems as well as public and private institutions a unified pool of available and accessible technologies and innovations, and built-in market-based analytics that can expand the agri-based and agrifood systems vertically and horizontally.

D. The Imperative for CRAFT R4D

The envisaged forward looking and market responsive climate R4D projects as well as ghe proposed robust knowledge development and management instruments (such as the dashboard applications) are important measures in strengthening the supply side of R4D provided by DA BAR. However, there remains the lack of effective and efficient approaches that can connect these array of profitable, environment friendly, novel, affordable, and demand-driven R4D technologies and innovations initiated through the DA BAR with approaches that would enable these innovations to be commercialized, standardized, and mass produced. At present, it is a critical constraint of the DA BAR as while it can serve as catalyst for these innovations for startup, it's the quantum leap to full-scale adoption and commercialization that the institution finds challenging to tackle because of its limited technical and financial resources. This also inhibits DA BAR to initiate the big push to accelerate the modernization process of the AF sector amid the uncertain and highly risky changing climate.

The next chapter looks at the implementation arrangements in terms of the transformative tasks that DA BAR can perform to enable it to pave the groundwork for the modernization process through its CRAFT R4D in sowing the seeds for the development of a critical mass of climate resilient and prosperous AF stakeholders. In turn, these can be the impetus for the buildup of more initiatives that achieve a modernized approach toward an inclusive, prosperous environmentally sustainable, and resilient AF sector with sound food and nutrition security operations.

Chapter VI

IMPLEMENTATION ARRANGEMENTS: TRANSFORMATIVE TASKS OF THE BUREAU OF AGRICULTURE RESEARCH

Implementation arrangements of the CRAFT R4D are divided into three parts: this chapter looks at the implementation arrangements from the perspective of the major tasks of the DA-BAR, which are to: 1) coordinate, fund, manage agriculture and fishery research; 2) develop partnerships and linkages with local and international research organizations; 3) facilitate technology utilization on a wide scale; 4) strengthen institutional capabilities for progressive modernization of the AF sector; 5) manage knowledge; and 6) to advocate policies and protocols for progressive agricultural and fishery sector value chains.

Chapter 7, the second part of the implementation arrangements, provides the Results Based Monitoring and Evaluation System at the project and at the sector (CRAFT R4D) level. The third part of the implementation arrangement is Chapter 8, which provides a schematic outline of the communication plan for promoting CRAFT R4D.

The three chapters should be viewed as integral of and interconnected components for an efficient and effective implementation arrangement of the CRAFT R4D for the AF sector.

A. DA-BAR: Vision, Mission, and Mandate

The Bureau of Agriculture Research of the Department of Agriculture (DA-BAR) was created under Executive Order 116 signed in 1987 to address the lack of coordination and integration of agricultural research and development among existing bureaus, councils, and agencies. Its specific mandate is to "..ensure that all agricultural research is coordinated and undertaken for maximum utility to agriculture" (EO292, or the Administrative Code of 1987). AFMA affirmed this leading role of BAR. Its role was expanded subsequently to orchestrate, consolidate, and strengthen the National Research and Development System for Agriculture and Fisheries (EOs 127(1999) and 338 (2000)):

> *"The Bureau coordinates and funds agricultural and fishery research and development activities, develops partnerships and linkages with local and international research organizations, sources funds from local and foreign donor institutions, strengthens institutional capabilities of the agriculture and fisheries sectors, manages knowledge, facilitates technology utilization, and advocates policies toward improved governance and progressive agricultural and fishery sector value chain."*

The primary mission and task of BAR are essentially to coordinate, integrate, fund, and manage the research for development (R4D) system to ensure its optimum utility for the sector.

BAR's vision is that it shall serve as

> *The lead R4D coordinating agency towards a technology empowered agricultural and fishery sector contributory to inclusive growth.*

The next section (B) of this chapter discusses its primary and its other tasks as expounded in its legal mandates. Each task is then related to the implementation of CRAFT R4D, highlighting their transformative effects in anticipating the variabilities and uncertainties of climate change, addressing these with a suite of strategic adaptation and mitigation measures that are tailored to the local biophysical and socio-economic-political terrains, and contributing to ensuring a modernization path for the AF that is inclusive, progressive, resilient and sustainable.

B. Transformative Tasks and Implementation Arrangements

Task 1: Coordinate, fund, and manage agriculture and fisheries research

A major constraint in ensuring strategic provision and delivery of R4D for the AF sector is the complex organizational structure of the R4D for AF (Chapter 2). This has resulted to multiple priorities for R4D funding, overlapping functions and duplication of projects, as well as fragmented and uncoordinated implementation of highly dispersed and small-scale R&D projects. Because of the overarching policy objective of ensuring self-sufficiency for rice, considered as a "political commodity," public investments in the AAF including R4D tended to focus on rice. Exacerbating the weak organizational structure of R&D for AF is the low and critically inadequate funding for this important public good despite numerous evidence of its transformative role in accelerating the modernization of the sector (Chapters 2 and 6). These have unnecessarily led to the misallocation and ineffective use of the meager funds for R4D leading to the R4D's insignificant impact in enabling the sector to anticipate, adapt, and be resilient to the vagaries of climate change. The Harmonized National R&D Agenda for Science and Technology for 2022-2028, orchestrated by the Department of Science and Technology (DOST), intends to address some of the weak attributes of the R4D at sector level by coming with a consensus-based strategy and agenda for action. Section 3 of this document is devoted on the R4D agenda for the agriculture, aquatic, and natural resources sector.

To ensure stronger collaboration and more concerted action in the provision and delivery of R4D for the AF sector, DA-BAR and the Philippine Council for Agriculture, Aquatic, and

Natural Resources Research and Development (PCAARRD) forged a memorandum of understanding for collaboration and resource sharing in 2023. The areas of collaboration include: (i) identification of common collaborative activities from respective participants in the science and technology community R4D thrusts and agenda that would address critical AF sectoral challenges; (ii) technology scaling, transfer and promotion; (iii) institutional development; and (iv) strengthening the complementation between the Agriculture and Fisheries Resources Research and Extension for Development Network (AFRREDN) and the DOST-PCAARRD's Regional Consortia within the context of improving the productivity and competitiveness of the AF sector. This collaboration will be reinforced upon the implementation of the Climate Resilient R4D strategy for the AF.

Specifically, DA-BAR and DOST's PCAARRD can explore joint programs and projects under the 7 sub-themes, such as basic and applied research of climate resilient technologies and practices that encourage (i) diversified farming systems; (ii) nature-based solutions for producing more AF outputs with less but efficient use of increasingly scarce natural resources (particularly land and water); (iii) environmental health and biodiversity; (iv) production of varied and novel agri-based and agrifood products particularly safe and nutrient dense food, waste and recycled circular economy-type inputs; (v) development of profitable and inclusive value chain nodes; and (vi) ensure optimal use of digital technology. These synergized R4D programs and projects for a climate resilient AF sector will open more income- and job-enhancing opportunities for the benefit of the rural poor and landless rural workers.

In the meantime, DA-BAR sees the need to advance the call for proposals for the 2025 and 2026 prospective projects by the second quarter of 2024. This will enable DA-BAR and PCAARRD to have time to review the priority R4D issues for climate resilient AF and to initiate their joint calls for proposals on climate resilient AF that can be funded and implemented by 2027 and 2028. Concerted work of DA-BAR and PCAARRD can provide the opportunity for more quality and strategically focused climate resilient R4D projects, maximize the use of scarce funds for R4D, and expand the outreach in terms of beneficiaries of the R4D projects, who are the small scale farmers, fisherfolk, livestock producers, as well as stakeholders involved in the midstream and downstream nodes of the agri-based and agrifood supply chains and those engaged at the upstream nodes (particularly the micro and small and medium enterprises that dominate the midstream value chain segments).

To ensure a more objective basis for the identification and selection of climate-resilient R4D projects under each sub-theme, a scorecard has been developed that evaluates the projects on four parameters: relevance, effectiveness, efficiency, sustainability. The indicative

scorecard is illustrated in Table 16. Note that the same criteria may be used, with some modifications, for the evaluation of the projects upon completion.

Table 16. Scorecard in identifying and selecting the prospective projects for the Climate Resilient R4D for the AF

Criterion / Parameter	Metrics %	Definition	1 Least score	2	3	4	5 Highest Score
Relevance	25						
• Clear presentation of outcomes targeted • Climate change hazard/s that should be addressed are clearly specified.		• Outcome to be achieved; minimum of 2 • What climate change hazards; is it for preparedness / anticipation (high score) or for disaster risk? • Who are the clients aimed by the project (poor? No? location?) and potential expansive number • Output responds to needs of consumers/clients?					
Effectiveness	25						
• The research problem is defined in the rationale • Collaborations and counterpart		• Understanding of the relevant value chain; socio- economic -political situation / global perspective • Who are the partners (organizations assessed) and prospective sites: use of CRVAs & poverty incidences, digital technologies • Gender inclusiveness					
Efficiency	25						
Feasible and cost-effective solution		• Rigors of analysis (science-based, evidence-based analysis) but replicable; method for replication / adoption by others ensured • Fallback measures for risks • Readiness for adoption • Counterpart funds share					
Sustainability	25						
Mode, pace, degree of adoption: methodology • Extension/advisory services of LGUs • Incubator • Demo farms / field sites • Scale out • Scale up		• Pace of scalability (shorter or longer adoption lag?); maybe combined with extension • Adoption method, replicability • Lowest maybe leave to normal extension route • Cost effectiveness of adoption methodology • Policy and capacity building requirements for scalability					

R4D=Research for Development
AF=Agriculture and Fisheries

DA-BAR's other function in the generation of climate resilient R4D projects is to proactively look for funds to support these projects. Its traditional fund source is from the national government, which as observed earlier, has perennially accorded low funds in relation to what is required for R4D to effectively contribute in the modernization of the AF. Between 2024 and 2028, innovative fund generation measures will be explored, including collaborations with the private sector (see Chapter 9). It can also explore resource pooling with other national governments such as PCAARRD. For the scalability approaches, it can tap government funds like the Go Negosyo of the Department of Industry and Trade, the Competitiveness Enhancement Fund, the tariff funds from the Rice Tariffication law, and the Innovation Grant overseen by the NEDA (see Box 6).

Immediately, DA-BAR will advocate for an increased share of R4D from the national government coffers. There is a lot of catching up that will need to be done for R4D to make a significant impact toward the achievement of the espoused impact of food and nutrition security. Presently, R4D intensity averaged at 0.19% from 2020-2023. This will need to increase annually to reach at least a 1.2% equivalent of the gross value added for the AF by 2028 (see Chapter 9).

Box 6. Promoting local agro-tech solution projects in national development and sustainable economic growth

NEDA announced that the National Innovation Council Executive Technical Board approved the allocation of PHP100 million for 25 innovation projects under the agency's 2023 Innovation Grants; this is in line with R 1293 ot the Philippine Innovation Act. The grants aim at promoting local innovations to pursue national development and sustainable growth. Some of the agri-tech project solutions were the: (i) alternative onion storage system using controlled temperature and automatic airflow mechanism to prolong the shelf life of onions dev by the Occidental Mindoro State College, (ii) Samar State University's Project Geospatial Mapping and Information System for Precise Farming and Smart Agriculture, (iii) Eastern Visayas State University's TABU: A Mobile Application as an E-Commerce Tool for the Agricultural Industry in Eastern Visayas, also made the list of the 25 approved projects; (iv) Philippine Rice Research Institute's proposed Artificial Intelligence for impact-based forecasting and early warning system; (v) the Pre-Commercialization of Non-Hold-On Type Decorticating Machine for Abaca developed by the Department of Science and Technology's Forest Products Research and Development Institute; (vi) Jose Rizal State Memorial University's Prototyping and Pilot Testing of Seaweed Harvester, (vii) Cebu Normal University's From Farm to Market: and Co-creating the Cinnamon Industry in Cebu, Philippines, (viii) Batangas Animal Movement Reporting Approach to Control Diseases by Batangas' provincial government, and (viii) the University of the Philippines Los Baños' Enhancement and Deployment of Smarter Pest Identification Technology.

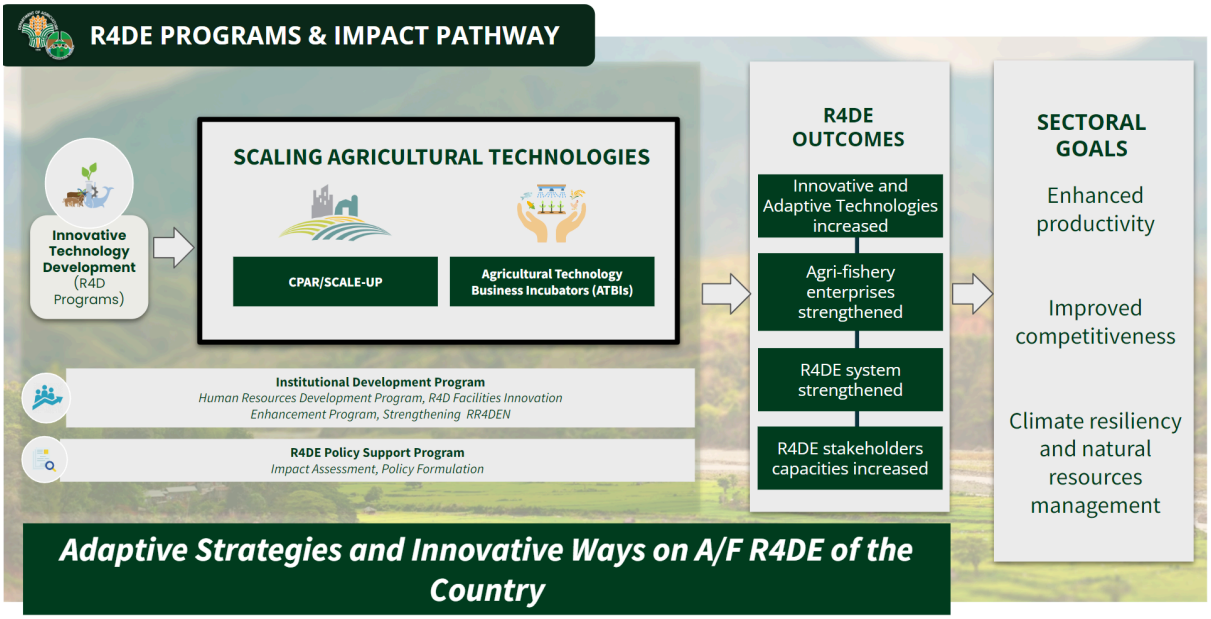
Source: https://www.pna.gov.ph/articles/1213014

Other funding sources have been identified in Chapter 9 and will be explored accordingly in the first years of the CRAFT R4D.

Tasks 2 to 6: Bridging R4D with effective adoption approaches

In recent years, DA-BAR has purposely shifted from serving mainly as a supplier of R4D for AF to enabling the R4D to proactively become a catalyst for the transformational change of the AF into competitive, prosperous, inclusive, resilient and environmentally sustainable agro-based and agrifood systems. Key intervention approaches that are being implemented and that intend to bridge the DA-BAR funded R4D outputs to their end users (small scale farmers, fisherfolk, livestock producers as well as stakeholders involved in the midstream and downstream nodes of the agri-based and agrifood supply chains and those engaged at the upstream nodes) are: (i) the scaling out and scaling up of agri-tech solutions, (ii)institutional development, and (iii) policy support. DA-BAR performs Tasks 2 to 6 to put these approaches into action. These tasks are discussed below in the context of enabling the transfer, adoption, and commercialization of the agri-tech solutions arising from the CRAFT R4D. Undertaking these tasks are envisaged to achieve the perceived R4D outcomes and the sectoral impacts (Figure 31).

