Republic of the Philippines
Department of Science and Technology

HARMONIZED NATIONAL RESEARCH AND DEVELOPMENT AGENDA 2022-2028

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ACRONYMS

AANR – Agriculture, Aquatic and Natural Resources

AI – Artificial Intelligence

AM – Additive Manufacturing

DNA – Deoxyribonucleic acid

DOST – Department of Science and Technology

DRR/CCA – Disaster Risk Reduction and Climate Change Adaptation

EO – Earth Observation

GIDA - Geographically Isolated and Disadvantaged Areas

GPS – Global Positioning System

HIV – Human Immunodeficiency Virus

HNRDA – Harmonized National Research and Development Agenda

ICT – Information and Communications Technology

IEET – Industry, Energy and Emerging Technologies

IoT – Internet of Things

MSMEs – Micro, Small and Medium Enterprises

NCDs – Noncommunicable Diseases

NIBRA – National Integrated Basic Research Agenda

NRCP – National Research Council of the Philippines

NUHRA – National Unified Health Research Agenda

PAGASA – Philippine Atmospheric, Geophysical and Astronomical Services Administration

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

PCHRD – Philippine Council for Health Research and Development

PCIEERD – Philippine Council for Industry, Energy and Emerging Technology Research and Development

PHIVOLCS – Philippine Institute of Volcanology and Seismology

R&D – Research and Development

RHRDC – Regional Health Research and Development Consortium

S&T – Science and Technology

INTRODUCTION

The Harmonized National Research and Development Agenda (HNRDA) 2017-2022 served as guide for the prioritization of research programs and projects funded in the last five years.

The next quinquennial will be a post-pandemic world, defined by the way society and the economy adapted to the health crisis. Science, technology and innovation are at the forefront in providing leaders with informed choices to help disease prevention and control. Beyond health measures, innovation held the key for industry to reawaken the economy and provide sustainable solutions to challenges in health and travel restrictions. The need for R&D continues, as every sector prepares for upcoming eventualities.

The Department of Science and Technology (DOST) as mandated by law to provide central direction, leadership and coordination of the scientific and technological efforts in the country spearheaded the updating of the HNRDA through its agencies the National Research Council of the Philippines (NRCP), Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), Philippine Council for Health Research and Development (PCHRD), Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD), and the Office of the Undersecretary for Scientific and Technical Services – Disaster Risk Reduction and Climate Change Unit, in cooperation with stakeholders in their respective sectors.

The DOST, in consultation with government and private research and development institutions, the academe, industry and other concerned agencies, prepared and updated the HNRDA 2022-2028 to direct and ensure anew that results of science, technology and innovation endeavors are geared towards and are utilized in areas of maximum economic and social benefit for the people.

SECTION 1

NATIONAL INTEGRATED BASIC RESEARCH AGENDA (NIBRA) 2022 – 2028

I. INTRODUCTION

The National Research Council of the Philippines (NRCP), a collegial body of over four thousand researchers, scientists, experts, and artists, is mandated to promote and support fundamental and basic research in the country as provided in the 9th Philippine Legislature Act No. 4120 passed on 8 December 1933. It is likewise mandated to provide advice on problems and issues of national interest.

Along this line, the NRCP supports research that is directed primarily towards developing a new and fuller scientific knowledge or understanding of any subject which may or may not have practical applications. Basic research results from intellectual curiosity aimed at proving the unknown, or it may seek new knowledge required for practical application in the future (Ref: Science Act of 1958 as amended by RA 3589).

Outputs of NRCP-funded researches are journal and scholarly publications, policy advisories, patent applications, and products used for community and public engagements such as books, manuals, monographs, among others. The outputs of basic research become part of the broader body of knowledge which become foundations of further research and development, i.e., applied research. The period of translation from basic research to applied research, technology transfer and commercialization varies depending on field of research and other variables.

The NIBRA 2022 to 2028 is a continuation of the research priorities of the 2017 to 2022 NIBRA which is a product of a series of consultations and forums that started in 2016. The thirteen disciplinal Divisions of NRCP generated their respective Division basic research agenda. These are the Divisions of Governmental, Educational and International Policies (Division 1), Mathematical Sciences (Division II), Medical Sciences (Division III), Pharmaceutical Sciences (Division IV), Biological Sciences (Division V), Agriculture and Forestry (Division VI), Engineering and Industrial Research (Division VII), Social Sciences (Division VIII), Physics (Division IX), Chemical Sciences (Division X), Humanities (Division XI), Earth and Space Sciences (Division XII), and Veterinary Medicine (Division XIII). The divisions are clustered into the following sub-groups:

Cluster 1 – Humanities (Division XI)
Governmental, Educational and International Policies (Division I)
Social Sciences (Division VIII)

Cluster 2 – Engineering and Industrial Research (Division VII)
Mathematical Sciences (Division II)
Physics (Division IX)
Earth and Space Sciences (Division XII)

Cluster 3 – Chemical Sciences (Division X)
Medical Sciences (Division III)
Pharmaceutical Sciences (Division IV)

Cluster 4 – Agriculture and Forestry (Division VI)
Biological Sciences (Division V)
Veterinary Sciences (Division XIII)

The NRCP's 2022 – 2028 NIBRA will prioritize fundamental research in support of the Philippine Development Plan, Sustainable Development Goals, the National Security Plan, and the Science for Change Program of the Department of Science and Technology.

As a result of the consultations made with the NRCP Governing Board as discussed in various meetings between October to December 2021, the Council will also support blue skies or pure basic research, and policy research for the period, 2022-2028 in addition to the oriented basic research.

The discussions on NIBRA was made part of a series of strategic planning sessions of the Governing Board in the last quarter of 2021. A third-party consultant contracted by NRCP for its strategic planning, fielded a survey to NRCP Members on September 15, 2021 and a total of 482 NRCP Members responded. Included in the survey are the following questions:

- What Basic Research area do you want NRCP to focus on?
- What Applied Research area do you think NRCP would focus on?
- What are the research areas where the Philippines is lagging?

The results of the survey were presented on October 8, 2021 at the first strategic planning session of the Governing Board. Succeeding discussions which included NIBRA followed on October 22, 2021 (2nd strategic planning session) and November 12, 2021 (3rd strategic planning session).

In between the 2nd and 3rd sessions, the GB Planning and Finance Committee also took up NIBRA as part of the series of input meetings on October 25, November 3 and 5, 2021.

In the last strategic planning session on 12 November 2021, the GB-approved expanded NIBRA was presented which still include the six research areas: inclusive nation building, sustainable communities, clean energy, food and nutrition security, health sufficiency, and water security, but with the addition of blue skies (pure basic) research, and policy research.

II. MAJOR COMPONENTS/RESEARCH AREAS/PRIORITY AREAS

For 2022 – 2028, NIBRA will have three major components:

II-1. BLUE SKIES RESEARCH OR PURE BASIC RESEARCH

II-2. ISSUE-BASED OR ORIENTED BASIC RESEARCH

A. Water Security – Tubig Program (Tubig Ay Buhayin At Ingatan)
B. Food And Nutrition Security – Sapat Program (Saganang Pagkain Para Sa Lahat)
C. Health Sufficiency – Likas Program (Likas Yaman Sa Kalusugan)
D. Clean Energy – Alert Program (Alternative Energy Research Trends)
E. Sustainable Community – Saklaw Program (Saklolo Sa Lawa)
F. Inclusive Nation-Building – Atin Program (Ang Tinig Natin)

II-3. POLICY RESEARCH

RESEARCH AREAS /PROGRAM AREAS:

II-1. BLUE SKIES OR PURE BASIC RESEARCH

Pure Basic Research, also referred to as Blue Skies research,[1] refers to fundamental research in the sciences and the humanities which have no impact or perceived practical use. These may be purely theoretical in scope and heralding disciplinal advances and pioneering works/discoveries.

It is a curiosity – driven basic research whose outcome is not anticipated in the beginning. Hence, the original motivation to address the question "Why is the sky blue?" was due to the interest on the observed physical phenomena itself rather than deriving any benefit from the answer. By definition, this type of research implies that the researcher is given free hand to set his/her own agenda. The aim is mainly to solve a fundamental unique problem without a specific target in mind.

As opposed to the strategic or goal-oriented research, the blue skies research can proceed to any direction and the discovery process is not stifled with pre-set expectations. Hence, doing an open and exploratory research can effectively bring in new knowledge that is not within the current accepted ways of thinking.

Blue skies research promotes creativity and research diversity which have led to a long history of serendipitous applications in science and technology. An example of such a technology is the Global Positioning System (GPS) which would not have been possible without Einstein's theory of general relativity[2]. When he was doing his research, Einstein only wanted to understand how gravity affects space and time. Another example is the wide use of ultrasound for medical applications. Ultrasound was first studied out of curiosity in determining the frequencies that could be heard by animals beyond the range of human hearing [3][3]. These illustrate that derived applications from blue skies research eventually stimulate scientific and technological development and, consequently, spur economic growth in the long term.