Figure 31. R4DE Programs and Impact Pathway



R4DE=Research for Development and Extension Source: DA BAR

Task 2: Develop partnerships and linkages with local and international research organizations

Status:

DA-BAR will continue to work closely with the DA's Agriculture Training Institute (ATI) especially as it is the main agency of the DA that provides extension and advisory services to the AF in close collaboration with the department's regional field offices and the local government units. CRAFT R4D will be implemented in sync with the ***ATI's Philippine Agriculture and Fisheries Extension Strategic Plan for 2023-2028***[15] , particularly in the achievement of the ATI's 4 strategic objectives as these are paramount in bridging the R4D products emanating from the sub-themes to the end-users of these products. The 4 strategic objectives of the ATI's plan are: (i) enhancing capacities for efficient production, (ii) improved competitiveness through agripreneurship, (iii) ensuring nourished farm/fisher families and consumers, and (iv) strengthening agricultural extension institutions and empowering extension stakeholders. In 2024, the close coordination of R4D of DA-BAR and the agriculture extension work of the ATI has been reinforced with the signing of the Memorandum Circular (MC) No. 2 series of 2022. This policy laid down the implementing guidelines on the institutionalization of the agriculture and fisheries resources, research and extension for development network (AFRREDN). The network connects the AF's R4D and extension at national regional levels to

> *"ensure the proper generation, dissemination, and scaling of AF technologies and address the needs of farmers and fisherfolk in the country. Also, this is for the R4DE system to have a bigger impact and contribution to the modernization and industrialization of the Philippine AF sector."*

Major areas of cooperation of the stakeholders in R4D and extension are: (1) knowledge and management, (2) technology incubation, (3) scaling of technologies, (4) co-creation/co-design of technologies (stakeholder engagement), (5) responsive interventions, and (6) policy development. These in many ways reflect the intervention areas outlined in the DA-BAR impact pathways.

DA-BAR brings into the Network the suite of partnerships and linkages that the bureau has instituted with its local and international research organizations. To date, DA-BAR has forged different collaboration modalities with 56 state colleges and universities and local research

[15] *ATI's Philippine Agriculture and Fisheries Extension Strategic Plan for 2023-2028* (https://ati2.da.gov.ph/ati-main/content/sites/default/files/2023-08/AFE%20Strat%20Plan%202023-2028.pdf

organizations, 8 non-government groups, 35 private sector groups, and state colleges and universities and 14 international research organizations. Additionally, DA-BAR has developed partnerships with local government units that serve as the frontliners for local advisory, extension and dissemination of agro-technology innovations as well as developed the appropriate protocols and regulations for the adoption of technologies under context-specific situations.

Forward Agenda:

A new partnership that will be explored during the 2024-2028 years will be collaboration initiatives with domestic-based private financial institutions and their non-profit foundations in test casing various funding vehicles for the R4D scale up of nature-based technology solutions that are of high impact in terms of outreach, environmental sustainability, and financial viability. DA-BAR will likewise explore international climate funds such as the Global Environment Fund, the Adaptation for Smallholder Agricultural Programme, etc. A list of these multilateral funds can be found in https://climatefundsupdate.org/the-funds/ .These potentially large climate funds will open more opportunities for the scale up and scale out of worthy R4D results.

Task 3. Facilitate technology utilization on wide scale

Status:

DA-BAR is prioritizing the scaling of climate resilient agricultural technologies and practices for widest adoption and commercialization especially among communities with high incidence of poverty and low agricultural productivity. Three modalities are employed: ***(i) innovative technology development,*** which covers support to technology generation, verification, promotion, and dissemination, done on farmers' fields, sites, or locations, and directed toward fine-tuning and validating newly developed technologies to determine its feasibility and utility on the ground level; ***(ii) Community-based R4DE Program for Accelerating Farm Productivity and Sustainability (CPAR)***, which ensure the transfer and adoption of technologies from research to the utilization of farmers, fishers, and fisherfolk groups and associations. The program enhances the role of R4D in technology transfer and production management, institutionalizes the active community participation in the planning and management of farm resources, and develops strategies for effective integration of support services for enterprise and agribusiness development; and, ***(iii) agricultural technology business incubators or ATBI***, which focuses on increasing the capacities of research and development institutions to start as technology business incubators and eventually graduating as agriculture and fisheries technology-based enterprises. DA-BAR

provides technical, business, and networking support for them to ascend the supply chain ladder from production-based to innovative agri-business enterprises. The accomplishments in these areas are shown in Table 17.

Table 17. Featured technologies, CPAR, and ATBI in 2023

	Climate Resilient Technologies
Cereals:	
· Rice	● Pest Risk Identification and Management (PRIME) - transitioning PRIME from research to operation to target beneficiaries such as the DA, DA-BPI, DA-PhilRice, DA regional field offices, farmers, and rice consumers; soon for scale out ● Rice Seed Information System, an online, offline, and web-based platform for collecting, consolidating, and disaggregating data of near real-time rice seed production and distribution data at the municipal, provincial, and national levels with ready for scale up in 2-3 years time
· Corn & cassava	● The CGUARD program, Safeguards and improves native corn varieties in the Philippines by preserving and developing the native corn varieties of the Philippines; native corn varieties are collected and screened for varietal improvement. ● The Nutrient Expert software for cassava tailored to a specific field or growing environment; provides farmers with the knowledge to determine the optimal type and quantity of fertilizer for their crops, the ideal planting locations for cassava, and the appropriate timing for fertilizing cassava crops to make informed decisions ● Early warning system for corn and cassava arthropods, pests, and disease utilizing the Open Data Kit, providing timely alerts for farmers, providing them with information to foresee and address potential pest issues, and recommendations for pest management.
High value crops	● Rain shelter technology for off season mangosteen production: asmicroclimate inside the rain shelter was controlled resulting in as drought and higher temperature that triggered the mangosteen trees to induce flowers after 60 days of stress ● Use of CRISPR-Ca9 for banana bunchy top virus ● Bugcheck – bioperticide formulation to control armyworms infesting corn & onions; ready for commercialization after registration with DA-Fertilizer & Pesticide Authority ● Mobile solar-based precooler to minimize postharvest losses and extend the shelf life of highly perishable high value crops and can serve as an alternative cold storage when not in use, especially in remote areas. UPLB will further optimize the prototype as a cold chain facility from precooling to storage and transport of high value perishable crops. ● Utilizing ICT to manage pests thru a mobile application (e-IRM App) that will provide farmers easy access to site-specific integrated pest management recommendations to manage pests, as well as delay and avoid the occurrence of insecticide resistance ● Microbial source tracking of E. coli contamination in fresh produce; used as one of the bases in the development of the Philippine National Standard on General Standards for Microbial Hazard Limits in Primary and Postharvest Food and the FeedProduct Standard.

Organic agriculture	● Ceylon tea production, processing, and marketing in Zamboanga Peninsula; DA Zamboanga Peninsula regional field office & La Oaz Experiment Station led in the technology transfer and commercialization of Ceylon. Women farmers participated; return on capital after 5 years is 426.2% ● Meat processing of organically-grown native pigs and processed products with three farmer cooperatives, two of which have been certified by the Food and Drug Administration with license to operate. DA BAR and the Organic Agriculture Research and Development Center of DA-CALABARZON undertook this technology development.
Livestock & poultry	● Established pyramid breeding structure: nucleus farm for pure line improvement, and multiplier farms to multiply stock or crosses ● Investigating immunological & microbiome composition of native chickens ● Optimized DNA analysis for accurate diagnosis of emerging deadly viruses ● Method & toolkit for detecting ASF developed & pending patent but stalled because it required Food Drug Agency certification of vaccine drug used
Aquatic & marine resources	● Site-specific protocols for red tilapia production established in Ilocos region, Cagayan Valley region, and Central Luzon
Source: DA BAR 2023 Annual Report	

CPAR=Community-based Participatory Action Research
ATBI=Agri-Aqua Technology Business Incubation

Noteworthy CPAR types of projects involved the fishery sector, which essentially linked communities and the development of technology-induced fishery production supply segments to prospective markets. These are the:

- Sustainable production of the African catfish fingerlings at a village-level pilot hatchery, through collaboration of DA NFDRI, BFAR-National Freshwater Technology Center, and BCRFA as cooperators; they adopted: 1) induced spawning using extracted pituitary glands from sacrificed male breeders to female breeders; 2) larval rearing through sorting every day-7 and day-14 to ensure quality African catfish fingerlings; 3) feeding procedures particularly on the propagation of natural food, Moina sp. Eleven grow-out cooperators from Ilocos, Cagayan Valley, and Cordillera Administrative regions obtained and benefitted from the increased hatchery production.
- Improved milkfish hatchery and nursery system protocols developed in Central Luzon & Cagayan: it utilized village-level clusters of milkfish farms with 1 hatchery and 2 nursery farms (which were provided with technical support to improve operations and then upgrade their service; these were linked to grow-out farms for supply of quality fry and fingerlings and markets to nearby provinces.
- Adoption of Modified Intensive fry production and nursery rearing of tilapia *(Oreochromis niloticus)* at village level production in northern Luzon. During the COVD19 pandemic when supply of tilapia was hampered with logistics restrictions,

this project was conceived with the aim of ensuring sustainable quality seed stock of tilapia. This was done though a modified intensive hatchery (MITH) and fry rearing of tilapia to advance fingerling stage through close cooperation and partnerships of the village-level hatchery that learned the MITH technology and the fry rearing nursery cooperators that were provided with training and some advance equipment. The two forged close cooperation with the grow-out farms and these in turn, expanded their market ties. The combination of good technology for the nursery and hatchery and the grow-out farms ensured steady supply of tilapia and stabilized prices for this fish to the end-consumers.

Forward Agenda:

A comprehensive study of the lessons generated from these experiences of DA-BAR (from 2020 to 2023) as well as other country cases shall be done to find measures of making these impact pathway instruments financially and sustainably feasible as wide-scale measures for R4D dissemination, adoption, transfer, replication, scale out and scale up. Partnership arrangements such as public-private approaches, private sector coordination or integration agreements, management contract agreements, and joint venture schemes will also need to be assessed in terms of their appropriateness in the development, adoption, and commercialization of climate resilient technologies. **It is envisaged that by 2028, at least five of DA DA-BAR sponsored R4D technologies, practices, and protocols would have been scaled up or scaled out.**

Additionally, external experts will need to be tapped to assist in the packaging of proposals targeting the multilateral organizations and capacitate DA-BAR staff and also DA ATI as well as PCAARRD in the preparation of large-funded climate resilient projects. More technical capacities essential for the DA-BAR to become technically equipped to serve as catalysts for these transformational changes are described in Task 6.

Task 4. Strengthen institutional capabilities toward improved governance and progressive modernization of the AF sector

Status:

DA DA-BAR has a two-pronged approach to institutional capability development: the first involves providing degree scholarships and thesis grants; support for scientific career development as means for career recognition, progression, and rewards for public service; and support for DA employees who are involved in scientific and technological activities to avail of the benefits accorded by the Magna Carta for Scientists, Engineers, Researchers,

and other Science and Technology Personnel in the government, and participation in various online workshops, seminars, and short-term technical and non-technical training courses. The end goal of this array of human resource development activities is to build a cadre of agri-based and agrifood scientists, researchers, and other science and technology technical staff. The second approach to institutional development is through research facilities development.

Since 2000, the degree scholarship program has produced 129 gradates – 68 at MS level and 61 earned their PhDs. In 2023, DA-BAR supported 10 MS degrees and 5 PhD scholars. In 2023, DA-BAR admitted 10 applicants for the scientific career system, while it facilitated the evaluation and endorsement of 2,534 applicants for the Magna Carta for DA science and technology workers of whom more than 96% were approved and received the certificate of eligibility. Key short-term training and forums conducted in 2023 were: (i) consultation workshop for the consolidation and harmonization of the agri-fishery climate change R4DE agenda and programs 2024-2028 (precursor activity for the development of the CRAFT R4D), technology readiness level workshop, validation workshop for the process documentation of DA-DA-BAR's ATBI program; Go Negosyo training for DA-BAR-ATBI project implementers; etc.

The second approach is through the modernization of research facilities and equipment. In 2023. A total of 5 facilities were upgraded in response to the R4D needs of its farmer clients. These included the tissue culture facility of the Mindanao State University that responded for the increased demand for tissue-cultured saba plantlets; a tissue culture of banana seedlings laboratory upgrade at the University of Southeastern Philippines; the upgrade of the hatchery of the Romblon State University to increase the production of fish fry in response to the needs of small-scale fisherfolk; the refurbishing of the crop processing facility of the Quirino State University to cater to the processing needs of both food processors and farmers in the province; and the Technology Commercialization R4D center with the DA-MIMAROPA.

Moving Forward:

One area to explore further is the government-to-government (G-2-G) collaboration for agri-based and agrifood system collaboration. Important G-2-G collaboration would be: DA-BAR- Department of Agrarian Reform to explore innovative farm consolidation and clustering modalities as well as farm management approaches; DA-BAR and Department of Tourism to find ways of incorporating tourism and climate resilient AF sector development; DA-BAR, Food Development Center, and the Food and Nutrition Research Institute to come

up with a stronger database for the nutrition aspects and links of food security for achieving healthy, safe, affordable and nutritious food as well as to come up with more strategic action agenda for promoting safe and nutritiously dense food; and DA-BAR and the Food and Drug Administration to come up with streamlined protocols for registration of animal and plant-related vaccines as well as coordinate DA-BAR research on vaccines and other related drugs at the start of the R4D activities; these will ease the conduct of businesses and encourage the use of the vaccines.

Another area for partnerships is to come up with development interventions that will organize smallholder farmers to link them effectively with private investors of both domestic and foreign R4D. This strategy ensures horizontal and vertical coordination and can pave the way for inculcating an innovation culture and entrepreneurship. DA-BAR has started work in this area of partnership with the LGU support (Box 7).

Box 7. R4D collaboration with the local government

The LGU Muñoz and Bauertek Corporation collaborated for the establishment of a state-of-the-art research, manufacturing and development facility in the premises of the Central Luzon State University. DA-BAR partnered with Bauertek Corporation with the aim of linking stakeholders to the private sector that may provide further support in the implementation of R4D programs, projects and activities.

Source: DA BAR 2023 Annual Report.

More partnerships should be scaled up during this CRAFT R4D time frame especially in the areas where the technology innovations have already been tested and verified in terms of acceptability and adoption by its prospective farmer-clients. In 2023, several projects showed promise of scaling up and/or scaling out (Box 8). Further work will need to be done to see their financial and sustainable viability.

Box 8. Time to Scale-up or Scale-out: a priority implementation agenda under CRAFT R4D

Soil Health Cards. Together with DA regional field offices and LGUs, DA-BAR has piloted the SCALE-UP program of soil health cards in Ilocos Region, CALABARZON, Eastern Visayas, and Zamboanga Peninsula. Various soil health activities were conducted in participatory manner with farmers, such as developing regional crop suitability and water resource map; conducting GIS-based soil health thematic maps with corresponding fertilizer recommendations; incorporation of these information in the soil health cards. Adoption of the farmers in these regions are high considering the impact on their farm incomes and production costs.

Legume products through technology business incubation. Capitalizing on the region being the peanut and mungbean capital of the Philippines, the Cagayan State University (CSU) established the CVLTBI with DA BAR support. As a startup enabler, CSU it addressed the gap between the legume industry and its supply chain and the university's research and innovation by providing technology generation and transfer, techno-preneurial training, and other training tailored to the needs of the legume industry. As a result, the CVLTBI initiated the application and publication for Utility Models of three selected incubatees' products to the Intellectual Property Office of the Philippines.

Ready-to-drink and ready-to-eat from passion fruit, bignay and lipote. It is a joint project of UPLB and farmer partners. Through the project, the processing of passion fruits into puree were standardized; ready-to-drink products were developed including passion fruit juice, passion fruit-lipote juice, and passion fruit-bignay juice; and ready-to-eat jelly snacks like passion fruit jelly, passion fruit-lipote jelly, and passion fruit-bignay jelly were also produced. Farmer-partners, PFVGMAL and SINLIKAS Import Export Packaging, underwent trainings on good manufacturing practices, sensory evaluation, and alpha testing of food products to equip the processors with the skills for better product development. The PFVGMAL is the major supplier of the raw materials and the SINLIKAS provides the processing facility. The project also assisted the farmer-partners on the different label designs for their products. This collaboration resulted in increased utilization for passion fruit, lipote, and bignay. The developed technologies also provided an avenue to generate additional incomes and job opportunities.

Daerrys tilapia ice cream and cookies. The CLSU and its farmer partner, Manggagawang Bukid ng Guimba Agriculture Cooperative, served as part of the supply chain from the spin-off company, the Vera Bella Enterprises Limited Company. The latter was registered with the Security Exchange Commission. As part of the legal requirement in the technology transfer, two Technology Licensing Agreements were forged, with CLSU and as an incubatee of CLSU-Agri-Fisheries Technology Business Incubation, which developed the technology that eliminated the fishy flavor and after taste of tilapia following a series of steps in cleaning, cooking, and made into flakes. Value products were produced: tilapia ice cream classic cups; tilapia ice cream classic sandwich; tilapia ice cream praline crunch; tilapia ice cream fryewich; tilapia oatmeal cookies fingerleengs plain; and tilapia oatmeal cookies fingerleengs choco dipped. Nutritional analyses showed that the products contain more protein than the commercially available ice cream, can be marketed as a high protein dessert and snacks and can help provide more protein to children and individuals to alleviate malnutrition. Currently, the Daerrys products are distributed in Nueva Ecija, specifically at Milka Krem, Science City of Munoz, Philippine Carabao Center at CLSU, Daerrys Scoop 'N Bites, Shell Select, Mega Shell, etc. Partnerships and agreements with small business enterprises like Kaffeina Café, Enrico's Food Products Trading, EDJE Food Products Manufacturing, and Justainable Philippines were also established. A Joint Venture Agreement was likewise forged with PWD Smart Farmability, Malaysia, to introduce the products to the global market. And in the early 2023, first tilapia ice cream shop-Daerrys Scoop 'N Bites-opened to the public, showcasing various products and menus highlighting Daerrys tilapia ice cream and tilapia cookies.

Soya products in Quirino province. The Quirino State University through the DA BAR, implemented a project that promotedand hopefully would commercialize bakery and snack products using soya flour as base ingredient, as healthy and high-protein food. The soya-based products included soya pandesal, soya nuggets, soya butterscotch, banana soya bread, and soya loaves. To sustain the source of raw materials for product processing, interested soybean farmers entered into a contract growing scheme, with an assured 116% rate of Return of Expenses. One of its clients was QYEA, which forged a memorandum of agreement to supply its soya bakery products to the feeding program of DepEd and DSWD. Subsequently, 1welve Technology Licensing Agreements were entered among the adopters of these soya products, stipulating their role to adopt and commercialize the technology transferred to them by the soya project of the University.

Task 5. Manage knowledge

Status:

DA-BAR maintains four social media platforms, namely Facebook, Instagram, YouTube, and a website. These platforms serve as venues for communicating and disseminating the bureau's programs, strategies, supported projects, activities, and R4D generated technologies. These platforms also serve as knowledge exchange forums. Aside from these, imparting knowledge is done through publications and other printed forms such as manuals, infographics, etc.

Moving forward:

Dashboards will be developed (see Chapter 5 on the stepwise progression of the dashboard development). These are platforms that combine (i) the aggregation of relevant information on agri-based and agrifood production and value chain systems with (ii) analytical visualization tools that enable key stakeholders to understand the chokepoints as well as opportunities where transformational changes can be targeted. It enables stakeholders like the policymakers to make better, more informed, and data-driven decisions on R4D and extension interventions that are directed toward climate resilient, competitive, and inclusive modernization pathways for the AF sector.

The first dashboard system that will be developed in 2024 is the aggregation of climate resilient, locally tailored nature-based technology solutions and practices, and protocols and regulations that have been developed from DA-BAR's R4D projects. The objective of this dashboard is to place into one digitalized system all these R4D works from 2020 to date of DA-BAR, the database of which may possibly be expanded to include those from PCAARRD and members of the AFRREDN and the Regional AFRREDN. Status in terms of the pace of their transfer, replication, adoption or commercialization through scaling up or out measures will also be included in the dashboard. The visualized analytical tools (e.g., pie charts, tables on cost-benefits, financial and economic viability, etc.) will provide easy to understand analysis on the uptake, chokepoints, and opportunities for transformational changes. Feedback loops and increased social media use will also be established. Tiktoks that illustrate or promote several technologies may also be looked at as a modality for extension.

Dashboards on agri-based and agrifood production and value chain systems that emanate from the R4D works will also be developed with the end-view of providing the evidence- and science-based information (e.g., supply and demand data) and highly visual analytical tools

(e.g., cost-benefit, revealed comparative advantage) that are essential for market intelligence in general and for planning and decision-making of investments in particular.

More dashboards on the knowledge products generated from the R4D projects and AFRREDN activities will be provided during this period (see Chapter 5). As mentioned earlier, a dashboard will focus on market intelligence data (e.g. supply and demand) and basic market analytical tools (e.g., internal rate of return, profitability ratios) of the agri-based and agri-food production and value chain systems. The market intelligence dashboards to be classified by the commodity systems prioritized by the NAFMIP, will be useful in identifying R4D and extension efforts that are societally more impactful- economically, politically, socially, and environmentally. These would contribute in accelerating the modernization pathway of the AF toward a prosperous, inclusive, climate resilient and environmentally sustainable sector.

A set of dashboards on the financial and organizational state of DA-BAR and AFRREDN will also be included to ensure transparency and accountability.

Another dashboard will be developed that is dedicated for indicative projects which will serve as a repository of R4D proposals. Additionally, the indicative dashboard will be used to project R4D investments in the medium term and can serve as a lobbying tool for the increase in R4D funds.

Task 6. Advocate policies for progressive agricultural and fishery sector value chains

Status:

The following were achieved in 2023 and early 2024:

- Special Order (SO) No. 36 series 2024- creation of the DA National Intellectual Property and Technology Transfer Committee
- Administrative Order No. 2 on the implementing policies and guidelines and procedures for the establishment and operations of the Agriculture and Fisheries Mechanization RDE Network
- The next two are on the institutional development of human technical resources; these are (i) SO No 39 Series 2023 on reconstitution of the DA scientific career system evaluation committee, (ii) MC No 28 Series 2023 on DA-BAR grants manual
- Site specific protocols for red tilapia production involving provinces of Ilocos, Cagayan Valley, Central Luzon, Cordillera Administrative region, and Bicol region

- Method and test kit for detecting ASFV developed and is pending for patent
- Tissue-cultured clones of drought-tolerant & semi-dwarf Saba & obtaining higher yields developed, protocols done, and banana plants disseminated to farmers in drought-prone areas

In support of maximizing the utilization of technologies generated and developed from the DA-BAR initiatives, it continues to strengthen its intellectual property (IP) policy by (i) first evaluating the products in terms of IP potential, and (ii) support in compliance of the Intellectual Property Office of the Philippines' examination reports. In 2023, these included:

- Assistance to the DA- Bicol Region in the drafting of claims and online filing for a utility model on the process for producing milk from Pili.
- DA-SOKSSARGEN was assisted in trademark application for the logo to be used in the ATBI program.
- In 2022, the Central Luzon State University successfully received its certificate of registration in 2022 for Nutri Orayz from IPOPHL. DA-DA-BAR filed the trademark in 2021 to cover the developed products like instant rice porridge, rice cookies, and rice milk-based ice cream substitutes.

Forward Agenda:

The policy agenda that emanated from the R4D undertakings from 2021-2023 and will need action are listed in the Table below.

Table 18. Agenda for policies, protocols, regulations for 2024-28

Policy/Protocol/Regulatory Measure	2024	2025-2026	2026-2028
Policy advocacy & incorporation in GAA of increased funding for R4D for climate resilient AF: from 0.19% to 1.2%	Commence advocacy	Either increase annually or commitment to increase for the next 4 years reaching 1.2% of GVA	
Policy on the prevention and control of invasive species in the aquaculture areas			
Policy or regulation concerning the introduction of invasive aquatic species to be cultured			
Policy on the recommendation on the restoration of native biodiversity			

Policy on Geographic Indication (GI) for indigenous agriculture and fishery commodities	Start work on potential of GI for pili; study on other potential crops, livestock and fishery commodities that can meet GI & capture wider market outlets internationally		It is hoped that at least 3 GI products from the Philippines will be approved.
Study on smart policies for promoting technology innovations in the AF (e.g., encourage entrepreneurship by expanding Small Business Administration credit for start ups; adding entrepreneurial skills courses in agriculture science schools ; offering tax incentives for R4D scale out /scale up; review of the IP policy in relation of promoting innovations in AF, etc.)			
Trade-related policies on agriculture and fisheries; promoting those with high revealed comparative advantage for export Trade related policies on agriculture and fishery imports			
Policy for a sustainable milkfish broodstock management program to ensure reliable supply of high-quality milkfish eggs for the nursery, including protocols for milkfish hatchery & nursery			
Policy on preventing and controlling respiratory and gastrointestinal swine viral infections; may require DA BAR and FDA memorandum of agreement to streamline the process of registration of animal and plant vaccines			
Policy on optimized DNA analysis for accurate diagnosis of various livestock viral diseases			
Protocol standards using molecular based analysis to determine the authenticity of coffee green beans roasted & ground coffee for authenticity & ensure proper labelling			
Policy on ultra-processed foods			
Policy on increasing the funding modalities and sources of DA BAR for climate resilient R4D			
Policy on developing a scorecard for DA on the identification of programs, activities, and policies for systematic climate change expenditure tagging			

Source: DA BAR Annual Reports, 2021-2023

An imperative and immediate policy action that is urgently needed is the increase of funding for R4D for the AF sector. The proposal is to increase this funding in phases within the period of 2024 to 2028, from a low of research intensity 0.19% for R4D and extension for the sector for the past years to a target of 1.2% research intensity by 2028. The rise in research intensity is less than the 1.7% as proposed by ASTI (2018). For this plan, the proposed research intensity is from 0.19% to 1.02% by 2028 (or earlier) to fund particularly those sub-themes that have not been well-funded in the past; funding for out-scaling, upscaling, replication, incubator activities of climate resilient technologies, practices, regulations to ease the cost of start-ups and registration of micro and small agri-based businesses; grants for formal and informal trainings to boost the number of scientists including food scientist, nutritionists, agri economists and agribusiness short term courses and on-the-job trainings, etc.

Other policy reforms and more standardized and streamlined protocols and regulations will ensue from the R4D and extension works of DA-BAR and AFRREDN.

To serve as an efficient and effective catalysts for technology promotion and dissemination, as well as for development of novel scale-out or scale up arrangements, the following trainers' training capacity to retool the DA-BAR staff shall be needed; they in turn will capacitate the researchers/implementers of DA DA-BAR funded projects:

- Business incubation, technology transfer, business plan preparation
- Orientation of DA IP policy guidelines and technology pathway
- For DA BAR technical staff, (i) policy analysis and formulation of policy briefs, development of protocols and regulations, and (ii) intensive technology promotion modalities, (iii) Technology readiness/valuation assessment of each project, (iv) results based evaluation and monitoring system, and (v) modern communication tools.

E. DA BAR as it steers CRAFT R4D for the AF Sector

The CRAFT R4D document is NOT cast in stone. It is a "living document" that will be regularly assessed in the context of the variable, more frequent and intensifying changing climate, global economic and political (both the known such as the Ukranian conflict, the growing and uncertain Middle East conflict, increasing geo-spatial influence of the PRC, etc.; and the "unknown " factors such as another global health pandemic) and the domestic environment. Lessons generated from the R4D initiatives and extension work as well as the

latest legal and legislative developments that may deter nature-based technology innovations will also have to be taken into consideration.

Cognizant of these global and domestic perspectives that will have direct implications on both the demand and supply side of the public funded R4D (and now, including the public-operated extension services through the AFRREDN; refer to Chapter 4), the 2024 action agenda measures, which are firm, will play a catalytic role in accelerating the transformative adaptive stage of CRAFT.

To summarize, the key measures that were identified for the start-up of CRAFT R4D in 2024 are:

- The 39 climate resilient R4D projects that have been approved, funded and are in their implementation phase
- The set up of the first dashboard to be lodged at the DA-BAR, which is the suite of climate resilient R4D nature-based technology innovations, practices, protocols and policies that were developed from 2019-2023; the inventory will be regularly updated.
- Advocacy for an increased budget for the R4D, the increased share (from the present 0.19% research intensity to 1.2% research intensity) shall be phased from 2025 to 2028; the DA-BAR will draft an Administrative Order of ensuring the fruition of the budget increase
- The set up of the baseline data for quantifiable and evidence-based metrics for measuring the outputs, outcomes and impact consistent with the PDP RBME for the AF sector (see Chapter 8); the RBME framework will be done in a consultative and participatory manner. The data will be gender disaggregated and nutrition related indices will likewise be included.
- The pipeline works and activities on the 7 sub-themed climate resilient R4D for 2025 will be assessed, validated and verified in a participatory fashion. Finalization is envisaged by second semester of 2024.
- Joint calls for the R4D projects by DA-BAR and PCAARRD will commence by 2025 to set the stage for the 2026 to 2028 time frame of CRAFT. Evaluation of the criteria for the selection process will be done employing the proposed scorecard in the CRAFT and will be applied by joint calls for proposals of DA-BAR and PCAARRD.
- Generating more funds for enlarged R4D agenda with built-in measures for the scale up or scale out of successful and impactful R4D through the replication, transfer, adoption and commercialization modalities will be done. The first priority is to retool and build the technical capacities of DA-BAR and the secretariat of the AFRREDN to

commence the project/program proposals for funding from the multilateral climate funds.

- The policy component of the DA-BAR will be organized and operationalized by end quarter of 2024. Important protocols and regulations for the ease of business of adoption and commercialization of R4D innovations will be identified and policy analysis performed for actions at the department level. The DA-BAR together with PCAARRD will set up a technical working group to initiate a policy dialogue to discuss the priority policy issues that will require executive or legislative actions. Part of the policy concerns will be the array of trade related policies as these impact market access for the country's agri-based and agri-food commodities and products that have a comparative edge.
- The skeletal communication plan is included in the CRAFT (Chapter 9). A team from the DA-BAR will be instituted to flesh out the communication plan for its commenced implementation.

Moving Forward

The pipeline works and activities for 2026-2028 on the 7 sub-themed climate resilient R4D will be assessed, validated and verified in a participatory fashion by the last quarter of 2024. Dialogues for consultation will be done through the AFRREDN and the regional AFRREDN. Changes to CRAFT may ensue as global and local contexts interplay, influencing the R4D landscape. Changes should aim at accelerating the modernization pathway of the AF sector by enhancing the productivity and profitability for each of the value chain nodes; augmenting the income sources and job opportunities for the rural labor force through value chain ascendancy type of works diversified income sources that are gender-sensitive; expanding to nutritious and safe products; and consciously ensuring resource utilization that is cost efficient, least wasteful, biodiversity-friendly, and facilitate renewable and recycled forms of inputs. It is envisaged that by 2028, the R4D together with demand-driven extension services will contribute significantly in putting the AF sector on the modernization track that assertively ensure a suite of affordable, accessible, environmentally friendly produced and climate adapted nutritious and safe food products in agri-based inputs.

Chapter VII

IMPLEMENTATION ARRANGEMENTS: RESULTS-BASED MONITORING AND EVALUATION SYSTEM

To ensure transparency and accountability in the governance and management of the CRAFT R4D and its contribution to the AF sector, a robust results-based M&E (RBME) is paramount. RBME is different from the usual M&E schemes employed in implementing projects and programs because it puts emphasis on the achievement of the outcomes and impacts more than the delivery of the outputs and inputs. While the traditional way of M&E is still important, it is imperative for agencies to account for effects of interventions rather than measuring success by physical and financial accomplishments alone. RBME provides DA-BAR the systematic tool for regularly assessing the progress of its implementation of the CRAFT R4D. Further, RBME provides crucial insights for policy recommendations to further enhance the development of projects and programs, and the recalibration of this project and the overall CRAFT R4D. This RBME is done at two levels: one at the project level, and the other at the DA-BAR level. This chapter expounds on the RBME system for these two levels.

A. Key elements of the RBME

The overall goal of the CRAFT R4D Medium Term Plan 2024-2028 is a climate-resilient AF sector that ensures food security and nutrition by minimizing the effects of climate change on the productivity and income of farmers and fishers while maintaining the long-term sustainability of the AF resource base with increased R4DE budget/funding.