[1] Linden, B. *Basic Blue Skies Research in the UK: Are we losing out?* J. Biomed Discov Collab. **3**: 3 (2008). https://doi.org/10.1186/1747-5333-3-3

[2] Ashby, N. *Relativity in the Global Positioning System*. Living Rev. Relativ. **6,** 1 (2003). https://doi.org/10.12942/lrr-2003-1

[3] Nadrljanski, M., Bell, D. *History of ultrasound in medicine*. Reference article, Radiopaedia.org. (accessed on 06 Dec 2021) https://doi.org/10.53347/rID-8660

PROPOSED BUDGET FOR BLUE SKIES OR PURE BASIC RESEARCH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
2.194 M	5 M	7 M	9 M	11 M	13 M	15 M

II-2. ORIENTED BASIC RESEARCH

This covers research which seeks new knowledge required for application purposes, but which may of course contribute to general scientific advancement in the process. There are six (6) issue-based agenda in the NIBRA.

A. WATER SECURITY

TUBIG Agenda (Tubig Ay Buhayin At Ingatan)

The Philippines will experience a high degree of water shortage in year 2040. Climate change and the world's growing population are considered to be the drivers of widespread water shortage (World Resources Institute Technical Note, 2015; United Nations Report on Climate Change, 2009).

This research agenda will help mitigate this foreseen water shortage due to natural and human activities that render water undrinkable, unavailable and inaccessible. New processes, methodologies, cutting-edge science and technology (S&T)-based approaches will be explored.

The research agenda aims to: 1) develop solutions for the detection and management of water quality for drinking water resulting from chemical, biological, and human activities, 2) come up with better water management strategies for household use, 3) identify alternative and/or new sources of potable water, and 4) provide policy recommendations.

For the past six years, six projects have been funded under the TUBIG agenda. Five of which are still ongoing. Notable outputs such as low cost and portable electrochemical sensor for heavy metal detection in water have been generated under this program. Other outputs like the decision support system and nurturing management protocol for watersheds, groundwater network data, and the solar-driven membrane seawater desalination set-up are expected to be produced by the ongoing projects under the TUBIG agenda.

Identified gaps like the mathematical modeling, supply and demand analysis of drinking water in coastal and island communities and the causes of salt-water intrusion and its effect on the availability and accessibility of drinking water, will hopefully be addressed by the ongoing projects and the future projects funded programs/projects under this agenda.

For 2022-2028, the areas for research include:

1. Watershed studies
    a. Biological, chemical and physical characterization
    b. Water supply stress index
    c. Population growth impacts on water resource availability

2. Water quality, accessibility and availability
    a. Pollutants/contaminants (surface and ground waters)

a. Analysis of historical flows, sediment and toxicity loads of lakes and rivers
b. Weather modification for increasing water supplies in special localized areas

PRIORITY AREAS FOR 2022 – 2025

1. Water quality, accessibility and availability for safe drinking purposes in coastal and island Communities
   a. Mathematical modeling
   b. Characterization which includes pollutants/contaminants/toxicity
   c. Physico-chemical, socio-economic, biological and morphological studies
   d. Supply and demand analysis of drinking water in coastal and island communities

2. Salt-water intrusion in drinking water among coastal and island communities
   a. Causes of salt-water intrusion and its effect/impact on the availability and accessibility of drinking water

PRIORITY AREAS FOR 2026 – 2028

1. Water quality, accessibility and availability for safe drinking purposes
   a. Pollutants/contaminants (surface and ground waters)
   b. Analysis of historical flows, sediment and toxicity loads of lakes and rivers
   c. Weather modification for increasing water supplies in special localized areas

2. Watershed studies
   a. Biological, chemical and physical characterization
   b. Water supply stress index
   c. Population growth and sector policy impacts on water resource availability

PROPOSED BUDGET FOR WATER SECURITY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
12.918 M	27 M	36.25 M	40 M	45 M	52 M	60 M

B. FOOD AND NUTRITION SECURITY

SAPAT Agenda (Saganang Pagkain Para sa Lahat)

This research agenda will provide science-based data to address critical knowledge gaps in the four key elements of food security, i.e. accessibility, availability, utilization and stability. Programs under this agenda will mainly capitalize on biodiversity researches in aid of harnessing knowledge base on ecosystem functioning and the provision of goods and services that are essential to human health and well-being. Biodiversity is the source of the components of production (crops, livestock, fisheries), and the genetic diversity within these that ensures continuing improvements in food production, allows adaptation to current needs and ensures adaptability to future ones. The continued decline of biodiversity, including loss or degradation of ecosystems, is reducing the ability of biodiversity and ecosystems to provide essential life-sustaining services and, in many cases, leads to negative outcomes for health and well-being.

On the other hand, food safety is a critical component for sustainable development, hence, it is critical to human nutrition and food security. Safer food contributes to less illness, therefore, increases productivity and improves livelihood. Poor nutrition and foodborne

diseases often combine to a vicious cycle of worsening health. Therefore, food safety must be systematically integrated into policies and interventions to improve nutrition and food security. Thus, programs under SAPAT will also explore fundamental researches towards better understanding of abiotic and biotic factors that threaten the safety of food from farm to table.

For the past five years (2017-2021), significant accomplishments under this agenda include the risk and safety analysis of agricultural farms specifically on the heavy metal, bacterial and parasitic contaminations in selected vegetables. The results of these studies provided science-based evidence which could be adopted for possible legislation addressing the issues concerning farming practices that pose threats to farmers and consumers' health. It provided information on the food-borne diseases linked to farm produce.

To further address the food safety and security issues on a national level, research topics on these areas are being prioritized for 2022-2028. Studies on Halal are added to mainstream researches on this field.

For 2022-2028, the areas for research include:

1. Taxonomic studies of flora and fauna as food sources
    a. Biology and population dynamics of pests, diseases, and natural enemies
    b. Diseases and pathogens of important crops
    c. Taxonomy of eco-friendly species (e.g. arthropods and microorganisms) for Integrated Pest Management
    d. Taxonomy of neglected and underutilized species for food
    e. Genetic analysis (biochemical, cytogenetics, molecular)
    f. Exploring allelopathic potentials of indigenous botanicals

2. Food safety of raw and processed products of micro, small and medium enterprises (MSMEs)
    a. Safety analysis of raw and processed food products
    b. Identification and characterization of raw and processed food/feed contaminants and adulterants
    c. Epidemiology of food- and feed-borne contaminants

3. Halal Studies
    a. Documentation of consumption and production practices (product-specific)
    b. Knowledge, Attitude, Practice, Skills (KAPS)
    c. Integration and mainstreaming of Halal in the food and beverage industry

PRIORITY AREAS FOR 2022 – 2025

1. Food safety of raw and processed products of MSMEs
    a. Contaminants and adulterants in street foods (preferably on products without existing code of practice)

2. Taxonomic studies of flora and fauna as food sources
    a. Genetic analysis (biochemical, cytogenetics, molecular)
    b. Morphological, allelopathic, and bioecological studies for food security and sustainability

3. Halal Studies
    a. Documentation of consumption and production practices (product-specific)

b. Knowledge, Attitude, Practice, Skills (KAPS)
c. Integration and mainstreaming of Halal in the food and beverage industry

PRIORITY AREAS FOR 2026 – 2028

1. Taxonomic studies of flora and fauna as food sources
2. Population dynamics of pests, diseases and natural enemies
   a. Diseases and pathogens of important crops
   b. Taxonomy of eco-friendly species (e.g. arthropods and microorganisms) for Integrated Pest Management
   c. Taxonomy of neglected and underutilized species for food Halal Studies

PROPOSED BUDGET FOR FOOD AND NUTRITION SECURITY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
6.199 M	27 M	41.25 M	45 M	50 M	56 M	62 M

C. Health Sufficiency

LIKAS Agenda (Likas Yaman sa Kalusugan)

Programs under LIKAS aim to support the objective of the national government in improving the quality of life of every Filipino through scientific-based data which will provide scientific-based understanding and solution to: a) possible zoonotic diseases (both emerging and re-emerging), b) possible alternative sources of health improvement initiatives for disease control and management through fundamental researches on natural products development from rare environments and endemic species, and c) evaluation of the existing health policies and programs towards achieving the Sustainable Development Goals in securing better health for Filipinos today and for years to come.

Notable accomplishments through this endeavor include the identification of more than 100 bioactive compounds isolated from marine sediments, bat guano, caves, and mangroves. It also produces new knowledge on biodiversity riches, medicinal potential of the said natural resources.

While most of the research programs and projects funded deal with the discovery of novel bioactive compounds for possible medicinal use, however, some of previously isolated samples are due for further studies on pharmacogenomics and toxicogenomics to fully determine the lead bioactive compound suitable or effective against a certain antimicrobial disease/ pathogenic agent. Likewise, with the Philippines rich biodiversity, there is still a need to search and discover from other rare environment and endemic species considering its known potential in producing possible medicinal drug.

Moreover, to prepare for possible another pandemic which might be brought about by zoonotic diseases, research initiatives along this area have been considered and included for undertaking.