Its development objectives are to have an integrated agriculture and fishery R4DE program that builds and enhances the national and local capacities to minimize risks and reduce the vulnerability of rural communities to variable and changing climate.

The indicative Key Performance Indicators (KPIs) are specific, often quantifiable metrics, used to measure progress toward achieving the desired outputs and outcomes of a project or program. In the context of the seven sub-themes and its R4D potential project areas in the DA-BAR, KPIs could include metrics related to agricultural productivity, competitiveness, sustainability, adoption of best practices, social inclusion, impact on farmers' income, and more.

Potentially many KPIs can be identified and used in any context, but the objective should be to select those measures that have certain inherent qualities that deliver the most value as a

tool for policy analysis, program M&E, performance improvement, and communication of results. Often, the acronym “SMART” is used to refer to the characteristics of good performance indicators. Each letter of the acronym represents an important characteristic of an indicator: Specific: It is clear from the target how success is defined; Measurable: Reliable data exist, are easily collected, and can be accessed in time to be useful; Achievable: The target level should be a challenge, but not impossible to reach (Conversely, if a program always exceeds its targets, the targets are probably not sufficiently ambitious); Relevant: The target supports what the program or activity fundamentally wants to achieve; and Time-bound: There is a clear deadline for when the target must be achieved.

When defining a KPI, therefore, the minimum data sets should include only the core data elements required to operationalize that KPI, and to the extent possible, maximize use of any existing routine computer-based RBME system and personnel. Table 22 shows the KPIs for each sub-theme of R4D.

In navigating the CRAFT R4D strategy toward achieving the envisaged outcomes and impact, a simple but quantifiable ***design and monitoring framework (DMF)*** shall be used at two levels: one is at the R4D project level (Figure 33), and the other is at the DA-BAR level (Figure 32).

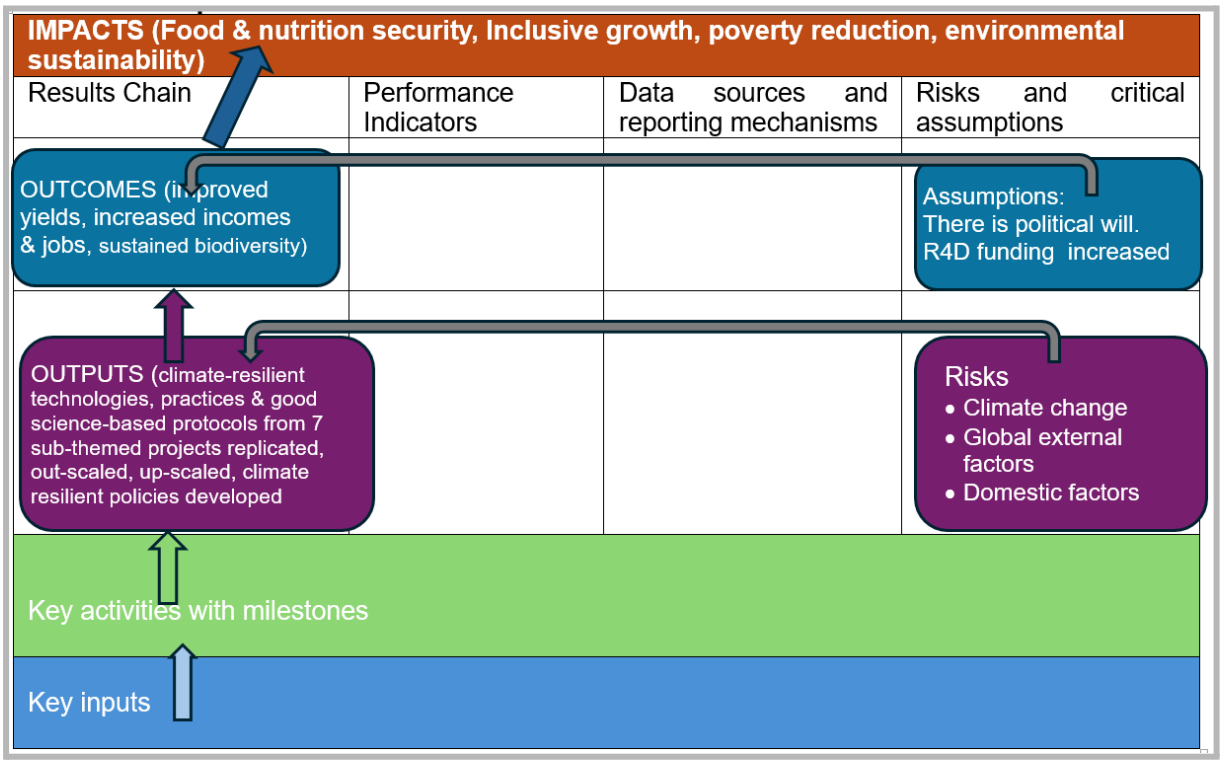
B. DMF at DA BAR Level

The DMF at the DA-BAR level is represented in Table 19 wherein the overall causal pathway from which the CRAFT R4D navigates is laid out and factored in for monitoring and evaluation. The DMF focuses on what has to be done (i.e., the outputs); how to do it within a specified timeframe and the resources that are available for use (key activities and inputs); the risks involved (uncertainties due to continuing climate change compounded by other global and domestic factors that may ensue); and the assumptions (which have to be grounded on the existing environment). Quantifiable or measurable parameters that are verifiable are specified at the start of project and strategy implementation. The DMF serves as the guidepost of DA- BAR in enabling it to make an objective assessment of whether the outputs of the projects can be achieved. In turn, these indicators are linked to the outcomes, which also have quantifiable performance-related barometers. The stepwise flow pathway (from key activities>>outputs>>outcomes>>impact) provides the parameters for gauging if the outcomes proposed by the project can subsequently contribute to the envisaged outcomes and impact. The risks (the primary one for this strategy is changing climate) and assumptions will need to be examined regularly to ensure more pragmatic climate resilient

solutions. Table 20 and Table 21 present the KPIs, MOV, and Risks and Assumptions for the outputs (performance-based) and the short-term outcomes (results-based) of the DMF.

Figure 32 is the DMF for the DA-BAR as it enforces the CRAFT R4D AF. By 2028, it is envisaged that with the achieved outputs, outcomes are ensured through out-scaling, up-scaling and massive replication approaches, and that the AF sector is on the modernization track towards inclusive, prosperous, resilient, and sustainable growth.

Figure 32. Results based Monitoring and Evaluation Framework of the CRAFT R4D Implementor: DA BAR



Source:ADB, 2020, pp. 3-21. The formulation process is equally important; see pp. 22-37.

CRAFT R4D=Climate Resilient Agriculture and Fisheries Through Transformative Research for Development

Prior to the RBME implementation, a baseline study will be conducted to develop the baseline information for the performance indicators specified in the DMF; the baseline data are then compared with the target KPIs. The baseline data will be gender-disaggregated to ensure that gender issues are taken into account. Such baseline assessment will be implemented by the M&E technical working group of DA-BAR, along with routine monitoring schedules and budget support for a digital M&E system.

In addition, short-term, medium-term and long-term evaluations will be conducted by external evaluators to assess the progress of implementation of the plan. Results of these studies shall provide insights on the status of implementation and policy recommendations in the continuation or recalibration of the plan.

Table 19. Results Framework for the DA-BAR CRAFT R4D Plan 2024-2028

OUTPUTS			RESULTS			
Inputs	**Activities**	**Outputs**	**Short Term Outcome**	**Medium Term Outcome**	**Sectoral Goal**	**Societal Goal**
R4D Funds and investments Technical Capacities R4D Personnel, Researchers, experts Machineries	Sustaining R4D enabling environment	R4D enabling environment sustained	Climate-related R4D initiatives intensified Climate resilient Products, Publications, People and Places, Policy, Places and Partnerships, and Intellectual Property ready for adoption, upscaling, outscaling, commercialization increased	Productivity improved Incomes and Yields diversified Biodiversity sustained	Economic opportunities in agriculture, forestry and fisheries products expanded Access to economic opportunities of farmers and fisherfolk increased Consumer options for more affordable, nutritious and locally-grown food expanded	A food-and nutrition secure, resilient Philippines with empowered and prosperous farmers and fisherfolk Inclusive growth Environmental sustainability Poverty reduction
	Increasing capacities of R4D stakeholders and institutions	Capacities of R4D stakeholders and institutions increased				
	Implementation of Proactive Communication Plan	Proactive Communication Plan actively implemented				

DA-BAR CRAFT R4D= Department of Agriculture-Bureau of Agricultural Research Climate Resilient Agriculture and Fisheries Through Transformative Research for Development

Table 20. Short-term outcome, indicators, and MOV

Short Term Outcome	KPI	MOV	Risk and Assumption
Climate-related R4D initiatives intensified Climate resilient Products, Publications, People and Places, Policy, Places and Partnerships, and Intellectual Property ready for adoption, upscaling, outscaling, commercialization increased	No. of climate resilient technologies generated, practices, innovations and modalities developed, verified ready for adoption, upscaling, outscaling, commercialization ST1. No. of research designs and modelling approaches developed No. of agroecological and climate related impact studies conducted No. of climate resilient varieties and breeds improved, tested, evaluated No. of genetics R4D initiatives conducted and completed ST2. No. of water, land and energy efficient technologies or models generated ST3. No. of practices on resource decoupling developed No. of zero waste technologies generated ST4. No. of technologies and management protocols across the different nodes of the value chain developed Percentage increase in the number of smallholder farmers accessing markets No. of partnerships with local communities and organizations to enhance resilience ST5. No. of digital technologies developed/established ST6. No. of nutrition focused studies conducted ST7. No. of alternative livelihoods for income diversification promoted/ready for adoption	Project reports (interim, annual, completion) BAR and other agency Annual Report	Sustained linkages and continuum among Research, Development and Extension partners and institutions. Knowledge and outputs from R4D are adopted and utilized by stakeholders Inconsistent policies in addressing climate related risks and hazards. More frequent and increased in intensity of climate hazards

Table 21. Outputs, indicators, and MOV

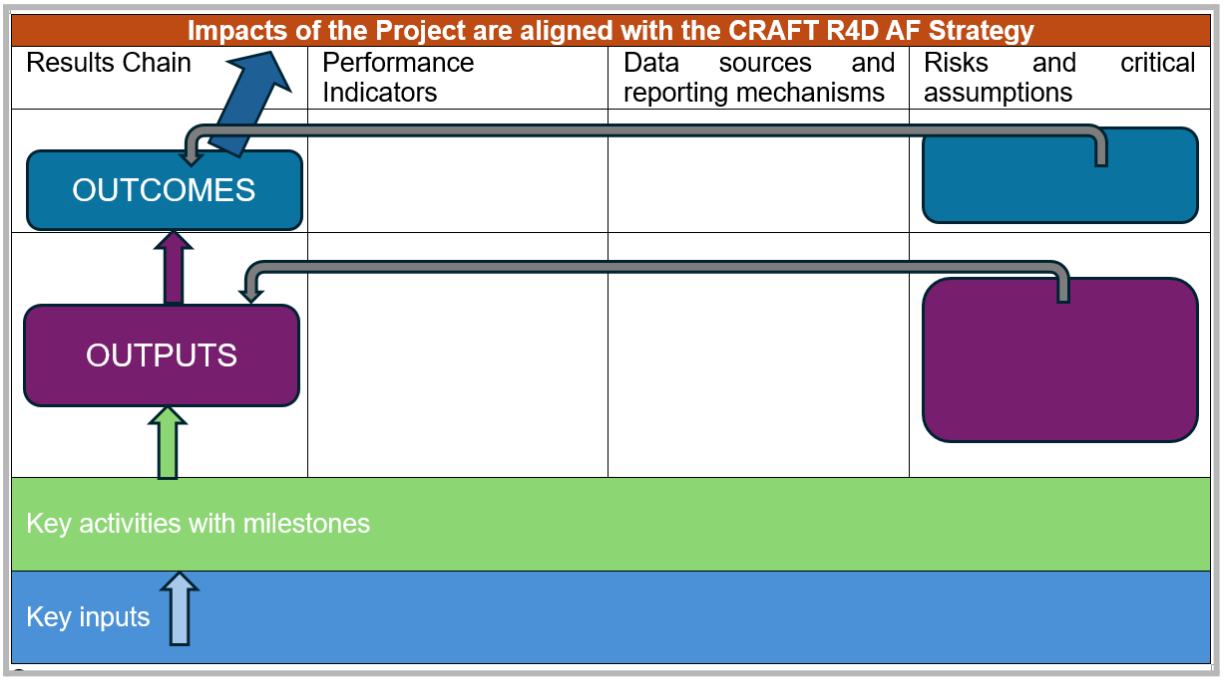
Outputs	KPI	MOV	Risk and Assumption
R4D enabling environment sustained	No. of R4D proposals reviewed and evaluated No. of R4D projects approved, funded and implemented No. of ongoing and completed R4D projects monitored and evaluated No. of research institutions engaged and collaborated with % R4D projects adherent to the proposed timelines Policies, protocols, and regulations for an enabling climate resilient R4d implemented R4D increased annually by an average of 25% from 2025.	Reports from concerned BAR divisions	Continuous technical and funding support to R4D initiatives and collaborative efforts among R4D institutions Sustained interest and prioritization of and adherence to climate resilient agenda and plans. Unforeseen delays and recalibration of programs and priorities through changes in management
Capacities of R4D stakeholders and institutions increased	No. of capacity building activities conducted (trainings, workshops) No. of research institutions supported and assisted No. of individuals supported and assisted	Activity reports, Project reports	
Proactive Communication Plan actively implemented	No. of R4D outputs disseminated to next users (e.g. extension, operations, banner programs, LGUs) No. of stakeholders (e.g. research institutions, policymakers) aware of the plan No. of knowledge products produced Frequency of utilization of communication channels Engagements in multimedia platforms	Link of digital knowledge products Printed materials/ outputs	

MOV=Means of Verification

C. DMF at Project Level (by sub-themes)

Further, the DMF is broken down into the seven (7) different sub-themes which will become the roadmap of R4D proponents, partners, and other research institutions at the project level (Figure 33). Similarly, the activities and outputs of the various sub-themes all converge, in a stepwise manner (from key activities >> outputs >> outcomes >> impact), into the overall development objectives, outcomes, and impacts envisaged in this plan. Hence, all projects should contribute in achieving the desired outcomes and impact of DA-BAR as an institution.

Figure 33. Results Based Monitoring and Evaluation Framework at the Project, Sub-Theme Level



Source: ADB, 2020. PP. 3-21. The formulation process is equally important; see pp. 22-37.

The R4D proposals will undergo a series of processes which are laid out under DA-BAR's Grants Manual (GM)[16]. The GM covers screening/evaluation, approval and funding, and monitoring and evaluation of R4D projects. Among the key activities are a series of review and evaluation of proposals by DA-BAR and external experts prior to approval and funding to ensure adherence of proposals to this plan. Moreover, mid-term and end-term evaluations are conducted similarly by BAR and its pool of external evaluators to assess the continued relevance of an intervention and the progress made toward achieving its planned objectives; they provide an opportunity to make modifications to ensure the achievement of these objectives within the lifetime of the project, as well as identifying areas for improvement for the CRAFT R4D plan in next medium term.

[16] DA Memorandum Circular No. 28 Series of 2023: Revised Grants Manual (GM) of the DA-Bureau of Agricultural Research.