For 2022-2028, priority research areas include:

1. Fundamental Studies on Potential Sources of Natural Products from rare environments and endemic species

With various emerging and re-emerging diseases that the Philippines is currently facing, this research program will be an initiative for generation of new knowledge and/or possible alternative sources of medicinal drugs for disease control and management through natural products development from rare environments and endemic species.

This will include biodiversity studies grounded on taxonomic classification and identification of microorganisms found in caves, mangroves, marine sediment, volcanoes, mud springs, mesophotic reefs and the like, in search of potential sources of bioactive compounds. Breakthroughs from taxonomic studies will pave the way for the development of next generation chemotherapeutic agents and antimicrobial drugs from the discoveries of molecules with wide ranging bioactivities including antibiotics, antifungal and anticancer properties isolated from various organisms.

Areas for research include:

a. Bioprospecting (e.g. marine organisms for biomedical use)
b. Bioinformatics
c. Characterization and structure elucidation of isolates and bioactive compounds
d. Pharmacogenomics and toxicogenomics
e. Lead identification and pre-clinical studies

2. Basic Veterinary Studies

This initiative is for the identification and characterization of possible zoonotic diseases (etiology, transmission and control), which may include researches on the economically important animal diseases and those that pose risks to be transmitted to humans, in order to be able to create and provide effective disease control and management in pursuit of attaining better health for all.

Areas of research include:

a. Identification and characterization of zoonotic diseases
b. Emerging and re-emerging zoonotic diseases and its management

PRIORITY AREAS FOR 2022 – 2025

1. Isolation and Characterization of potential sources of natural products from rare environments and endemic species
   a. Volcanoes, caves, mudsprings, mined-out areas, mesophotic reefs, marine environments, mangroves and others
   b. Endemic species from aquatic environments

2. Basic Veterinary studies
   a. Zoonotic Diseases (etiology, transmission and control)
   b. Emerging and re-emerging zoonotic diseases and its management

PRIORITY AREAS FOR 2026 – 2028

1. Lead compound optimization and pre-clinical studies of bioactive compounds rare environments and endemic species
   a. Volcanoes, caves, mudsprings, mined-out areas, mesophotic reefs, mangroves and others
   b. Endemic species from aquatic environments

2. Basic Veterinary studies
    a. Zoonotic Diseases (etiology, transmission and control)
    b. Emerging and re-emerging zoonotic diseases and its management

PROPOSED BUDGET FOR HEALTH SUFFICIENCY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
8.761 M	37 M	50.5 M	71 M	77.5 M	84 M	92 M

D. CLEAN ENERGY

ALERT Agenda (Alternative Energy Research Trends)

Programs under ALERT aim to investigate alternative energy sources in the Philippines. As our country continues to modernize and industrialize, its energy needs are expected to double over the next 20 years. The challenge is to meet these needs while trying to stop accelerating greenhouse gas emissions that contribute to climate change. Thus, researches on cleaner energy sources is very important. Above all, this program will lay out how renewable energy can save the government money, bring jobs to the country, create wealth, expand access to energy for the most vulnerable in poor communities, and foster national energy independence.

The demand for energy has dramatically risen in the past years. In response to these challenges, energy sectors have evolved to focus on cleaner and more sustainable energy projects. What began, earlier this decade, as interventions in electricity expansion projects—oil and gas sectors, and power sector reforms—have now advanced to investments in alternative source of energy and renewable energy. This program will contribute in addressing this problem.

For the past five years (2017-2021), ALERT has already funded seven projects. Notable accomplishments under ALERT includes: optimal design of a polygeneration system using various clean and low carbon technologies, sustainability assessment of algae-based biofuels in the Philippines, and the development of a P-graph based model for designing Philippine agricultural waste-based integrated biorefinery.

Gaps like commercial viability studies of the clean and renewable sources of energy will hopefully be addressed by projects to be funded under this research agenda.

For 2022-2028, areas of research will include:

1. Alternative Energy
    a. Resource assessment of potential sources of clean and renewable energy
    b. Identification and characterization of clean and renewable sources of energy (wind, solar, biofuels, hydro)

<u>PRIORITY AREAS FOR 2022 – 2025</u>

Resource assessment of potential alternative and renewable sources of energy, preferably for Geographically Isolated and Disadvantaged Areas (GIDA)

    a. Solar, wind, biofuels, hydro, waves, and others

PRIORITY FOR 2026 – 2028

From 2026-2028, priority will be on conduct of commercial viability studies of the potential clean and renewable sources of energy identified from previous studies.

PROPOSED BUDGET FOR ALERT PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
5.497 M	12 M	16.25 M	20 M	25 M	32 M	40 M

E. SUSTAINABLE COMMUNITIES

SAKLAW Agenda (Saklolo sa Lawa)

This research agenda aims to establish scientifically crafted sustainability management solutions (action plans/roadmaps/models) to the pressing ecological problems, as well as the encompassing social issues affecting the different vulnerable communities/ecosystems in the country. The agenda is into geographical, community-based (people), ecosystem-based (environment), and transdisciplinary in approach which will diagnose problems and challenges on ecological and sociological components that hinder sustainability of the ecosystem and surrounding communities, in order to come up with scientific solutions and policy recommendations.

In the past five years (2017-2021), SAKLAW supported several assessment studies several assessment and environmental scanning on Lake Lanao, Laguna Lake, and the Seven Lakes of San Pablo. This initiative has produced several policy recommendations on the conservation of the said lakes. A new biomarker indicating estrogen pollution in lakes has also been discovered by the program.

For 2022-2028, areas of research include:

1. Vulnerable Ecosystems (Lakes, Rivers, Wetlands, Seas, and Oceans)
    a. Soil science
    b. Carrying capacity models of ecosystems
    c. Environmental scanning of physical, aquatic, marine, and terrestrial resources
    d. Endangered species
    e. Economic valuation of ecosystems, natural capital, and cost-benefit analyses
    f. Evaluation of adaptive socio-ecological systems in a changing environment
    g. Assessment studies on the resource sustainability of various ecosystems
    h. Models and frameworks for enhancing adaptive capacities of vulnerable communities
    i. Biological pollution

2. Greening Mined out Areas in the Philippines (GMAP)
    a. Reduction of heavy metals exposure among communities

3. Risk Communication Studies for Disaster Management
    a. Human dimensions research on climate change (drivers, impact, responses, adaptive capacities)
    b. Risk communication models for disaster risk reduction and climate change adaptation (DRR/CCA)

4. Biodiversity and Ecosystem Studies
    a. Environmental scanning of physical marine and terrestrial resources (taxonomy, systematics, ecology)

PRIORITY AREAS FOR 2022 – 2025

1. Vulnerable Ecosystems: Lakes (Lanao, Sebu, Mainit, Seven Lakes of San Pablo; Sumlang, Nag-Aso and Danao of Albay; Lakes Danao, Mahagnao and Bito of Leyte)
    a. Carrying capacity models of ecosystems
    b. Environmental scanning of physical, aquatic, and terrestrial resources
    c. Economic resource assessment and valuation
    d. Physico-chemical characterization
    e. Risk assessment
    f. Socio-economics

2. Greening the mined-out areas in the Philippines (GMAP) (Surigao, Cebu, Zambales, Benguet)
    a. Heavy metal contamination assessment
    b. Vulnerability and risk assessment
    c. Economic resource valuation
    d. Social, environmental and technology scanning
    e. Heavy metal sequestration, soil regeneration
    f. Reduction of heavy metals exposure among communities

3. Risk Communication Studies for Disaster Management particularly on earthquakes, landslides, flooding and climate change hazards (Benguet, Samar, Bukidnon, Masbate, Sorsogon, Negros Oriental)
    a. Assessment/situational Analysis
    b. Design, implementation and evaluation of risk communication (Riskcom) plan
    c. Riskcom Innovation Models for resilient disaster risk governance

4. Biodiversity and ecosystem studies
    a. Genetic analysis (biochemical, cytogenetics, molecular)
    b. Morphological, allelopathic and bioecological studies

PRIORITY AREAS FOR 2026 – 2028

1. Vulnerable Ecosystems: Lakes (Lanao, Sebu, Mainit, Seven Lakes of San Pablo; Sumlang, Nag-Aso and Danao of Albay; Lakes Danao, Mahagnao and Bito of Leyte)
    a. Carrying capacity models of ecosystems
    b. Environmental scanning of physical, aquatic, and terrestrial resources
    c. Economic resource assessment and valuation
    d. Physico-chemical characterization
    e. Risk assessment
    f. Socio-economics

2. Greening the mined-out areas in the Philippines (GMAP) (Surigao, Cebu, Zambales, Benguet)
    a. Reduction of heavy metals exposure among communities

3. Risk Communication Studies for Disaster Management particularly on earthquakes, landslides, flooding and climate change hazards (Saranggani, Surigao del Norte, Surigao del Sur, Dinagat Islands, Southern Leyte, Eastern Samar)
   a. Assessment/situational Analysis
   b. Design, implementation and evaluation of Riskcom plan

PROPOSED BUDGET FOR SUSTAINABLE COMMUNITIES (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
27.2 M	72 M	86.25 M	117 M	124.5 M	140 M	159 M

F. INCLUSIVE NATION-BUILDING

ATIN Agenda (Ang Tinig Natin)

The inclusive nation-building (ATIN) agenda aims on transforming the country into a nation united in its ethnic diversity; just and humane among its people's interrelations; respectful, even appreciative of their diverse and divergent ways of life, arts, languages, practices, and cultures; fostering and nurturing their cultural integrity together with economic self-sufficiency. This re-visioned national development adheres to moral and ethical principles; reclaims the rich past (including archaeological roots) and resilient present (through Filipinnovation in the arts and cultures). This nationalist direction utilizes innovative strategies for comprehensive development of communities, and maximizes reforms on all levels, complemented by multimedia dissemination, towards encompassing positive social change.