Table 22. Proposed target output and outcome key performance indicators of sub-theme of CRAFT R4D Medium Term plan

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 1: Technology and Innovations for sustainable agriculture, fisheries, and livestock	• Genetic improvements for excellence in agronomy • Sustainable intensification initiatives • Responses to crop, fishery and livestock diseases and alternative sustainable methods and practices of pest and disease control • Sustainable productivity of crops, livestock, fisheries • Managing the plant microbiome • Research studies on the impacts of climate change on fish and fishery concerns & climate-smart solutions: (1) changes in migratory routes of fishery resources; (2) alterations of fish reproduction and stress responses; (3) Increased risks of speciation, low survival, and immobility; and (4) habitat disruptions. • Complex crop/farming systems research, multiple commodity-wide value chains (diversification), natural resource management & embracing technology (e.g. crop rotation, intercropping, organic farming) • Livestock management strategies • Fishery management strategies • Innovations in buffer stocking for emergencies and natural disaster preparedness • Agroecology research, managing whole systems and landscapes • Reducing or eliminating crop tillage • Promoting biodiversity	Research designs and modeling approaches to assessing impacts of changing climate and its effects of new technologies at different ecosystems for sustainable agriculture, livestock, and fisheries prepared and adopted for upscaling Climate-resilient varieties and breeds tested and evaluated for efficacy Commodity development on gene-editing strategic/action plan to ensure long-term productivity is prepared and established No. of climate-resilient technologies generated ready for commercialization and adoption by farmers and fishers	DA-BAR R4D functions and services are efficiently and effectively performed in target farmers, fishers, and other stakeholders and partners Increased farm productivity and profitability of farmers, fishers, and livelihood for women and youth	Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 2: Natural Resource Use Efficiency	• Sustainable intensification by producing more through resource use efficiencies: better water, energy, and land management technologies and practices • Low-water use technology to mitigate the weather phenomenon's impact on farmers • Land, water, energy technologies and practices that increase production, lower production costs, while taking into account enhancing biodiversity services • Precision farming, fishing, livestock production • Try out and development of import substitute inputs (fertilizers, etc.) • Economies of scale through land consolidation, clustering, AMIA, agribusiness industrial hubs • Modern basic needs clustering that cover food security and agro-industrial including coffee, cacao, coconut, fruits and nuts, tropical fibers, rubber and other high value crops, fishing, blue economy, and sectors that foster economic resilience such as energy efficiency, renewable energy, and goods that improve the quality of life while minimizing the use of resources and input • Invest in farmers' ability to promote soil health and thrive in the face of 21st-century challenges such as climate change	A cross-sectoral assessment methodology procedure, that facilitates the evaluation for Land-Water-Energy for positive Food and Nutrition security nexus are prepared and adopted No. of climate-resilient land-water-energy nexus technologies generated ready for commercialization and adoption by farmers and fishers	Increase of resource efficiency of land-water-energy nexus projects for positive food and nutrition security	Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 3: Zero waste, recycling, and circular economy	● Import substitutes for fertilizers & other chemicals ● Import substitutes of local seeds, environmentally based propagating materials, tools, and machinery, as well as biobased fertilizers, pesticides, and Nature based packaging materials for manufacturing industries	· Developing guidance and practices towards decoupling economic activities from the consumption of resources are adopted by stakeholders · Products and packaging materials are renewably, regeneratively, or sustainably produced · Percentage of waste diverted from landfills or the amount of recycled materials produced.	· Reduction in waste production across households and industry operators · Increased regulations and policy advocacy for zero waste, recycling and circular economy	Government Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST4: Climate resilient food- and agri-based processing, marketing, and logistics systems	• R4D on institutional arrangements and practices that improve product quality and services of micro- and small enterprises that serve the AF sector as more than 3/4s of food manufacturing & services relate to AF; • R4D on inclusive agribusiness defined by efficiency, productivity, sustainability & resilience • Improving the “last mile” of R4D technology delivery • Strengthen buffer stocking for emergencies and disasters • R4D on improving the interconnectedness of multimodal transport and logistics, particularly for perishable products • Research and advisory services/technical capacity upgrading that will improve capacity of primary producers to process raw materials, understand markets, and ensure that food safety and quality standards are • Sustainability, and resilience • Use of mobile platforms and channels that encourage marketing, payment, insurance, and product delivery • Optimizing digital platforms for the marketing and delivery of food, • More efficient and faster service delivery to the people, more transparency	· Percentage increase in the number of smallholder farmers accessing markets · Reduction in post-harvest losses · Percentage increase in the use of sustainable transportation methods · Number of partnerships with local communities and organizations to enhance resilience · on-time delivery rates, inventory turnover, percentage of post-harvest losses, and farmer income levels.	· ensure that all stakeholders in the food supply chain, including smallholder farmers, women, and marginalized communities, have access to efficient and reliable logistics services · Increased food security, improved livelihoods for farmers, reduced post-harvest losses, and enhanced market access for agricultural products.	Government Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 5: Digitalization	● Ensure availability of subnational, ethnicity-disaggregated nutrition and nutrition-related data for targeted policy advice and interventions ● Real-time decision support tools for production management and post harvest and processing ● Locally suitable and low cost drones and sensors for production management and monitoring. ● Provide access for rural communities to training, education, and knowledge, which makes their lives better. ● Blockchain technology for tracking of food safety and quality control and helps farmers adjust to changing weather conditions, eventually making Philippine agriculture more sustainable. ● Coordinated, inclusive and technology-enabled emergency preparedness, science-based anticipatory action, response, and social protection that are responsive to extreme natural- and human-induced disasters; ● DRR management practices will be improved by capacitating public institutions to develop specific and anticipatory work plans, including one-health approach; better analyze climate, temperature, rainfall, zoonotic and other risk data; establish warning mechanism for early actions; and put in place inclusive and risk-informed SRSP systems (e.g., risk insurance and digital financing). ● 2024-2025: Portal of climate smart technology + market intelligence to provide informed knowledge of needs of actors in the food and agri-based sectors for R4D: Create mechanisms for integrating a market/user information system Working through the various collaborative hubs such as the KIST Parks, technology business incubation, regional inclusive innovation centers (RIIC), and research and extension offices of state universities and colleges (SUC), the government will establish a common and accessible portal that provides market intelligence	· Develop guidance on digitalization for climate-resilient agriculture of using ICT to collect and analyze data related to farming and fishing practices, weather patterns, soil health, and other factors that can impact agricultural productivity and resilience to climate change · No. of capacity building training-workshop among researchers, LGUs, farmers, fishers, women and youth on the use of digital technologies as decision-support systems for climate-resilience and DRRM	· Increase and easy access to visualize and analyze climate data, crop/fish yields, and other relevant information to help inform decision-making and improve climate resilience.	Government Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

	● support to conduct primary data collection that can capture relevant market data, such as customer needs and preferences, competitors, customer demographics, market trends, market price, and potential marketing processes. These can be used to guide or inform the R&D process and aid in the generation of technology and innovation. ● Provide analytics on markets and customers The private sector will be encouraged to share its observations, knowledge, and insights on people's motivations and preferences, and product trends to help improve R4D products in terms of function, aesthetic impressions, and market value. ● Contribution of digital technology in transforming the Philippines' farming industry for food security, economic growth, and the environment			

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 6: Nutritious food, sustainable diets, and consumption	● Food data central database: what we eat and nutrient content ● Traceability systems ● Legumes & pulses, millet, sorghum ● Food supplements & medicinal products ● Traditional food culture: investing in local food systems will help ensure food security by reducing food costs, shortening food miles, creating local employment, and fostering pride in the country's food heritage. ● In addition, RDE on indigenous species and varieties of plants and breeds of animals and promoting traditional food culture through active advocacy and formal and informal education shall be prioritized. ● The government will also institute policies to encourage investments in growing, processing, marketing (domestic and international), and consuming nutritious and safe local dishes ● Food fortification	· Research designs on the rapid loss of Indigenous knowledge; Indigenous Peoples' land rights and food sovereignty; and the impacts of industrial agriculture on Indigenous species and varieties, and food systems, stressing the need for decolonial approaches to revitalize Indigenous knowledge at different ecosystems for sustainable agriculture, livestock, and fisheries prepared and adopted for upscaling · Quantity of fortified food invested and provided	· Increased adoption of indigenous food systems and food fortification	Government Government priorities in terms of commodities and research activities remain valid and supported under the medium/long term agriculture/fisheries sector plan Collaboration/implementing modalities with partner institutions/RDE networks are further enhanced. Regional agricultural/ fisheries development plan prepared/research and development priorities defined Sustained/enhanced support to SUCs/RDE networks in terms of manpower development and facilities upgrading

Subtheme	Potential R4D Areas	Key Performance Indicators		Risk and Assumption
		Output	Outcome	
ST 7:Landless rural workforce and non-farm jobs	• Peri-urban • Skills upgrading, on-the job training	No. of skills upgrading, on the job training prepared and conducted Number of jobs created in the agricultural sector (in the project area due to activities of the CC R4DE Action Plan) No. of providing non-farm livelihood options to seasonal farm and fishery workers, as well as women and youth	Raise/Increase the quality of farm employment in agricultural and fishery sector for marginalized and landless farmers and fishers	Landless rural workers in agriculture and fishery face numerous risks and assumptions in their work. Some of the risks they face include lack of job security, low wages, poor working conditions, exposure to harmful chemicals, and limited access to social protection. Assumptions made about these workers often include the belief that they are easily replaceable, unskilled, and not valuable to society.

CRAFT=Climate Resilient Agriculture and Fisheries Through Transformative Research for Development

Chapter VIII
IMPLEMENTATION ARRANGEMENTS: COMMUNICATION PLAN

This chapter outlines the proactive communication plan for CRAFT R4D for the AF sector. It is divided into nine parts. It starts with an exposition of the objectives for this communication plan, and the subsequent steps that will be taken. An important element of the plan is the prioritization of the key messages that the CRAFT R4D will impart. An exposition of these elements is illustrated in Table 23.

1. Objective

Primary goal: Advocate for and facilitate the integration of climate resiliency strategies into the R4D budget and agricultural policies in the Philippines. This involves targeting various stakeholders with a multi-faceted approach.

- Enhance awareness and support: Increase awareness among key stakeholders about the critical need for climate-resilient agriculture in the Philippines.
- Influence policy and budget allocation: Influence policymakers to prioritize and allocate a significant portion of the R4D budget towards climate resilience in agriculture.

Target audience: The communication plan will be tailored to effectively convey the urgency and importance of integrating climate resilience into the agricultural sector in the Philippines, targeting specific individuals and institutions:

- Government legislators: Senate (Chairpersons and Members: Committees on Agriculture, Food, and Agrarian Reform; Environment, Natural Resources, and Climate Change; Science and Technology; Sustainable Development Goals, Innovation, and Futures Thinking; Economic Affairs), House of Representatives (Committees on Agriculture and Food; Climate Change; Science and Technology; Ecology; Sustainable Development Goals; Trade and Industry)
- Executive agencies: Department of Agriculture, Department of Science and Technology, Department of Budget and Management, National Economic Development Authority, Commission on Higher Education, Climate Change Commission
- Agricultural researchers and academics: Engage with scientists and researchers from institutions such as the University of the Philippines Los

Baños (UPLB) and other state universities and colleges, private universities, Philippine Rice Research Institute (PhilRice), International Rice Research Institute (IRRI)

- Farmers and agricultural communities: Directly benefit from climate-resilient practices, organizing community workshops in rural farming regions
- Non-governmental organizations (NGOs): Collaborate with NGOs like the Haribon Foundation, World Wide Fund for Nature (WWF) Philippines, and Oxfam
- Private sector stakeholders: Partner with companies and investors involved in agricultural production, food manufacturing, seed production and delivery, logistics and supply chain
- General public: Build broader support for climate-resilient policies and practices through social media campaigns and public engagements

2. Political Economy Mapping

To ensure effective advocacy, it is crucial to identify the most likely supporters, neutrals, and potential opponents of increasing the R4D budget for climate change:

- Supporters: legislators, government executives, and other policymakers with strong advocacies on agriculture and environmental protection, climate change adaptation and mitigation
- Neutral: legislators, government executives, and other policymakers who are generally supportive of agricultural development but needs more convincing on specific budget allocations
- Opponents: some national executives and local government officials who might oppose budget reallocations if it affects other national and local priorities; some private sector stakeholders whose interests may not align with climate-resilient practices due to perceived short-term costs

3. Prioritized Key Messages

- Importance of climate resiliency in agriculture and fisheries: Emphasize the critical need for agriculture in the Philippines to adapt to and mitigate the impacts of climate change
- Budget reallocation for climate resilience: Advocate for a significant portion of the R4D budget to be allocated towards research and implementation of climate-resilient agricultural practices

- Economic benefits: Highlight the economic advantages of climate-resilient agriculture
- Success stories and potential benefits: Highlight successful examples such as the AMIA villages and potential benefits of climate-resilient practices
- Policy support and engagement: Encourage policymakers to support and prioritize climate-resilient agriculture in their legislative agendas and emphasize the role of supportive policies in driving the adoption of climate-smart technologies and practices.

4. Communication Channels and Modalities

- Government channels:
  - Formal proposals and policy briefs: Submit detailed proposals and policy briefs to key government departments and legislative committees
  - Meetings and roundtable discussions: Arrange meetings with policymakers and stakeholders to discuss and advocate for budget reallocation
  - Collaborate with government media agency: Philippine Information Agency, People's Television (PTV), Radyo ng Bayan, Philippine News Agency
- Community outreach:
  - Workshops and seminars: Conduct educational workshops and seminars for farmers and local communities
  - Field days: Organize field days to demonstrate climate-resilient practices
- Media engagement:
  - Press releases and news articles: Use press releases and news articles to reach a broader audience, especially policymakers and those in the A and B classes
  - Social media campaigns: Leverage social media platforms, which are the primary news sources for 70% of Filipinos, to raise awareness and engage with the public: (a) short blogs and videos: Develop short blogs and videos (4-5 minutes) for broad public engagement; (b) lecture videos: Produce a series of lecture videos (12-15 minutes) for those seeking more in-depth information
- Academic and research platforms:
  - Journal publications: Publish findings in academic journals

- Conferences and symposia: Present at national and international conferences

- Partnerships with NGOs and private sector:
  - Collaborative projects: Partner with NGOs and private companies for joint projects or initiatives
  - Corporate sponsorships: Seek sponsorships or partnerships with private companies for funding and resource support

5. Content Strategy

- Data-driven approach: Use data from the R4D budget analysis to support arguments for budget reallocation
- Storytelling: Share stories of communities and farmers who have successfully implemented climate-resilient practices
- Visual aids: Develop infographics, charts, and videos to simplify complex information
- Educational materials: Create practical guides and manuals for farmers
- Regular updates: Maintain a blog or newsletter to provide regular updates
- Interactive content: Host webinars and online forums to engage with stakeholders
- Tailored content for different audiences:
  - For policymakers: Fact sheets and policy briefs
  - For farmers: Practical guides and videos
  - For the general public: Engaging social media content and articles

6. Enhancing DA-BAR's Proficiency with and Use of Social Media Tools

To effectively engage with the public and raise awareness on climate-resilient agriculture, it is essential to enhance BAR's proficiency with social media tools; strategies include:

- Training workshops:
  - Conduct regular training workshops for BAR staff on the use of various social media platforms, focusing on TikTok, Instagram, and Facebook
  - Collaborate with social media experts to provide hands-on training sessions that cover content creation, video editing, and effective engagement strategies

- Content creation teams:
  - Establish dedicated teams within BAR responsible for creating and managing social media content

    - These teams should include members skilled in video production, graphic design, and social media marketing
- Collaborations with influencers:
    - Partner with popular social media influencers and content creators who have a strong following in the agriculture and environmental sectors
    - Collaborate on creating engaging content that highlights the importance of climate-resilient agriculture
- Interactive campaigns:
    - Launch interactive social media campaigns that encourage user participation, such as challenges, Q&A sessions, and live broadcasts
    - Use hashtags to track engagement and increase the visibility of the campaigns
- Short-form videos:
    - Focus on producing short-form videos (4-5 minutes) for platforms like TikTok and Instagram, which are highly effective in capturing public attention
    - Create content that showcases success stories, practical tips for farmers, and the economic benefits of climate-resilient practices
- Educational series:
    - Develop a series of educational lecture videos (12-15 minutes) that provide in-depth information on climate-resilient agriculture
    - These videos can be shared on YouTube and other video platforms, offering valuable resources for those seeking more detailed knowledge

7. Public Awareness and Benchmarking

According to recent surveys by Pulse Asia and Social Weather Stations (SWS), public awareness on climate change is relatively high, with over 80% of Filipinos recognizing climate change as a serious issue. However, only about 50% prioritize it for government action, indicating a gap in translating awareness into advocacy and policy support (Philippine Star, 2023 October 09; Rappler, 2023 March 24).