Under this initiative, fundamental studies on social processes, indigenous knowledge, and Filipino arts, history and culture will be conducted towards an increased awareness and appreciation of the Filipino identity and heritage.

For the past five years (2017-2021), this initiative has produced copyrights of nature's presence, and seven dances of life and sound tenderness, monographs documenting the state of traditional music and dance, and Cebuano songs, and an e-dictionary for language preservation and use among indigenous group.

In valuing the arts, culture and heritage using science, technology and innovation, it is imperative that diverse studies on preservation, conservation and uses for equity and nation building have to be conducted in addressing the gaps in misappreciation, improper use, and lack of policy supporting promotion, valuing its economic benefit and securing safety.

For 2022-2028, areas of research include:

1. Heritage and Arts for Tourism and Creative Industries (HATCI)
   This will look into and investigate the artistic and cultural dynamics of selected creative industry sectors for a much deeper perspective, understanding and support to maximize its potentials in contributing to the productivity of the creative industry sectors, as well as its potentials for agro or cultural tourism. HATCI will also document Philippine indigenous knowledge, culture, and heritage.

   a. Documentation of Philippine indigenous knowledge, culture, and heritage

- Extant arts, music, and language
- Indigenous technology in Filipino expressive culture

b. Filipinnovation of Arts, Culture and Heritage for Tourism and Creative MSMEs/Industries
   - Documentation, preservation and knowledge transfers
   - Industry-based assessments
   - Value chain analysis
   - Art history
   - Modernization, digitization and/or use of artificial intelligence (AI)
   - Characterization/analysis of materials

2. Defense and Security - Kapakanan ng Tao sa Oras ng Pandemya (DaS - KTOP)
   This will include issues that concern sovereignty such as biosecurity, cybersecurity, public safety and welfare. It will also include studies on the socio-economic dimension of the COVID-19 pandemic which threatened public health safety and welfare of the Filipinos, under the Kapakanan ng Tao sa Oras ng Pandemya (KTOP) Program. These researches will aid in policy making and help individuals and organizations in adapting new measures in different settings.

   a. National security and sovereignty
      - Biosecurity
      - Cybersecurity
      - Territorial Integrity
      - Public safety and security
   b. Socio-economic dimension of the COVID-19 pandemic and health emergencies
      - Assessment of remote and/or blended learning
      - Employment
      - Livelihood sustainability
      - Emerging e-commerce (MSMEs, informal sector)
      - Work-from-home
      - Behavioral response; socialization processes

PRIORITY AREAS FOR 2022 – 2025

1. Heritage and Arts for Tourism and Creative Industries (HATCI)
   a. Documentation of Philippine indigenous knowledge, culture, and heritage (Extant arts, music and language)
      - By specific indigenous group
      - Site-specific (geographical)
   b. Filipinnovation of Arts, Culture and Heritage for Tourism and Creative Music Industry
      - AI-aided preservation of culture and use of arts
      - Scoping and scanning the industry
      - Value chain analysis

2. Defense and Security (DaS - KTOP)
   a. National security and sovereignty
      - Cybersecurity
        - Review of cybersecurity policies
        - IT and communication
        - Data protection in the government sector

b. Socio-economic dimension of the COVID-19 pandemic and health emergencies
   - Assessment of remote and/or Blended learning
   - Emerging e-commerce (MSMEs, informal sector)
   - Work-from-home
   - Behavioral response; socialization processes
   - Recovery plan/mechanism (education, social, tourism, economic, care system)

PRIORITY AREAS FOR 2026 – 2028

1. Heritage and Arts for Tourism and Creative Industries (HATCI)
   a. Documentation of Philippine indigenous knowledge, culture, and Heritage
      - Extant arts, music, and language
      - Indigenous technology in Filipino expressive culture
   b. Filipinnovation of Arts, Culture and Heritage for Tourism and Creative Wood and Bamboo MSMEs

2. Defense and Security (DaS - KTOP)
   a. National security and sovereignty
      - Biosecurity
      - Public Safety and security
   b. Socio-economic dimension of the COVID-19 pandemic
      - Information and communications technology (ICT) application for remote/blended teaching-learning and/or management tools
      - Emerging e-commerce (MSMEs, informal sector)
      - Work-from-home
      - Behavioral response; socialization processes
      - Post-Pandemic studies

PROPOSED BUDGET FOR INCLUSIVE NATION-BUILDING (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
4.825 M	76 M	112.956 M	120 M	130 M	146 M	161

II-3. POLICY RESEARCH

As an advisory body to the government, as mandated in Act 4120, the Council funds Policy Research to address issues related to public welfare, hence, will need legislation that is based on scientific inquiry and evidence. Research projects address problems related to public welfare. They fall under two tracks: (1) demand-driven research projects --- where the issues are identified by solons from the Lower House or the Senate, and (2) Council-directed research projects --- where the issues are identified by the Governing Board. The objective of Policy Research is to provide the science to aid legislation, hence, promote evidence-based policymaking in the country. The output of a Policy Research project may include a draft policy proposal/recommendation or a policy statement which will be shepherded to appropriate Committees/Offices in the two Houses and/or relevant government agencies.

PRIORITY AREAS FOR 2022 – 2025

The policy research areas initially identified by the Governing Board are as follows:

- Waste to energy
- Future Earth
- Music heritage
- Hunger
- Mother tongue-based education

PROPOSED BUDGET FOR POLICY RESEARCH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
3.8 M	5 M	7 M	9 M	11 M	13 M	15 M

For all the NIBRA, cross-cutting themes include gender, KAPS (knowledge, attitude, practices, skills), policy studies, valuation and cost benefit-analysis, impact studies, and DRR/CCA dimensions will be considered.

SECTION 2

HEALTH RESEARCH AND DEVELOPMENT AGENDA 2023 – 2028

I. INTRODUCTION

Ten (10) program areas comprise the health research priorities within the purview of the Philippine Council for Health Research and Development (PCHRD). These are:

A. Tuklas Lunas (Drug Discovery and Development)
B. Functional Foods
C. Nutrition and Food Safety
D. Re-Emerging and Emerging Diseases
E. Diagnostics
F. Omic Technologies for Health
G. Biomedical Devices Engineering for Health
H. Digital and Frontier Technologies for Health
I. Disaster Risk Reduction/Climate Change Adaptation in Health, and
J. Mental Health

The PCHRD conducts annual, mid-term, and end of term assessment of the priority program areas under the Harmonized National Research and Development Agenda (HNRDA), and the National Unified Health Research Agenda (NUHRA) in entirety. Program areas were assessed to check whether the sub-topics or areas of research were supported and addressed already or should be retained prior to the development of a new agenda. While most of the program areas were retained, additional identified programs were included and others expanded including their sub-topics.

The Mental Health program, for example, was added in 2019, with the completion and launch of the National Mental Health Research Agenda in the same year. The program on Re-Emerging and Emerging Diseases, on the other hand, is an expansion of the previous program on Dengue and other Arboviruses to cover other diseases of public health significance. Furthermore, the previous ICT for Health program was renamed to Digital and Frontier Technologies for Health to be more encompassing and reflective of the multidisciplinary concept and developments in digital care programs and technologies with applications and impact to health, healthcare, living, and the society.

Similar to the previous agenda, the research priorities for 2023-2028 was a product of consultation with experts and stakeholders from the private and public sectors including other line agencies of government, academe, and industry. Consultations were done through meetings, workshops and focused group discussions (FGDs). The research priority setting activities were anchored on national and global developments and initiatives.

The HNRDA which serves as one of the frameworks in the updating/formulation of the NUHRA has been using the Philippine National Health Research System's (PNHRS) Health Research Prioritization Guidelines to ensure that national and regional organizations are included during the research agenda setting.

II. PROGRAM AREAS

A. TUKLAS LUNAS (DRUG DISCOVERY AND DEVELOPMENT)

The program envisions producing world-class medicines derived from the Philippine biodiversity, leveraging on local expertise. The program involves the development of standardized herbal drugs and discovery of new drug candidates from local terrestrial and marine sources for development up to the clinical stage.

B. FUNCTIONAL FOODS

The program involves the development of innovative, safe, beneficial, and accessible functional foods and ingredients from locally-available natural products for the national and global market

C. NUTRITION AND FOOD SAFETY

The program will address the improvement of the Filipinos' health through research-based solutions for proper nutrition and safe food.

D. RE-EMERGING AND EMERGING DISEASES

The program aims to utilize research to develop local technology platforms, therapeutics, surveillance, control and management protocols against Re-emerging and Emerging diseases.

E. DIAGNOSTICS

The Diagnostics Program focuses on the development of rapid, cost-effective, and minimally invasive diagnostic kits/devices/tools/tests for early detection and monitoring of communicable/infectious diseases, non-communicable diseases, and neglected tropical diseases in the Philippines, by utilizing existing and/or novel techniques or technologies.

F. OMIC TECHNOLOGIES FOR HEALTH

The program utilizes ''OMIC' technology platforms in generating meaningful information as input into development of personalized/precision medicines, diagnostics, therapeutics, and as support to health and clinical practice guidelines and policies of the Philippines.

G. BIOMEDICAL DEVICES ENGINEERING FOR HEALTH

The Program aims to address the need for research on improvisation and local development of reliable, safe, and affordable biomedical devices, for supportive and therapeutic care, for local health service provision, and international markets.

H. DIGITAL AND FRONTIER HEALTH TECHNOLOGIES

The Program aims to address the need for efficient, equitable, and affordable healthcare system and patient management through evidenced-based policy making and innovative healthcare interventions via research and development of tools utilizing artificial intelligence and new fields of information and communication technologies in digital health.

I. DISASTER RISK REDUCTION/CLIMATE CHANGE ADAPTATION IN HEALTH

The program involves the development of technologies that address or prevent health effects leading to a disaster resilient and climate change adapted Philippines

J. MENTAL HEALTH

The program supports research on quality, effective, and culture- appropriate mental health R&D innovations.

PRIORITY AREAS:

A. DRUG DISCOVERY AND DEVELOPMENT (2023 – 2028)

Development of standardized herbal drugs and discovery of new drugs from local terrestrial and marine sources for development up to the clinical stage. Drugs will be developed for:

1. Infectious Diseases
    a. Antibiotic-resistant bacterial infections (ESKAPE pathogens: *Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species)*
    b. Viral diseases (i.e. dengue, influenza)
    c. Fungal infections
2. Non-communicable diseases
    a. Cancer
    b. Diabetes mellitus
    c. Cardiovascular diseases
    d. Other lifestyle-related diseases

PRIORITIES FOR 2023 – 2025

1. Development of standardized herbal drugs
    a. Screening for bioactive extracts from natural sources using validated protocols of the program
    b. Formulation of priority bioactive extracts into standardized herbal drugs
    c. Scale-up studies for formulated standardized bioactive herbal product
    d. Pre-clinical/In-vivo studies of priority bioactive candidates
    e. Phase 1/2 clinical studies of candidate herbal drugs
    f. Cultural management/propagation of priority organisms

2. Drug Track
    a. Isolation of bioactive compounds from natural sources using validated protocols of the program
    b. Lead optimization of bioactive compounds to come up with new chemical entities (NCEs)

PRIORITIES FOR 2026 – 2028

1. Development of standardized herbal drugs
    a. Formulation of priority bioactive extracts into standardized herbal drugs
    b. Scale-up studies for formulated standardized bioactive herbal product
    c. Phase 1/2/3 clinical studies of candidate herbal drugs
    d. Cultural management/propagation of priority organisms
2. Drug Track
    a. Isolation of bioactive compounds from natural sources using validated protocols of the program
    b. Lead optimization of bioactive compounds to come up with new chemical entities (NCEs)

PROPOSED BUDGET FOR DRUG DISCOVERY AND DEVELOPMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
320 M	375 M	395 M	425 M	435 M	405 M	415 M

B. FUNCTIONAL FOOD (2023 – 2028)

The program involves the development of innovative, safe, beneficial, and accessible functional foods and ingredients from locally-available natural products for the national and global market.

1. Edible mushrooms
    a. Product development
    b. Efficacy studies on mushroom based developed products
2. Seaweeds
    a. Safety tests on raw seaweeds and seaweed products
    b. *In vitro* and/or *in vivo* assays
    c. Efficacy studies on seaweed based developed products
3. Rootcrops
    a. Efficacy studies on rootcrop based developed products
4. Pigmented and unpolished rice
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
    e. Efficacy studies on rice based developed products
5. Local berries
    a. Product development
    b. Efficacy studies on local berries based developed products
6. Pulses
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays

    d. Product development
    e. Efficacy studies on rice based developed products
7. Indigenous vegetables (alugbati, amaranth)
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
    e. Efficacy studies on developed products
8. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
9. Local citrus fruits
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
    e. Efficacy studies on developed products

PRIORITIES FOR 2023

1. Edible mushrooms
    a. Product development
    b. Efficacy studies on mushroom based developed products
2. Seaweeds
    a. Safety tests on raw seaweeds and seaweed products
    b. *In vitro* and/or *in vivo* assays
    c. Efficacy studies on seaweed based developed products
3. Rootcrops
    a. Efficacy studies on rootcrop based developed products
4. Pigmented and unpolished rice
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
    e. Efficacy studies on rice based developed products
5. Local berries
    a. Product development
    b. Efficacy studies on local berries based developed products
6. Pulses
    a. Characterization
    b. Safety tests
7. Indigenous vegetables (alugbati, amaranth)
    a. Characterization
    b. Safety tests
8. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
    a. Characterization
    b. Safety tests
9. Local citrus fruits
    a. Characterization
    b. Safety tests

PRIORITIES FOR 2024

1. Edible mushrooms
    a. Product development
    b. Efficacy studies on mushroom based developed products
2. Seaweeds
    a. Safety tests on raw seaweeds and seaweed products
    b. *In vitro* and/or *in vivo* assays
    c. Efficacy studies on seaweed based developed products
3. Rootcrops
    a. Efficacy studies on rootcrop based developed products
4. Pigmented and unpolished rice
    a. Characterization
    b. Safety tests
    c. *In vitro* and/or *in vivo* assays
    d. Product development
    e. Efficacy studies on rice based developed products
5. Local berries
    a. Product development
    b. Efficacy studies on local berries based developed products
6. Pulses
    a. Characterization
    b. Safety tests
7. Indigenous vegetables (alugbati, amaranth)
    a. Characterization
    b. Safety tests
8. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
    a. Characterization
    b. Safety tests
9. Local citrus fruits
    a. Characterization
    b. Safety tests

PRIORITIES FOR 2025

1. Edible mushrooms
    a. Efficacy studies on mushroom based developed products
2. Seaweeds
    a. *In vitro* and/or *in vivo* assays
    b. Efficacy studies on seaweed based developed products
3. Rootcrops
    a. Efficacy studies on rootcrop based developed products
4. Pigmented and unpolished rice
    a. Product development
    b. Efficacy studies on rice based developed products
5. Local berries
    a. Efficacy studies on local berries based developed products
6. Pulses
    a. *In vitro* and/or *in vivo* assays
    b. Product development
    c. Efficacy studies on rice based developed products
7. Indigenous vegetables (alugbati, amaranth)
    a. *In vitro* and/or *in vivo* assays

   b. Product development
   c. Efficacy studies on developed products
8. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on developed products
9. Local citrus fruits
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on developed products

PRIORITIES FOR 2026

1. Pigmented and unpolished rice
   a. Product development
   b. Efficacy studies on rice based developed products
2. Pulses
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on rice based developed products
3. Indigenous vegetables (alugbati, amaranth)
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on developed products
4. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on developed products
5. Local citrus fruits
   a. *In vitro* and/or *in vivo* assays
   b. Product development
   c. Efficacy studies on developed products

PRIORITIES FOR 2027

1. Pulses
   a. Product development
   b. Efficacy studies on rice based developed products
2. Indigenous vegetables (alugbati, amaranth)
   a. Product development
   b. Efficacy studies on developed products
3. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
   a. Product development
   b. Efficacy studies on developed products
4. Local citrus fruits
   a. Product development
   b. Efficacy studies on developed products

PRIORITIES FOR 2028

1. Pulses
   a. Product development
   b. Efficacy studies on rice based developed products

2. Indigenous vegetables (alugbati, amaranth)
    a. Product development
    b. Efficacy studies on developed products
3. Underutilized fruits (guava, atis, durian, mangosteen, tiesa, siniguelas, camachile)
    a. Product development
    b. Efficacy studies on developed products
4. Local citrus fruits
    a. Product development
    b. Efficacy studies on developed products

PROPOSED BUDGET FOR FUNCTIONAL FOOD (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
221.5 M	220 M	222 M	230 M	232 M	240 M	244 M

C. NUTRITION AND FOOD SAFETY (2023 – 2028)

1. Nutrition
    a. Research on malnutrition and infectious diseases
    b. Pre-pregnancy and perinatal nutrition for older women (above aged 35)
    c. Intervention studies on GIDA communities
    d. Research on nutritional assessment of individuals with physical and mental/intellectual disabilities
    e. Research on personalized diets through nutrigenomics
    f. Research on eating disorders, prevalence and efficacy of fad diets
2. Food Safety
    a. Dietary Exposure Assessment of Selected Chemical Hazards in Food
    b. Exposure Assessment of Selected Microbiological Hazards/Pathogens in Food
    c. Tech-Enabled Traceability
    d. Smarter Tools and Approaches for Prevention and Outbreak Response
    e. R&D to foster, support and strengthen Food Safety Culture
    f. Research on Food Safety and Security
    g. Use of omic technologies for food safety
    h. Studies on predictive microbiology and intervention technologies to identify mitigation steps to reduce contamination during food production and processing
    i. Research on the mechanism of foodborne pathogens