This communication plan aims to bridge this gap by leveraging these survey results to:

- Benchmark public awareness: Use the data from Pulse Asia and SWS surveys as a baseline to measure improvements in public awareness and engagement
- Targeted campaigns: Design campaigns that not only raise awareness but also emphasize the urgency and need for government action on climate resilience in agriculture
- Public engagement: Develop content that appeals to the general public, focusing on the impacts of climate change on their daily lives and livelihoods

8. Outputs and Metrics

To ensure the effectiveness of the communication plan, the following outputs and metrics may be used as indicative targets based on similar initiatives conducted by other entities

- Policy briefs: Develop and submit 10 policy briefs to key government officials and legislative committees
- Workshops and seminars: Conduct 20 workshops and seminars for farmers and local communities
- Field days: Organize 15 field days showcasing climate-resilient practices
- Social Media Campaigns: Launch 5 targeted social media campaigns, each reaching at least 100,000 people
- Short blogs and videos: Produce 20 short blogs and 20 short videos (4-5 minutes each) to engage the public
- Lecture videos: Create 10 lecture videos (12-15 minutes each) for in-depth information dissemination
- Infographics and videos: Produce 10 infographics and 10 short videos to disseminate key messages

.

By integrating these specific details, outputs, and benchmarks, the communication plan aims to effectively build momentum, engage stakeholders, and achieve tangible results in enhancing climate resiliency in Philippine agriculture

Table 23. Elements of the CRAFT R4D Communication Plan

OBJECTIVE	AUDIENCE	MESSAGES	ACTIVITIES	WHO				WHEN	RESOURCES	M&E
				R	A	C	I			
Communicate the bureau's medium-term CRAFT R4D agenda	Government legislators (Senate, House of Representatives), Executive agencies, Agricultural researchers and academics, Farmers and agricultural communities, NGOs, Private sector stakeholders, General public	We translate the bureau's R4D undertakings on climate change, priority research areas for reference partner R4D institutions.	Formal proposals and policy briefs, consultation and roundtable discussions, workshops and seminars, field days, press releases and news articles, social media campaigns, blogs and online forums, journal publications, conferences and symposia, collaborative projects, corporate sponsorships	CC R4D Team	Lead/ CC R4D Team	Executive Committee	Research implementers, NGOs, Private Sector, General Public	Annual	Manpower, ICT equipment and productivity tools/software, social media engagements, camera, funding, resources from NGOs and private sector	No. of knowledge products developed, No. of R4D proposals received, No. of reports submitted, No. of write-ups published, knowledge exchange activities conducted
Gather resources that will aid in the development & implementation of various R4D interventions that will respond to the CRAFT R4D agenda	Implementing agencies, R&D institutions, training and extension arms	We issue a Call for Proposals on CRAFT researchable areas	Annual call for proposals, social media engagement	PDD-PPES	Division Head/ PDD	PDD/ PMU	Research implementers, R4D stakeholders,	Annual	Manpower, social media engagements	No. of R4D proposals received
Organize resources to increase R4D investment in Climate Change	Oversight agencies, policymakers	We continuously provide support to our partners for the generation of technologies, geared towards an increased fund allocation for Climate Change R4D	Annual Report, Periodic Reports	CC R4D Team	Lead/ CC R4D Team	BAR Executive Committee	DA Management, DA CRAO	Annual	Manpower	No. of reports submitted
Disseminate available CRAFT R4D technologies developed/commercialized thru BAR-supported programs, projects, and activities	Implementing agencies, other R&D institutions, training and extension arms	We cascade R4D technologies developed from funded programs/projects to partner-implementing agencies and the general public.	BAR Chronicle, BAR R4D Digest, Research Talks, Seminar Series, Technology Forum/Exhibit	CC R4D Team	Lead/ CC R4D Team	BAR Executive Committee	Research implementers, R4D stakeholders, General Public	Periodic	Manpower, camera, ICT equipment and productivity tools/software	No. of write-ups published, knowledge exchange activities conducted

CRAFT=Climate Resilient Agriculture and Fisheries Through Transformative Research for Development R4D=Research for Development

OBJECTIVE: Goals to be achieved by the communication plan
AUDIENCE: Target groups to whom the messages are directed
MESSAGES: Key points to be communicated to the target audience
ACTIVITIES: Actions and events planned to communicate the messages
WHO: The responsible team or individuals

- R: Responsible - the person or team doing the work
- A: Accountable - the person or team ultimately answerable for the activity's success
- C: Consulted - individuals or teams to be consulted for their expertise or input
- I: Informed - individuals or teams to be kept informed about the activity's progress

WHEN: Timeline for the activities
RESOURCES: Required resources for the activities
M&E: Monitoring and Evaluation metrics

Chapter IX

SEEDING SUSTAINABLE PROGRESS: FINANCIAL MECHANISM FOR CRAFT R4D

With the country facing significant challenges from climate change particularly impacting its agriculture and fisheries (AF) sectors, DA-BAR is leading efforts to enhance climate resilience through research and development. Despite a cumulative R4D allocation of 16.6 billion pesos from 2020-2024, the proportion of R4D funding relative to the total DA budget has decreased, underscoring the urgent need for increased funding. Resource mobilization from the national budget is paramount to finance climate resiliency in agriculture and fisheries.

CRAFT R4D proposes raising annual R4D funding from 0.2% of GVA in 2024 to 1.2% of GVA by 2028. This increase is vital for supporting ambitious climate-responsive agriculture goals. The chapter provides a plan to mobilize resources from national budgets, international donors, private sector investments, and public-private partnerships. Key actions include implementing policy measures to mandate higher R4D budget allocations, utilizing institutional frameworks for substantial R&D financing, exploring external sources such as green bonds and venture capital, and establishing a robust monitoring and evaluation framework. By integrating national and external financial sources, the Philippines can enhance its capacity to develop and implement innovative climate-resilient agricultural practices, ensuring sustainable growth and food security.

A. Recent historical antecedents of AF R4D funding

The level of AF R4D financing in the recent past years (2020 to 2023), with 2024 as a baseline year, is presented to show historical trends and patterns. Consequently, strategic actions on the level of increase for R4D financing for fiscal year 2025 and onwards should be identified.

The financial support for agri-fisheries R4D within the DA has exhibited an appreciative increase over the recent medium-term period (2020-2024) (Table 24). As per the provisions outlined in the General Appropriations Act (GAA), the cumulative R4D investments by the DA during the 2020-2024 timeframe amounted to 16.6 billion pesos, with a rate of increase of 5.4% from 2020 to 2024. However, this pales in comparison to the rate of increase in the total budget of the Department of Agriculture on new appropriations over the same period, which is at 88.39%, indicating a good opportunity for a corresponding growth in budgetary allocation for R4D in the agriculture and fisheries sector.

Table 24. DA investment in R4D vs total DA budget GAA 2020-2024 (at constant 2018 prices)

	2020	2021	2022	2023	2024	Total	Rate of Inc/Dec 2020-2024 (%)
DA's R4D investment (in million pesos)	3,386	3,125	3,134	3,347	3,568	16,560	5.40
Annual Rate of Inc/Dec (%)	n.a.	-7.7	0.3	6.8	6.6		
DA Budget, New Appropriations (in million pesos)	50,966	58,660	58,799	85,882	96,016	350,323	88.39
Annual Rate of Inc/Dec (%)	n.a.	15.1	0.2	46.1	11.8		
R4D as % Total DA Budget	6.6	5.3	5.3	3.9	3.7	4.7	-0.4
Annual Rate of Inc/Dec (%)	n.a.	-19.8	0.1	-26.9	-4.6		

R4D=Research for Development; DA=Department of Agriculture; GAA=General Appropriations Act

Chapter 2 introduced the observation based on historical data that the trend of DA R4D Investment to AFF GVA has relatively remained unchanged. The next table shows the DA's R4D investment from 2020 to 2024 relative to the AFF GVA for the same period. The annual DA's R4D investment averaging PhP2.366 billion during these periods showed a consistent trend relative to the annual AFF GVA (at constant 2018 prices) at a miniscule share of 0.19%.

Table 25. DA's investments in R4D vs AFF GVA 2020-2023 (at constant 2018 prices)

	2020	2021	2022	2023	2024	Total	Average
DA's total R4D investment (in million)	3,386	3,125	3,134	3,347	3,568	16,560	2,366
AFF GVA* (in million)	1,780,391	1,775,358	1,780,000	1,780,000	1,780,000	8,895,749	1,270,821
% share of DA R4D investment to the total AFF GVA	0.19%	0.18%	0.18%	0.19%	0.20%	0.19%	

DA=Department of Agriculture; R4D=Research for Development; AFF= Agriculture, Fisheries, and Forestry
GVA= Gross Value Added

Table 26 shows distribution of funds, which was documented based on the prioritization of each agency's core funds for R4DE, along with the R4DE allotment for prominent programs, including the National Rice Program, National Corn Program, National Livestock Program, National High-Value Crops Program, and the National Organic Agriculture Program[17]. 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

[17] DA-BAR, 2023. National Agriculture and Fisheries Research for Development and Extension Agenda (NAREA) 2023-2028.

World Bank (2020) observes that the budget portfolio for agriculture leaves much to be desired in promoting modernization, industrialization, land consolidation, market support, R&D, and extension.

Table 26. DA's Investments in R4DE by Agency, 2020-2024 (at constant 2018 prices)

Agency	Funding for R4D based on the General Appropriations Act 2018-2022					Rate Inc/Dec
	2020	2021	2022	2023	2024	2020-24 (%)
Bureaus	1,119,531,000	1,101,688,000	1,030,568,000	1,111,676,000	1,177,054,000	5.1
Attached Agencies	889,452,000	679,402,000	768,659,000	855,753,000	997,102,299	12.1
Corporations	406,616,000	386,933,000	386,933,000	401,750,000	476,495,000	17.2
RFOs	970,096,000	956,887,000	947,801,000	977,382,000	917,795,335	-5.4
Total	**3,385,695,000**	**3,124,910,000**	**3,133,961,000**	**3,346,561,000**	**3,568,446,634**	**5.4**
Annual Rate Inc/Dec (%)	n.a.	-1.6	-6.5	7.9	5.9	

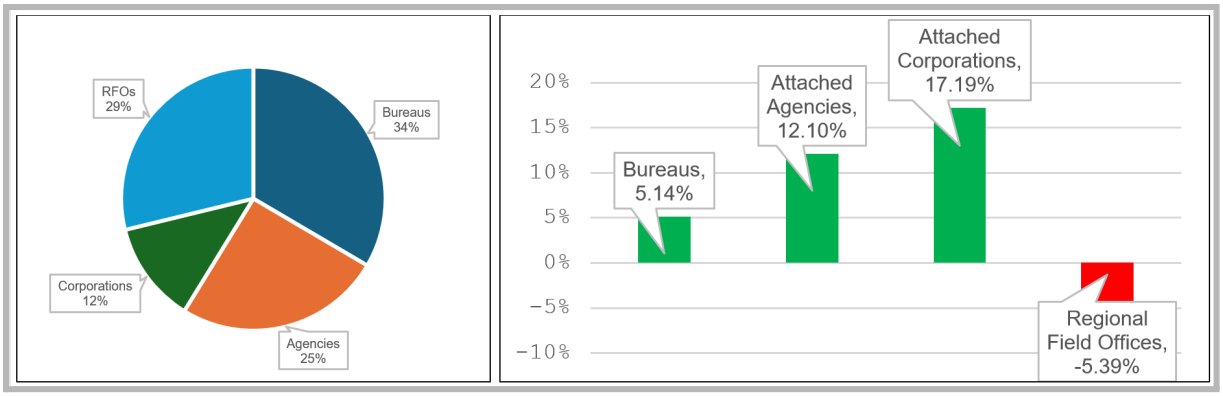
R4DE=Research for Development and Extension

A significant portion of the R4D funds, amounting to 34%, has been allocated to various bureaus. There was also a notable increase in funding for bureaus over the four-year period, with a growth rate of 5.1%. This substantial share and significant rise underscore the critical role that bureaus play in advancing the R4D initiatives, reflecting their involvement in key research activities and projects aimed at driving agricultural development and resilience, particularly the Bureau of Agricultural Research, which garnered the lion's share in the fund allocation.

The attached agencies received 25% of the total R4D funds, which grew by 12.1% during the same period, highlighting the importance of these entities in supporting specialized research efforts and contributing to the overall objectives of the R4D agenda. A total of 12% of the R4D funds have been directed towards attached corporations, with the relatively smaller proportion compensated by the larger rate of increase of 17.2%. This allocation signifies the increasing role of corporate entities in facilitating research and development through innovation, technology transfer, and the implementation of commercially viable solutions that enhance agricultural productivity and sustainability.

The RFOs have been allocated 29% of the total R4D funds. This considerable share highlights the emphasis on regional and local research initiatives that address the unique needs and conditions of different geographical areas, as the RFOs play a pivotal role in ensuring that R4D activities are tailored to local contexts, thereby promoting inclusive and sustainable agricultural practices. However, their funding decreased significantly by -5.39% during the period. This shift in resource allocation requires a reassessment of the important but largely untapped roles and functions of RFOs within the R4D framework.

Figure 34. (a) Share by Agency of Total R4D Funds from 2020 to 2024, and (b) Rate of Increase/Decrease of Funding by Agency from Same Period



B. Past investments on R4D investments centered on climate-resilient agriculture

In Chapter 2 (Table 9), the DA and DOST R&D investment is presented relative to AFF GVA for 2018 to 2022. To provide some indicative numbers in terms of R4D investments devoted specifically to climate resilient agriculture, the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), which is attached to the Department of Science and Technology (DOST), offers a good study. The council maintains a list of investments made specific for "climate-smart agricultural" projects. Table 27 below shows the allocation from 2021 to 2023, the last year when complete data is available. It also reveals the recipients of such project funds, which are mostly coming from the government or public sector.

Table 27. PCAARRD Investments for R4D for Climate-Smart Agriculture, 2021-2023

Agency	No. of Projects	2021	2022	2023	Total	Rate of Inc/Dec 2021 to 2023
State Universities and Colleges	71	106,746,845	181,818,203	166,477,479	455,042,526	55.96%
Department of Science and Technology	4	0	11,446,185	11,057,080	22,503,265	n.a.
Department of Agriculture	6	2,285,269	19,659,697	11,714,526	33,659,492	412.61%
Department of Environment and Natural Resources	2	2,159,532	1,623,427	1,216,659	4,999,618	-43.66%
Private	3	2,620,967	6,706,283	4,823,141	14,150,391	84.02%
Total	**86**	**113,812,613**	**221,253,794**	**195,288,885**	**530,355,292**	**71.59%**

PCAARRD=Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development

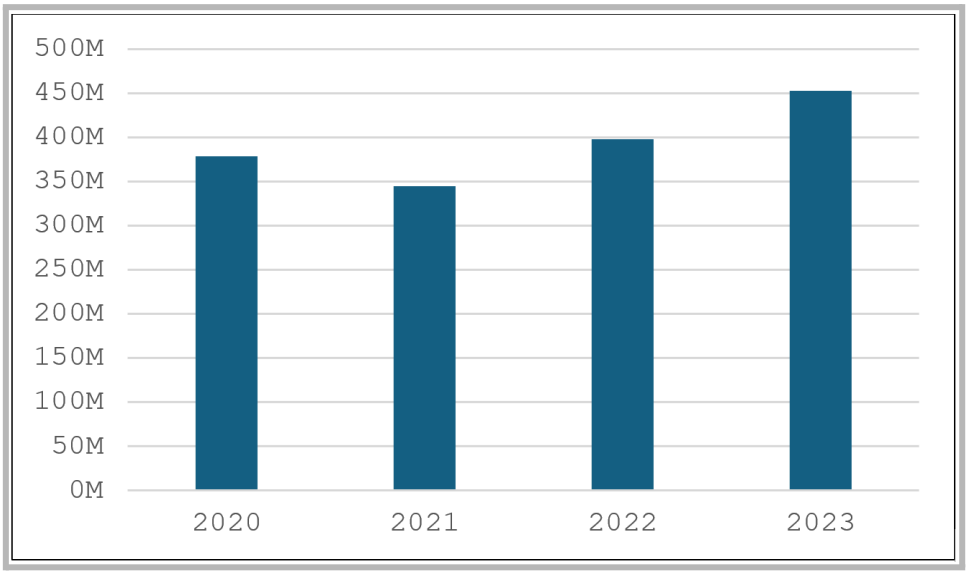
Of the 86 project implementers funded by PCAARRD during the period, more than 80% are SUCs and the rest largely coming from other government agencies. Only three projects were identified originating from the private sector: two from a private university and one from a private corporation. The largest share of these investments in monetary terms was poured to SUCs, with them receiving about 86 centavos for every peso invested by PCAARRD. During this three-year period, total budgetary support amounted to more than half a billion pesos. Although a slight decrease was observed from 2022 to 2023, the overall rate of increase from 2021 to 2023 was quite significant at 71.6%.