PRIORITIES FOR 2024

1. Nutrition
    a. Research on malnutrition and infectious diseases
    b. Pre-pregnancy and perinatal nutrition for older women (above aged 35)
    c. Intervention studies on GIDA communities
    d. Research on nutritional assessment of individuals with physical and mental/intellectual disabilities
    e. Research on eating disorders, prevalence and efficacy of fad diets
2. Food Safety
    a. Dietary Exposure Assessment of Selected Chemical Hazards in Food
    b. Exposure Assessment of Selected Microbiological Hazards/Pathogens in Food
    c. Tech-Enabled Traceability
    d. Smarter Tools and Approaches for Prevention and Outbreak Response
    e. R&D to foster, support and strengthen Food Safety Culture

f. Research on Food Safety and Security
g. Studies on predictive microbiology and intervention technologies to identify mitigation steps to reduce contamination during food production and processing
h. Research on the mechanism of foodborne pathogens

PRIORITIES FOR 2025

1. Nutrition
   a. Research on malnutrition and infectious diseases
   b. Pre-pregnancy and perinatal nutrition for older women (above aged 35)
   c. Intervention studies on GIDA communities
   d. Research on nutritional assessment of individuals with physical and mental/intellectual disabilities
   e. Research on personalized diets through nutrigenomics
   f. Research on eating disorders, prevalence and efficacy of fad diets
2. Food Safety
   a. Dietary Exposure Assessment of Selected Chemical Hazards in Food
   b. Exposure Assessment of Selected Microbiological Hazards/Pathogens in Food
   c. Tech-Enabled Traceability
   d. Smarter Tools and Approaches for Prevention and Outbreak Response
   e. R&D to foster, support and strengthen Food Safety Culture
   f. Research on Food Safety and Security
   g. Studies on predictive microbiology and intervention technologies to identify mitigation steps to reduce contamination during food production and processing
   h. Research on the mechanism of foodborne pathogens

PRIORITIES FOR 2026

1. Nutrition
   a. Research on personalized diets through nutrigenomics
   b. Research on eating disorders, prevalence and efficacy of fad diets
2. Food Safety
   a. Tech- Traceability
   b. Smarter Tools and Approaches for Prevention and Outbreak Response
   c. Use of omic technologies for food safety

PRIORITIES FOR 2027 – 2028

1. Nutrition
   a. Research on personalized diets through nutrigenomics
   b. Research on eating disorders, prevalence and efficacy of fad diets
2. Food Safety
   a. Tech-Enabled Traceability
   b. Smarter Tools and Approaches for Prevention and Outbreak Response
   c. Use of omic technologies for food safety

PROPOSED BUDGET FOR NUTRITION AND FOOD SAFETY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
410 M	410 M	419 M	430 M	440 M	450 M	472 M

D. RE-EMERGING AND EMERGING DISEASES (2023 – 2028)

The program aims to utilize research to develop local technology platforms, therapeutics, surveillance, control and management protocols against Re-emerging and Emerging diseases.

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (noncommunicable diseases (NCDs) and infectious)
2. Epidemiological Research on infectious and non-communicable diseases
3. Preventive interventions (Vaccine, and other modalities) Against Emerging and Re-emerging Diseases
4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases

PRIORITIES FOR 2023

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
   a. Development of multiagent yet specific advanced therapeutics
   b. Researches on soil transmitted, food borne, air borne, and water borne diseases
2. Epidemiological Research on infectious and non-communicable diseases
   a. Studies in epidemiology on re-emerging and emerging infectious and non-communicable diseases
   b. Use of science/technology and innovation to map disease incidence/outbreaks and development of simulation models for prediction and risk management
3. Preventive interventions (Vaccine, and other modalities) Against Emerging and Re-emerging Diseases
   a. Research promoting practical applications of vaccines and evaluations of immunizations
   b. Fundamental Virology Research for development of Vaccines
   c. Capacity Building and expansion of research network in Virology
   d. Vector Control via SIT of mosquitos
4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
   a. Development of early warning systems integrating disease, entomological, environmental, and socio-demographic data for immediate response and the prediction of outbreaks

PRIORITIES FOR 2024

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
   a. Development of multiagent yet specific advanced therapeutics
   b. Researches on soil transmitted, food borne, air borne, and water borne diseases
   c. Evaluation of possible treatment and therapeutic modalities against the emerging diseases
2. Epidemiological Research on infectious and non-communicable diseases
   a. Studies in epidemiology on re-emerging and emerging infectious and non-communicable diseases
   b. Use of science/technology and innovation to map disease incidence/outbreaks and development of simulation models for prediction and risk management
3. Preventive interventions (Vaccine, and other modalities) Against Emerging and Re-emerging Diseases

a. Studies leading to prevention of mother-to-child transmission (MTCT) of human immunodeficiency virus (HIV) / acquired immunodeficiency syndrome (AIDS)
b. Development of bioinformatics computational facility dedicated to virology, vaccinology and vaccine development
c. Development of preventive interventions against cardiovascular diseases (CVD), Diabetes, Obesity, Cancer and chronic obstructive pulmonary disease (COPD)
d. Antimicrobial resistance biotechnology research for prevention and detection

4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
    a. Development of early warning systems integrating disease, entomological, environmental, and socio-demographic data for immediate response and the prediction of outbreaks

PRIORITIES FOR 2025

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
    a. Development of multiagent yet specific advanced therapeutics
    b. Researches on soil transmitted, food borne, air borne, and water borne diseases
2. Epidemiological research on infectious and non-communicable diseases
    a. Policy recommendation and additional epidemiological data and perspective on re-emerging and emerging infectious and non-communicable diseases
    b. Epidemiological studies for diseases with significant deficiencies in epidemiological information
3. Preventive interventions (Vaccine and other modalities) Against Emerging and Re-emerging Diseases
    a. Fundamental Virology Research for development of Vaccines
    b. Biobanking of viruses
    c. Capacity Building and expansion of research network in Virology
    d. Development of bioinformatics computational facility dedicated to virology, vaccinology and vaccine development
    e. Pre-clinical research for vaccine against locally significant infectious disease
4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
    a. Promote innovation and research on antimicrobial resistance
    b. Antimicrobial resistance biotechnology research for prevention and detection

PRIORITIES FOR 2026

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
    a. Studies on social determinants contributing to the emergence of emerging and novel diseases and resurgence of controlled or eradicated diseases in the country
    b. Pathogen countermeasures to target common mechanisms of pathogenesis and functions or structures shared by groups of pathogens, or to modulate human biological response to pathogens
2. Epidemiological Research on infectious and non-communicable diseases
    a. Policy recommendation and additional epidemiological data and perspective on re-emerging and emerging infectious and non-communicable diseases
    b. Epidemiological studies for diseases with significant deficiencies in epidemiological information

3. Preventive interventions (Vaccine and other modalities) Against Emerging and Re-emerging Diseases
    a. Use of pseudovirion for clinical diagnostics and vaccine development
4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
    a. Promote innovation and research on antimicrobial resistance
    b. Antimicrobial resistance biotechnology research for prevention and detection

PRIORITIES FOR 2027

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
    a. Studies on social determinants contributing to the emergence of emerging and novel diseases and resurgence of controlled or eradicated diseases in the country
    b. Pathogen countermeasures to target common mechanisms of pathogenesis and functions or structures shared by groups of pathogens, or to modulate human biological response to pathogens.
    c. Development and exploration of unconventional therapeutics against antimicrobial resistance infections
2. Epidemiological Research on infectious and non-communicable diseases
    a. Research to analyze and explore the etiology and epidemiology of emerging and re-emerging infectious diseases and determine genomic characteristics and evolution of pathogens
3. Preventive interventions (Vaccine and other modalities) Against Emerging and Re-emerging Diseases
    a. Clinical Development of local vaccines
    b. Development and exploration of unconventional prevention interventions against antimicrobial resistance infections
4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
    a. Research promoting comprehensive countermeasures against infectious diseases (surveillance, pathogens database and measures to stop the spread of infectious diseases)

PRIORITIES FOR 2028

1. Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)
    a. Studies on social determinants contributing to the emergence of emerging and novel diseases and resurgence of controlled or eradicated diseases in the country
    b. Pathogen countermeasures to target common mechanisms of pathogenesis and functions or structures shared by groups of pathogens, or to modulate human biological response to pathogens.
    c. Development and exploration of unconventional therapeutics against antimicrobial resistance infections
2. Epidemiological Research on infectious and non-communicable diseases
    a. Research to analyze and explore the etiology and epidemiology of emerging and re-emerging infectious diseases and determine genomic characteristics and evolution of pathogens
3. Preventive interventions (Vaccine and other modalities) Against Emerging and Re-emerging Diseases
    a. Advanced Clinical development of locally developed vaccines

4. Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases
    a. Research promoting comprehensive countermeasures against infectious diseases (surveillance, pathogens database and measures to stop the spread of infectious diseases)

PROPOSED BUDGET FOR RE-EMERGING AND EMERGING DISEASES (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
662 M	630 M	601 M	658 M	569 M	590 M	726 M

E. DIAGNOSTICS (2023 – 2028)

The Diagnostics Program focuses on the development of rapid, cost-effective, and minimally invasive diagnostic kits/devices/tools/tests for early detection and monitoring of communicable/infectious diseases, non-communicable diseases, and neglected tropical diseases in the Philippines, by utilizing existing and/or novel techniques or technologies.

PRIORITY DISEASES

1. Communicable Diseases
    a. Respiratory Diseases (e.g., influenza, pneumonia, tuberculosis and COVID-19)
    b. HIV
    c. Hepatitis
    d. Neglected Tropical Diseases (e.g., leptospirosis, rabies, and soil-transmitted helminthiasis)
2. Non-communicable Diseases
    a. Cancer (e.g. breast, lung, colorectal, liver, and prostate)
    b. Diabetes
    c. Cardiovascular Diseases

RESEARCH PRIORITIES

1. Research advancements for early detection and/or monitoring of communicable diseases and substance abuse: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
2. Development of tools/tests for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
3. Diagnostics for non-communicable diseases

PRIORITIES FOR 2023

1. Research advancements for early detection and/or monitoring of communicable diseases and substance abuse: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
    a. Studies that detect and identify volatile organic compound biomarkers for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
    b. Studies on the development of rapid, cost-effective, and minimally invasive diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19

c. Studies that assess the effectiveness of remote diagnostics for respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
d. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
e. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
f. Studies on the detection of drug resistance to HIV
g. Researches on HIV subtype
h. Researches related to the screening tests for the diagnosis of liver diseases
i. Development of kits/tools for substance abuse

2. Development of tools/tests for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
   a. Studies on the development of near-patient detection assay for leptospirosis
   b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
   c. Studies on CRISPR technology in controlling parasitic diseases responsible in various infections
   d. Development of portable devices for efficient detection of bacterial and parasitic diseases
3. Diagnostics for non-communicable diseases
   a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases
   b. Studies on point-of-care assays of the early onset manifestation of cancer tumors

PRIORITIES FOR 2024

1. Research advancements for early detection and/or monitoring of communicable diseases: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
   a. Studies that detect and identify volatile organic compound biomarkers for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
   b. Studies on the development of rapid, cost-effective, and minimally invasive diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
   c. Studies that assess the effectiveness of remote diagnostics for respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
   d. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
   e. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
   f. Studies on the detection of drug resistance to HIV
   g. Researches on HIV subtype
   h. Researches related to the screening tests for the diagnosis of liver diseases
2. Development of tools/tests for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
   a. Studies on the development of near-patient detection assay for leptospirosis
   b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
   c. Studies on CRISPR technology in controlling parasitic diseases responsible in various infections

d. Development of portable devices for efficient detection of bacterial and parasitic diseases

3. Diagnostics for non-communicable diseases
    a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases
    b. Studies on multi-epitope peptide vaccine against cancer

PRIORITIES FOR 2025

1. Research advancements for early detection and/or monitoring of communicable diseases: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
    a. Studies that validate volatile organic compound biomarkers which can be used for developing devices for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
    b. Studies on the development of rapid, cost-effective, and minimally invasive diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
    c. Studies that assess the effectiveness of remote diagnostics for respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
    d. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
    e. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
    f. Studies on the detection of drug resistance to HIV
    g. Researches on HIV subtype
    h. Researches related to the screening tests for the diagnosis of liver diseases
2. Development of tools/tests for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
    a. Studies on the development of near-patient detection assay for leptospirosis
    b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
    c. Studies on CRISPR technology in controlling parasitic diseases responsible in various infections
    d. Development of portable devices for efficient detection of bacterial and parasitic diseases
3. Diagnostics for non-communicable diseases
    a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases
    b. Researches on deoxyribonucleic acid (DNA) vaccine for cancer immunotherapy

PRIORITIES FOR 2026

1. Research advancements for early detection and/or monitoring of communicable diseases: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
    a. Studies that utilize volatile organic compound biomarkers for diagnostic devices for early detection and monitoring of respiratory diseases
    b. Studies that validate developed diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19

c. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
d. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
e. Studies on the detection of drug resistance to HIV
f. Researches on HIV subtype
g. Researches related to the screening tests for the diagnosis of liver diseases

2. Validation of tools/test for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
   a. Studies on the development of near-patient detection assay for leptospirosis
   b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
   c. Studies on CRISPR technology in controlling parasitic diseases responsible in various infections.
   d. Development of portable devices for efficient detection of bacterial and parasitic diseases
3. Diagnostics for non-communicable diseases
   a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases
   b. Researches on the development of cancer diagnostic model dietary risk assessment through gut microbiome analysis

PRIORITIES FOR 2027

1. Research advancements for early detection and/or monitoring of communicable diseases: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
   a. Studies that utilize volatile organic compound biomarkers for diagnostic devices for early detection and monitoring of respiratory diseases
   b. Studies that conduct clinical testing on validated diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
   c. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
   d. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
   e. Studies on the detection of drug resistance to HIV
   f. Researches on HIV subtype
   g. Researches related to the screening tests for the diagnosis of liver diseases
2. Clinical testing of diagnostic tools for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
   a. Studies on the development of near-patient detection assay for leptospirosis
   b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
   c. Studies on CRISPR technology in controlling parasitic diseases responsible in various infections
   d. Development of portable devices for efficient detection of bacterial and parasitic diseases
3. Diagnostics for non-communicable diseases
   a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases

b. Studies on expression meta-analysis of predicted microRNA targets that identifies a diagnostic specified type of cancer

PRIORITIES FOR 2028

1. Research advancements for early detection and/or monitoring of communicable diseases: respiratory diseases, HIV, liver diseases, and other diseases associated with antimicrobial resistance
   a. Studies that utilize volatile organic compound biomarkers for diagnostic devices for early detection and monitoring of respiratory diseases
   b. Studies that commercialize clinically-tested diagnostic kits/devices/tools/tests for early detection and monitoring of respiratory diseases such as influenza, pneumonia, tuberculosis, and COVID-19
   c. Studies on cell-mediated and humoral immunities to SARS-CoV-2 infection after vaccination
   d. Studies on the development of multi-omics-based point-of-care detection tests for HIV and hepatitis
   e. Studies on the detection of drug resistance to HIV
   f. Researches on HIV subtype
   g. Researches related to the screening tests for the diagnosis of liver diseases
2. Commercialization of diagnostic tools/tests for detection of Leptospirosis, rabies and soil-transmitted helminthiasis
   a. Studies on the development of near-patient detection assay for leptospirosis
   b. Studies on point-of-care (POC) assays for detection of parasitic diseases through ranges of clinical samples
   c. Development of portable devices for efficient detection of bacterial and parasitic diseases
3. Diagnostics for non-communicable diseases
   a. Studies on the development of multi-omics-based point-of-care detection tests for cancer and metabolic diseases
   b. Researches on cancer molecular diagnostic kits
   c. Studies on liquid biopsy of cancer: multimodal diagnostic tool in clinical oncology
   d. Researches on measurements of hemoglobin A1c prediction of early symptoms of diabetes and stroke and heart disease
   e. Studies on the development for early detection of cancer cells through DNA nanostructured biomarkers

PROPOSED BUDGET FOR DIAGNOSTICS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
127 M	155 M	170 M	330 M	435 M	412 M	292 M

F. OMIC TECHNOLOGIES FOR HEALTH (2023 – 2028)

The program utilizes 'OMIC' technology platforms in generating meaningful information as input into development of personalized/precision medicines, diagnostics, therapeutics, other technologies, and as support to health and clinical practice guidelines and policies of the Philippines.