There is no readily available similar set of data on R4D investments for climate-smart agriculture from the DA. What was worked on for a comparable analysis was to assemble a similar dataset by requesting information from the different DA agencies on all R4D projects supported during the period, including the amount of budgetary allocation and project duration, then separating those projects individually identified for our purpose. Most DA agencies submitted the information requested, save for two attached agencies. From the list of 1,548 R4D projects supported by these different DA agencies from 2020 to 2023, about a third or a total of 512 have been classified as related to climate-smart agriculture. Total investments for climate-smart R4D projects for the four-year period reached P 1.575 billion. The annual year-on-year change in budgetary allocation for this subset of projects also reflects the trend observed for all R4D projects, a dip from the 2020-2021 cycle but an increasing trend thereafter. The rate of increase during the four-year period was a very significant 19.69% (Table 28; Figure 35).

Table 28. Indicative DA Investments for R4D for Climate-Smart Agriculture, 2020-2023

Agency	2020	2021	2022	2023	Total	Rate of Inc/Dec 2021 to 2023
Budget for Climate-Smart R4D Projects (in million pesos)	378.67	345.15	397.81	453.23	1,574.86	**19.69%**
Annual Rate of Inc/Dec (%)	**n.a.**	**- 8.85**	**15.26**	**13.93**		

Figure 35. Indicative DA Investments for R4D for Climate-Smart Agriculture, 2020-2023



C. Increase in national budget: from 0.2% of GVA to 1.2% of GVA

To achieve the strategic objectives of Climate-Responsive Agriculture (CRA) Research for Development (R4D), it is imperative to substantially increase the allocation of national budget resources. The current allocation of R4D funds, which stands at 0.2% of the Gross Value Added (GVA) in the agriculture, forestry, and fisheries sector, is inadequate to address the pressing challenges of climate change and ensure sustainable agricultural development.

Historical context and current allocation. In the recent medium-term period (2020-2024), the Department of Agriculture's (DA) investment in R4D has seen a cumulative allocation of 16.6 billion pesos, with a modest rate of increase of 5.4% from 2020 to 2024. Despite this increase, the proportion of R4D funding relative to the total DA budget has decreased, indicating a need for a more aggressive approach to funding allocation. The total DA budget's new appropriations over the same period saw an 88.39% increase, highlighting a significant opportunity to re-align and amplify the R4D budget.

Proposed increase in CRA R4D funding. For fiscal year 2025 and beyond, it is proposed that the annual R4D funding should escalate from the current level of 0.2% of GVA to 1.2% of GVA by 2028. While this increase represents a significant improvement, it is important to note that the projected 1.2% of GVA remains below the estimated requirement of 1.7% needed to fully address the sector's needs. Additionally, this increase is just 0.2% higher

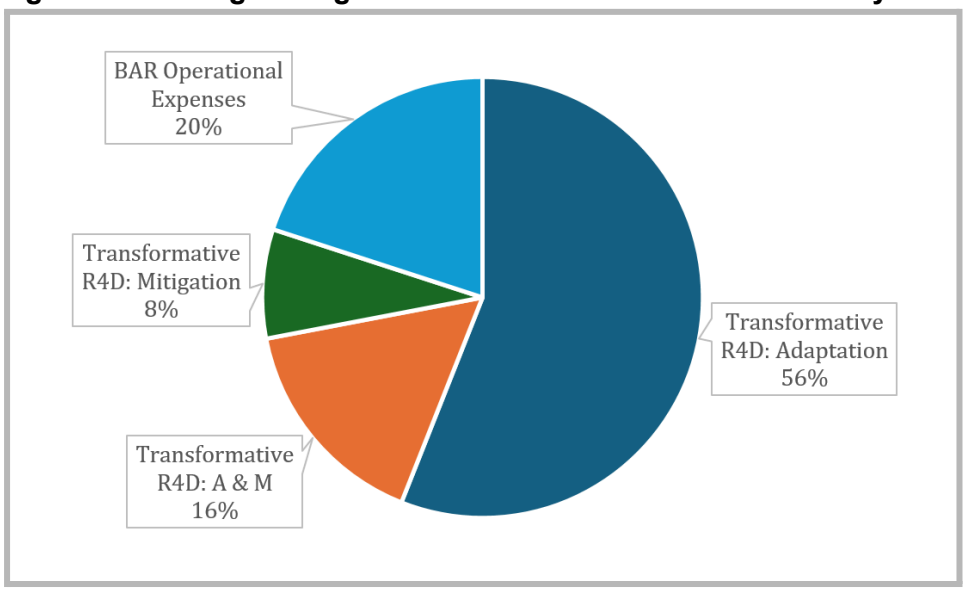
than the 1.0% stipulated in the Agriculture and Fisheries Modernization Act (AFMA), which underscores the need for further financial commitments. This increase is essential to support the ambitious goals of CRA R4D. Since the proposed national budget for next year (2025) has already been determined in collaboration with the DBM, the proposed annual R4D budget based on GVA is outlined in the table below:

Table 29. Projected Annual R4DE Budget Based on GVA[18]

Agency	2024	2025	2026	2027	2028
DA's total R4D investment (in million PhP)	3,568.44	4,282,136	9,991,651	15,701,165	**21,410,680**
% share of DA R4D investment to the total AFF GVA	**0.20%**	**0.24%**	**0.56%**	**0.88%**	**1.20%**

R4DE= Research for Development and Extension
GVA=Gross Value Added

Figure 36. Strategic budget allocation for climate resilient AF by 2028



AF-Agriculture and Fisheries

The proposal for increasing progressively and substantially the CRA R4D funds ensures sustained financial support for climate resilience projects and underscores the critical need for consistent and robust funding to drive transformative advancements in agriculture and fisheries. By 2028, the envisaged budget allocation is structured to optimize impact. Twenty percent of the budget is earmarked for operational expenses of BAR, ensuring the institution's efficient functioning and administrative support. The remaining eighty percent is dedicated to transformative R4D efforts, reflecting a strong commitment to climate action. Of this, a substantial seventy percent is allocated to adaptation strategies, highlighting the

[18] Estimates based on 2024 R4D Investment and ratio and proportion % GVA across years.

priority to enhance resilience against climate impacts. Additionally, twenty percent is designated for combined adaptation and mitigation initiatives, recognizing the interlinked nature of these approaches. Lastly, ten percent is focused solely on mitigation, recognizing the importance of reducing greenhouse gas emissions. This strategic allocation ensures a comprehensive approach to achieving climate resilience and sustainability in Philippine agriculture and fisheries.

To achieve this increase, policy discussions must involve key agencies such as the Climate Change Commission (CCC), Commission on Higher Education (CHED), Department of Agriculture (DA), Department of Science and Technology (DOST), Department of Budget and Management (DBM), National Economic and Development Authority (NEDA), and the Department of Finance (DOF). Strategic actions should include:

1. Policy Interventions: Implement policy measures that mandate increased budget allocations for R4D in agriculture and fisheries. This could involve leveraging the CCC/CHED and the CCAM-DRR Cabinet Cluster to push for higher budget proposals.
2. Institutional Mechanisms: Utilize institutional frameworks like the Climate Change Expenditure Tagging (CCET) to ensure that national agency budget proposals from research-granting agencies (e.g., DOST-PCIERD, PCAARRD, DA-BAR, CHED) include substantial increases in R&D financing for climate-smart agriculture.
3. Resource Mobilization: While the focus here is on national budget allocation, it is also critical to explore external sources such as green bonds, venture capital, and international development funds. These additional resources can supplement national budget allocations and ensure comprehensive financing for CRA R4D.
4. Monitoring and Evaluation: Establish a robust monitoring and evaluation framework to track the progress of R4D funding increases and their impact on agricultural resilience and sustainability. This will help in making data-driven adjustments and ensuring accountability.

Box 9. Scorecard for climate change expenditure tagging

A scorecard for identifying the climate change expenditures of the DA-BAR shall use the basic principles outlined when selecting and identifying the seven sub-themes for the CRAFT projects. These principles are:

- Deliver at least two outcomes (key outcomes are: boosting productivity, diversifying incomes and jobs, adapting to climate change, ensuring sustainable environment and biodiversity, and reducing greenhouse emissions);
- Shift away from merely the lens of productivity enhancement of specific crops, livestock fishery to a commodity systems perspective that consider the entire agri-based and agrifood value chains. The value chained commodity systems discussed in NAFMIP will be taken into account: (i) rice-based, (ii) livestock and poultry, (iii) coconut-based, (iv) fishery-based, and (v) geographically specialized (e.g., the pili commodity system of the Bicol region);
- Are demand-driven R4D, meaning the forging of stronger and more strategic collaborations among stakeholders to identify in participatory manner the R4D needs;
- Rely on robust science-based data collection and parameters in identifying suitable commodity systems and implementing sustainable intensification;
- Preserve the ecosystems and biodiversity while improving agri-based and agrifood commodity systems;
- Call for a holistic and systems-based approach that recognizes not only (i) the interconnection on the health of humans, animals, plants and the environment in ensuring food and nutrition security, but also (ii) the synergies and trade-offs of multiple objectives like land consolidation & small-scale farming tenurial rights; and

  Take a multidisciplinary approach.

A modified version of these principles can be developed into a scorecard for identifying the climate change expenditures of DA-BAR but also for the other DA banner programs, bureaus, and attached agencies and corporations.

By increasing the national budget allocation for R4D from 0.2% to 1.2% of GVA, the Philippines can significantly enhance its capacity to develop and implement climate-resilient agricultural practices. This strategic investment is crucial for ensuring food security, improving agricultural productivity, and building a resilient agricultural sector that can withstand the impacts of climate change.

D. Leveraging external sources

In addition to national budget allocations, leveraging external financial sources is crucial for augmenting R4D initiatives aimed at climate-resilient agriculture. By tapping into green bonds, venture capital, international development funds, and similar external sources, the Philippines can significantly enhance its funding capacity for sustainable agricultural projects.

Green bonds are debt instruments specifically earmarked to raise funds for projects that have positive environmental and climate benefits. Issuing green bonds can provide substantial capital for climate-smart agricultural projects, such as sustainable farming

practices, renewable energy integration, and water management systems. The Philippine government, in collaboration with financial institutions, can create a framework for issuing green bonds targeted at R4D projects. This will attract environmentally conscious investors and provide a steady stream of funds for agricultural development.

Venture capital (VC) is essential for fostering innovation and supporting start-ups that focus on climate-resilient agricultural technologies. Encouraging venture capital investment in the agricultural sector can lead to:

1. Agri-tech Innovations: Supporting start-ups that develop cutting-edge technologies for precision farming, pest control, and crop management;
2. Scaling Up Successful Models: Providing capital for scaling up successful pilot projects and innovative agricultural practices; and
3. Public-Private Partnerships: Facilitating partnerships between government agencies, private investors, and research institutions to accelerate the commercialization of research outputs.

To attract venture capital, the government can offer incentives such as tax breaks, grants, and favorable regulatory conditions for VC investments in agricultural R4D projects.

International development funds from multilateral and bilateral sources can play a pivotal role in financing large-scale R4D initiatives. These funds often come with technical assistance and capacity-building components, which are essential for implementing complex projects. Key sources include:

1. Multilateral Development Banks (MDBs): Institutions like the Asian Development Bank (ADB), World Bank (WB), and International Fund for Agricultural Development (IFAD) provide grants and low-interest loans for agricultural development projects.
2. Bilateral aid: Countries with advanced agricultural research capabilities often offer bilateral aid to support R4D initiatives in developing nations. These partnerships can provide both funding and expertise.
3. International climate funds: Programs such as the Green Climate Fund (GCF), Clean Technology Fund (CTF), Global Climate Change Alliance, Global Environment Facility (GEF), and Adaptation Fund offer financing for projects that address climate change and promote sustainable development. A more comprehensive list is found in https://climatefundsupdate.org/the-funds/.
4. Local financial institutions: Local banks and financial institutions are crucial in supporting R4D initiatives by providing accessible financing options tailored to the specific needs of the local agricultural sector. These include the Land Bank of the

Philippines (LBP), Development Bank of the Philippines (DBP), and Agricultural Credit Policy Council (ACPC).

The Philippine government should actively engage with these international institutions to secure funding for R4D projects. This involves presenting well-developed project proposals that align with the strategic goals of these funding bodies and demonstrating the potential impact on climate resilience and agricultural sustainability.

To effectively leverage these external sources, the following strategic actions are recommended to mobilize external funding:

1. Develop a comprehensive funding strategy: Create a detailed strategy that identifies potential sources of external funds, outlines the types of projects eligible for funding, and sets clear goals for resource mobilization.
2. Build institutional capacity: Strengthen the capacity of government agencies (especially BAR) and research institutions to develop compelling project proposals, manage funds efficiently, and comply with the reporting requirements of funding bodies.
3. Foster international partnerships: Establish and nurture partnerships with international organizations, donor countries, and private sector investors to enhance collaboration and access to funding.
4. Promote transparency and accountability: Implement robust monitoring and evaluation systems to ensure transparency and accountability in the use of external funds, thereby building trust and encouraging further investments.

By integrating national budget allocations with external financial sources such as green bonds, venture capital, and international development funds, the Philippines can significantly bolster its CRA R4D efforts. This holistic approach will enhance the country's capacity to develop and implement innovative, climate-resilient agricultural practices, ensuring sustainable growth and food security in the face of climate change.

Chapter X
MOVING FORWARD

The CRAFT R4D document will be regularly updated based on emerging trends and lessons learned. The focus areas for this implementation period include generating climate-resilient technologies and practices, ensuring their wide-scale application through out-scaling and up-scaling, building a cadre of agri-practitioners and promoting agri-preneurs and registered small and micro-enterprises engaged in modern agribusiness endeavors, and providing policies and regulations for developing robust, resilient, and sustainable agri-food and agri-based systems. Success relies on the collaboration and dedication of various stakeholders, including government agencies, non-governmental organizations, academic institutions, and the private sector, to achieve the objectives outlined in the CRAFT R4D plan and foster a resilient and sustainable agriculture and fisheries sector.

The CRAFT R4D Medium Term Plan for 2024-2028 is a crucial initiative of the Bureau of Agricultural Research that aims to transform the agriculture and fisheries sector of the Philippines into climate-resilient and sustainable systems. This plan focuses on prioritizing research and development, building institutional capacities, and fostering partnerships to secure a climate-resilient future for the country's agriculture and fisheries. Its ultimate goal is to ensure food and nutrition security and promote sustainable but inclusive economic growth even in the face of climate change challenges. This is the modernization pathway that the climate resilient R4D strategy and action plan will espouse for the Philippine agriculture and fishery sector.

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Annex 1. Indicative projects proposed for the Medium Term, 2026-2028

Project title / activities	Nature of Climate resilient measure			Local Partner	Expected Output / Output Indicator
	Adaptation	Mitigation	A +M		
ST1. Technology and Innovations for sustainable agriculture, fisheries, and livestock					
Studies on genetics (e.g. molecular characterization and gernplasm screening of resistance genes, genome editing)					
Vegetables and Legumes (Input) - Genetic improvement of tomato varieties through targeted gene editing	x			DA-BPI, DA-RFOs, SUCs	improved tomato varieties through targeted gene editing
Identifying the gaps on milkfish genomics	x			SUCs, SEAFDEC	Information on the identified gaps on milkfish genomics
Development of technologies for genetically improved milkfish	x			DA-NFRDI, DA-BFAR, SEAFDEC, SUC	Technologies for genetically improved milkfish
Varietal/broodstock improvement and development of new commercial varieties					
Identification of locally-adapted progenitors for seed production of vegatbles and legumes	x			DA-BPI, DA-RFOs, SUCs	documentation and information on locally adapted progenitors identified
Improvement of local legume varieties (ex. mutation breeding of red peanut)	x			DA-BPI, DA-RFOs, SUCs	improved local legume varieties
Development of quality mango planting materials	x			DA-RDIs, SUCs	Policy recommendation for the provement/enhancement of quality planting material standards
Adoption/utilization and promotion of new commercial mango varieties	x			DA-RDIs, SUCs	Information on the yield and growth performance of commercial mango varieties from other countries; Identified new commercial mango varieties suitable to Philippine conditions

Development of organicbased mango flower inducer	x			DA-RDIs, SUCs	Technology on the production and utilization of organic-based mango flower inducer
Varietal development and improvement of sweet sorghum local hybrids	x			DA-RFOs, SUCs	Local hybrids
Market-driven Broodstock improvement for fillet yield	x			DA-NFRDI, DA-BFAR, SEAFDEC, CPF, GENOMAR, other private sector research institutions	Benchmark, Improved broodstock management, Cost competitiveness, High fillet-yield tilapia strains
Agroecological/ impact studies on climate change, agrifisheries commodites and food systems					
Agroecology – Integration of ecological principles into the design and management of agricultural systems. It incorporates the long-term protection of natural resources as an element of food production, safe and nutritious			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of proposals reviewed and approved with funding No. of Package of Technologies (POTs) developed
Organic farming – R4D roadmaps and reviews; establishment of organic hubs for learning; AWD			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of proposals reviewed and approved with funding No. of organic hubs established Gender mainstreaming for livelihood conducted for women and youth No. of Package of Technologies (POTs) developed and used by farmers;
NbS landscape - Conducted R4D calls on actions to protect, sustainably manage, and restore natural landscape or modified ecosystems that address societal challenges			x	DA-BAR; DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of proposals reviewed and approved with funding No. of Package of Technologies (POTs) of NbS developed
Ecological impact study of coffee production			x	DA-BPI, DA-RFOs, SUCs	Carbon footprint, water footprint, and energetics of pulp

Ecological impact studies on sugarcane production			x	DA-SRA, DA-RFOs, SUCs	Carbon footprint Water footprint estimates Environmental impact assessment
Aquaculture sustainability and ecological impacts			x	DA-NFRDI, DA-BFAR, SUCs	Studies on sustainability and ecological impacts of aquaculture
Characterization of aquatic habitats in connection to protection and conservation of important whether freshwater or marine species for the sources of broodstocks	x			DA-NFRDI, SUCs	Quality assessment of the aquatic habitats
Sustainability and ecological impacts of milkfish cultures			x	UP-MSI	Studies on sustainability and ecological impacts of milkfish cultures
Development of production management practices, adaptability trials, and improvement and utilzation of POTs to advance productivity and efficiency					
Development of production management practices for local hybrids of sweet sorghum	x			DA-RFOs, SUCs	Protocols on fertilizer application, irrigation schedule, water management, pest and disease management for local hybrids
Development/improvement and utilization of POTs for ruminant, swine, and poultry management systems to advance productivity and efficiency	x			SUCs, DA-BAFS, DA-BAI, DA-RFOs	POT/protocols for ruminant, swine and poultry management system
Development and utilization of POT for native queen bee production	x			DA-BAI, DA-RFOs, SUCs	POT on native queen production
Field validation of production protocols of other aquaculture species such as mudfish/dalag and climbing perch/puyu and other indigenous species	x			DA-NFRDI, DA-BFAR	Validated protocols for the production of other aquaculture species such as mudfish/dalag and climbing perch/puyu and other indigenous species

Adaptability trial of growing silver therapon (Leiopotherapon plumbeus) in different stocking density and under different culture enclosure	x			DA-NFRDI, DA-BFAR	Growl trial of silver therapon in different cultured condition feasibility studies
Validation studies on feed formulations using low cost feeds for milkfish	x			DA-NFRDI, DA-BFAR, UPV, SEAFDEC	Commercially available cost-efficient feeds
Utilization of available raw materials as alternative for low-cost feed formulation and establishment of a village-type small-scale feed mills for milkfish	x			DA-NFRDI, DA-BFAR, SEAFDEC	Locally sourced and cost efficient feed formulation
Establishment of refined protocols and techniques for the larval rearing of milkfish	x			DA-NFRDI, DA-BFAR, SEAFDEC	Refined protocols and techniques for larval rearing
Growth comparison of milkfish reared in different environments	x			DA-NFRDI, DA-BFAR, SUCs, SEAFDEC	Report on the growth of milkfish reared on different environments
Ideal species combination for aquaculture integrated systems per area	x			DA-NFRDI, DA-BFAR, SEAFDEC, SUC	Multi-species aquaculture systems
Refinement and adaptation of existing seaweed rearing procedures for small and medium-scale farmers	x			DA-NFRDI, DA-BFAR, DA-BFAR 13, UP-MSI, LGUs	Adoption of enhanced seaweed production protocols for small/medium scale farmers
Development of management protocols on pests and diseases					
Development of pest and disease management protocols for pineapple	x			DA-RFO 5, DA-RFO 8, VSU, UPLB	Alternative pest control technologies for queen pineapple
ST2. Natural Resource Use Efficiency					
Farm consolidation and clustering, integrated production systems and diversified farming, more efficient irrigation systems and rainwater harvester, Renewable energy systems					
Energy - Renewable energy systems		x		SUCs, DA-BAFE, PhilMech	

Land – Conduct clustering and consolidation of adjacent farms and aquaculture-based farming systems			x	DA-CRAO; DA-BFAR	No. of clustered land area (in hectares) No. of farmers interested in farm clustering
Water – Constructed more efficient irrigation systems such as sprinkler and drip; rainwater harvesting system			x	BSWM, BAFE, NIA and RFOs	No. of new efficient irrigation systems (drip and sprinkler); No. of rainwater harvesting systems developed
ST3. Zero waste, recycling, and circular economy					
Reduction of feed inputs, recycling of wastes, eliminating pollution and development of Value added products					
Projects on elimination of waste and pollution, circulate products and materials (at their highest value), and regenerate nature.			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of proposals reviewed and approved with funding No. of Package of Technologies (POTs) on circular economy developed
Utilization of sweet sorghum waste to develop new and marketable value-added products	x			DA-RFOs, SUCs	Value-added products from sweet sorghum wastes
Value chain analysis and food development through wastes utilization (milkfish, shellfish, shrimp, Tilapia, seaweed)	x			DA-NFRDI, DA-BFAR, SUCs, DA BFAR 12. TAU, NWSSU, UNP	Products from fish waste materials
Nature-based materials					
Nature-Based Materials – Product development of bio-based, organic nature materials for value-added products for renewable materials			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) developed and used by farmers and fishers
ST4. Climate resilient food- and agri-based processing, marketing, and logistics systems					
Improving infrastructure and institutional measures and capacities					
Fisheries and aquaculture infrastructure and development	x			BFAR; NFRDI; Phil Fisheries Biotech Center; and RFOs	No. of Package of Technologies (POTs) developed and used by farmers and fishers

Livestock industry infrastructure and development	x			BAI; PCC; Phil Animal Biotech Center; and RFOs	No. of Package of Technologies (POTs) developed and used by farmers and fishers
Infrastructure and institutional measures, tools and capacity building – Design, construction and development; deployment and evaluation	x			DA-CRAO; DA-PRDP; DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of appropriate tools developed and adopted by farmers and fishers
Institutions measures including laws and policies	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of policy issuances and implemented
Improvement/upgrading of laboratory and improvement of human resource competencies in the fisheries sector	x			DA-NFRDI, DA-BFAR, DAFDC	Equipment human resource policy recommendations and requirements aligned with the international standards
Sustainable development bottomlines for aquaculture production with focus on social and inclusive benefits and environmentally sound economic benefits gain			x	DA-NFRDI, DA-BFAR, SUCs	Bottomlines in aquaculture
Policies that broaden markets through regional and global trade engagement and pool risks					
Policy studies that promote free trade, open borders and international cooperation	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus; PIDS	No. of policy briefs written and disseminated
Macroeconomic stabilization studies – Conduct policy studies in expanding spending or cutting taxes to stimulate an ailing economy, or slashing spending or raising taxes to combat rising inflation or to help reduce external vulnerabilities	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus; PIDS	No. of policy briefs written and disseminated

Major advances studies – Conduct on technologies in communication, information processing, and transportation innovations	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of policy briefs written and disseminated
ST5. Digitalization					
Digital Tools for climate change adaptation and mitigation					
Digital agriculture – Conduct the use of ICT-based digital and spatial technologies and smart devices designed to optimize agricultural production and farm management processes			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) using digital agriculture developed and adopted by farmers and fishers
Climate change risk and vulnerability assessments – Conduct of climate risk and vulnerability assessments			x	DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) developed
Responsible Agriculture and Food Supply Chains – Conduct supply chain mapping with SWOT analysis	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of food supply chain cum SWOT developed and implemented
Development of tools for market intelligence (e.g. VCA, Supply chain analysis, resource mapping)					
Supply chain analysis on cacao	x			DA-RFOs, SUCs, NGOs	Supply chain analysis
Aquxulture Value chain analysis and food development	x			DA-NFRDI, DA-BFAR, UPV	Market-driven value chain development initiatives and food products
Site carrying capacity assessment of tilapia production areas	x			DA-NFRDI, DA-BFAR, DABFAR 12	Assessment maps on carrying capacity of tilapia production areas
Resource need mapping for shellfish, shrimp	x			DA-NFRDI, DA-BFAR, SUCs	Shellfish needs source maps Chrimp fry source maps
ST6.Nutritious food, sustainable diets, and consumption					

Promoting and communicating healthy and sustainable dietary patterns					
Educating individuals and communities about the benefits of consuming a balanced diet	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	Proportions (%) of individuals and communities served
Advocating for policies and practices that support sustainable food production and distribution	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of policy briefs written and disseminated
Promote and communicate healthy and sustainable dietary patterns	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of healthy and sustainable dietary patterns served
Promote Geopolitical Indication (GI) of products or goods as a safeguard for culture and indigenous traditions	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of GI promoted and registered at IPOPHL, DTI
ST7.Landless rural workforce and non-farm jobs					
Sustainable community based farming, field demos and hands-on training workshops; capacity enhancements					
Active engagement of small farmers, fisherfolk, and agriculture laborers in sustainable agriculture – Conduct field demos and hands-on training workshops	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) developed and adopted by farmers and fishers; women and youth involvement
Promote sustainable community-based farming practices, fair wages, and improved livelihoods for those involved in food production - Conduct field demos and hands-on training workshops	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) developed and adopted by farmers and fishers; women and youth involvement
Policy studies on trade and certifications					
Fair trade certification, organic farming, and community-supported climate smart agriculture programs	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of Package of Technologies (POTs) developed and adopted by farmers and fishers; women and youth involvement

Agriculture trade and regional/global trade (WTO, ASEAN, RCEP, etc.) – Attendance and present trade and policy studies and positions papers	x			DA-ATI; SUCs; RFOs; other DA-Attached agencies and bureaus	No. of trade missions attended No. of trade/policy studies and position papers

Annex 2. Data Requirement for the Inventory/ Compendium of Climate Smart R4D Projects funded by DA-BAR (2020-2024)

Sub-Theme	CC risk addressed	Technology/ Practice/ Innovation	Description	Climate Resilient Measure (A / M/ A+M)	Total Investment	Location	Beneficiaries	Status	Total Project Cost (PHP M)	Lead Researcher, Agency / Contact Details	Project Link
Technology and Innovations for sustainable agriculture, fisheries, and livestock	*climate related risks and hazards addressed by the tech/prac*	*Name of the technology/ practice/ innovation*	*Brief description of the tech/prac generated*	*Identify if* *A = Adaptation* *M = Mitigation* *A+M = Adap+Mit*	*Investment required to utilize the technology* *Include financial indicators, if applicable (e.g. ROI, NPV, IRR)*	*Province, municipality, barangay*	*No of beneficiaries disaggregated by gender, age, location*	*e.g. Adopted Commercialized, Upscaled, Disseminated as of the current year*	*Total funding support*	*Name of L. Researcher and agency affiliation / official email/ contact no.*	*Link to project website, if any*
Natural Resource Use Efficiency											
Zero waste, recycling, and circular economy											
Climate resilient food- and agri-based processing, marketing, and logistics systems											
Digitalization											
Safe & nutrient dense food for everyone											
Landless rural workers with more & better quality jobs											

Annex 3. Data Requirement for Commodity Systems Climate Smart (CS) Research for Development (R4D) Analytics Dashboard

Value Chain	Commodity System (NAFMIP)	Productivity Data		Factor Efficiency	Available technologies/ practices/ innovations	Description	Sub-Theme	CC risk addressed	Climate Resilient Measure (A / M/ A+M)	Location	Beneficiaries	Total Investment	Status	Project Link
		Supply	Demand											
Input, *production,* *postharvest,* *processing,* *marketing,* *etc.*	*Rice-based* *Corn/ Livestock/ Poultry-based* *Coconut-based* *Fishery-based* *Geographically Specialized*	*Yield per cropping/ cycle, annual*	*Per capita consumption, potential areas for tech sharing*	*Labor Productivity, water efficiency, Total Factor productivity*	*Name of the technology/ practice/ innovation*	*Brief description of the tech/prac generated*	*Technology and Innovations for sustainable agriculture, fisheries, and livestock*	*climate related risks and hazards addressed by the tech/prac*	*Identify if* *A = Adaptation* *M = Mitigation* *A+M = Adap+Mit*	*Province, municipality, barangay*	*No of beneficiaries disaggregated by gender, age, location*	*Investment required to utilize the technology* *Include financial indicators, if applicable (e.g. ROI, NPV, IRR)*	*e.g. Adopted Commercialized, Upscaled, Disseminated as of the current year*	*Link to project website, if any*
		Prices *Elasticity* *Factors of production used (labor, capital)*					*Natural Resource Use Efficiency*							
							Zero waste, recycling, and circular economy							
							Climate resilient food- and agri-based processing, marketing, and logistics systems							
							Digitalization							
							Safe & nutrient dense food for everyone							
							Landless rural workers with more & better quality jobs							

Annex 4. Data Requirement for Commodity Systems Climate Smart (CS) Research for Development (R4D) Indicative Dashboard (2026-2028 proposals)

Value Chain	Commodity System (NAFMIP)	Sub Theme	Proposed technologies/ practices/ innovations	Description	Climate Resilient Measure (A / M/ A+M)	Gender Responsiveness	Target Location	Potential Beneficiaries	Total Investment	Total Fund Requirement	Proposed Project Duration	Project Proposal Link
Input, *production,* *postharvest,* *processing,* *marketing,* *etc.*	*Rice-based* *Corn/ Livestock/ Poultry-based* *Coconut-based* *Fishery-based* *Geographically Specialized*	*Technology and Innovations for sustainable agriculture, fisheries, and livestock*	*Name of the technology/ practice/ innovation*	*Brief description of the tech/prac generated*	*e.g. Adopted Commercialized, Upscaled, Disseminated as of the current year*	*Rating*	*Province, municipality, barangay*	*No of beneficiaries disaggregated by gender, age, location*	*Investment required to utilize the technology* *Include financial indicators, if applicable (e.g. ROI, NPV, IRR)*	*Total funding support needed from BAR and other agency counterparts*	*Indicate from what year to what year*	*Link to project website, if any*
		Natural Resource Use Efficiency										
		Zero waste, recycling, and circular economy										
		Climate resilient food- and agri-based processing, marketing, and logistics systems										
		Digitalization										
		Safe & nutrient dense food for everyone										
		Landless rural workers with more & better quality jobs										

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