1. Multi-omics approach on Health and Diseases
   a. Cancers, including lung, liver, colorectal, etc.; may include use of proteomics or metabolomics approaches

b. OMIC researches in neurosciences: focus on established neurological, neurodegenerative, or psychiatric diseases of relevance in the Philippines
c. Studies on pre-, peri-, and post-partum conditions affecting maternal and child health
d. The use of OMIC technologies in addressing malnutrition among children and adults

2. Genomic Epidemiology and Biosurveillance
   a. Expanding genomic biosurveillance coverage to include infectious diseases of priority in the Philippines using next-generation sequencing
   b. Researches on the incidence and prevalence of rare diseases of relevance in the country (following Republic Act No. 10747 "Rare Disease Act") using genomic biosurveillance
3. Translational Omics Research for Precision Medicine
   a. Validation of discovered biomarkers for NCDs among Filipinos on the following:
      - cardiovascular diseases,
      - diabetes mellitus, and
      - different cancers
   b. Functional studies (pharmacokinetic studies, cellular models) arising from pharmacogenetic studies on NCDs and cancers
   c. Research on novel therapies for cancer using Filipino OMICs data
   d. Establishing a national reference sequence for Filipino diseases such as NCDs and cancers
   e. Host immune responses for infectious diseases
4. OMICS for Forensics/Ethnicity Research
   a. Filipino population OMICs studies
   b. Forensic DNA profiling technology studies
5. Genomic Biobanking

PRIORITIES FOR 2023 – 2028

1. Multi-omics approach on Health and Diseases - NCDs, Cancers, Maternal and Child Health, Nutrition, Neurosciences, etc.
   a. Multi-omics approaches in Cancers (Lung, Liver, Colorectal, etc.), including use of Proteomics/Metabolomics approaches
   b. OMICS researches in Neurosciences
   c. Studies on pre-, peri-, and post-partum conditions affecting maternal and child health
   d. The use of OMIC technologies in addressing malnutrition among children and adults
2. Genomic Biosurveillance (Infectious/Communicable Diseases; Rare Diseases)
   a. Expanding genomic biosurveillance coverage to include infectious diseases of priority in the Philippines using next-generation sequencing
   b. Researches on the incidence and prevalence of rare diseases of relevance in the country (following Republic Act No. 10747 "Rare Disease Act") using genomic biosurveillance
3. Translational Omics Research for Precision Medicine
   a. Validation of discovered biomarkers for NCDs among Filipinos on the following:
      - cardiovascular diseases,
      - diabetes mellitus, and
      - different cancers
   b. Functional studies (pharmacokinetic studies, cellular models) arising from pharmacogenetic studies on NCDs and cancers

c. Research on novel therapies for cancer using Filipino OMICs data
d. Establishing a national reference sequence for Filipino diseases such as NCDs and cancers
e. Host immune responses for infectious diseases

4. OMICS for Forensics/Ethnicity Research (Forensic Applications; Researches on Filipino Ethnicity, Migration)
   a. Filipino population OMICs studies
   b. Forensic DNA profiling technology studies
5. Genomic BioBanking
   a. Studies involving establishment/integration of cancer and nutrition genomic biobanks (e.g. Breast, Liver, Colorectal)
   b. Policies/Governance Framework on Genomic Biobanking

PROPOSED BUDGET FOR OMIC TECHNOLOGIES FOR HEALTH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
37.744 M	310 M	340 M	400 M	410 M	400 M	400 M

G. BIOMEDICAL DEVICES ENGINEERING FOR HEALTH (2023 – 2028)

The program aims to develop accessible, affordable, good -quality, and innovative biomedical devices, that considers sustainability of materials, manufacturing processes, and products; to develop skills and expertise in biomedical engineering and related areas, and; to contribute to establishing and strengthening support systems towards a Philippine Biomedical Devices Industry.

1. Technology-assisted Surgical Innovations for Patient Safety
2. Innovations in Local Implants Development
3. Devices for Postoperative/Rehabilitative/Assistive Care
4. Devices for Health Emergency Preparedness and Response
5. Devices in support of Universal Health Care
6. Tissue Engineering

PRIORITIES FOR 2023 – 2025

1. Technology-assisted Surgical Innovations for Patient Safety
   a. Minimally-invasive surgical devices, tools, and aids that can be used in either endoscopic or robotic-assisted surgeries
2. Innovations in local implants development
   a. Development of local implants
   b. Wearable/subcutaneous implants
3. Devices for Postoperative/Rehabilitative Care
   a. Development of smart biomedical devices that can be used for movement rehabilitation
4. Devices for Health Emergency Response
   a. Human trials of locally-developed ventilators/respirators
5. Distributed Health Care devices/Hospital Equipment
   a. Studies on field evaluation of locally-developed hospital equipment
   b. Studies on local development of tools/ materials for medical training
6. Tissue Engineering

a. Bioengineered tissues for disease studies (development of tissues for studies on disease etiology or organ transplantation)
b. Tissue Regeneration (artificial tissues that have self-healing/ restorative properties that can be used for the treatment of damaged tissues)

PRIORITIES FOR 2026

1. Technology-assisted Surgical Innovations for Patient Safety
   a. Minimally-invasive surgical devices, tools, and aids that can be used in either endoscopic or robotic-assisted surgeries
2. Innovations in local implants development
   a. Development of local implants
   b. Wearable/subcutaneous implants
3. Devices for Postoperative/Rehabilitative Care
   a. Development of smart biomedical devices that can be used for movement rehabilitation
4. Devices for Health Emergency Response
   a. Development of biomedical devices used for health emergency situations
   b. Development of biomedical devices used for disaster response
   c. Development of biomedical devices used for pandemic
5. Distributed Health Care devices/Hospital Equipment
   a. Development of hospital/primary health care devices for communities
   b. Studies on local development of tools/ materials for medical training
6. Tissue Engineering
   a. Bioengineered tissues for disease studies (development of tissues for studies on disease etiology or organ transplantation)
   b. Tissue Regeneration (artificial tissues that have self-healing/ restorative properties that can be used for the treatment of damaged tissues)

PRIORITIES FOR 2027 – 2028

1. Technology-assisted Surgical Innovations for Patient Safety
   a. Minimally-invasive surgical devices, tools, and aids that can be used in either endoscopic or robotic-assisted surgeries
2. Innovations in local implants development
   a. Development of local implants
   b. Wearable/subcutaneous implants
3. Devices for Postoperative/Rehabilitative Care
   a. Development of smart biomedical devices that can be used for movement rehabilitation
4. Devices for Health Emergency Response
   a. Development of biomedical devices used for health emergency situations
   b. Development of biomedical devices used for disaster response
   c. Development of biomedical devices used for pandemic
5. Distributed Health Care devices/Hospital Equipment
   a. Development of hospital/primary health care devices for communities
   b. Studies on local development of tools/ materials for medical training - Field evaluation
6. Tissue Engineering
   a. Bioengineered tissues for disease studies (development of tissues for studies on disease etiology or organ transplantation)

b. Tissue Regeneration (artificial tissues that have self-healing/ restorative properties that can be used for the treatment of damaged tissues)

PROPOSED BUDGET FOR BIOMEDICAL DEVICES ENGINEERING FOR HEALTH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
21 M	150 M	200 M	230 M	250 M	270 M	300 M

H. DIGITAL AND FRONTIER HEALTH TECHNOLOGIES (formerly ICT for Health) (2023 – 2028)

The program aims to address the need for efficient, equitable, and affordable healthcare system and patient management through evidenced-based policy making and innovative healthcare interventions via research and development of tools utilizing artificial intelligence and new fields of information and communication technologies in digital health.

1. Artificial Intelligence in Healthcare Empowered by Data Analytics
   a. Improvements on Health Service Delivery Utilizing Health Data Analytics
   b. Disease modelling
   c. Clinical Decision Support Systems (CDSS)
2. Artificial Intelligence in Healthcare Applications
   a. Machine Learning in Development of Computer Software as Diagnostic Tools
   b. Development and Validation of Internet of Things (IoT) Applications for Health
   c. Space technology in health
3. Assessment and Development of ICT-enabled health delivery services
   a. Telemedicine and Teleconsultation Services

PRIORITIES FOR 2023

1. Artificial Intelligence in Healthcare Empowered by Data Analytics
   a. Improvements on Health Service Delivery Utilizing Health Data Analytics
   b. Disease modelling
   c. Clinical Decision Support Systems (CDSS)
2. Artificial Intelligence in Healthcare Applications
   a. Machine Learning in Development of Computer Software as Diagnostic Tools
3. Assessment and Development of ICT-enabled health delivery services
   a. Telemedicine and Teleconsultation Services

PRIORITIES FOR 2024

1. Artificial Intelligence in Healthcare Empowered by Data Analytics
   a. Improvements on Health Service Delivery Utilizing Health Data Analytics
   b. Disease modelling
   c. Clinical Decision Support Systems (CDSS)
2. Artificial Intelligence in Healthcare Applications
   a. Machine Learning in Development of Computer Software as Diagnostic Tools

PRIORITIES FOR 2025

1. Artificial Intelligence in Healthcare Empowered by Data Analytics
   a. Improvements on Health Service Delivery Utilizing Health Data Analytics

b. Disease modelling
c. Clinical Decision Support Systems (CDSS)

2. Artificial Intelligence in Healthcare Applications
   a. Machine Learning in Development of Computer Software as Diagnostic Tools
   b. Development and Validation of IoT Applications for Health

PRIORITIES FOR 2026

1. Artificial Intelligence in Healthcare Applications
   a. Development and Validation of IoT Applications for Health
   b. Space technology in health

PRIORITIES FOR 2027 – 2028

1. Artificial Intelligence in Healthcare Applications
   a. Space technology in health

PROPOSED BUDGET FOR DIGITAL AND FRONTIER HEALTH TECHNOLOGIES (2022–2028)

2022	2023	2024	2025	2026	2027	2028
75 M	75 M	75 M	225 M	315 M	315 M	315 M

I. DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION IN HEALTH (2023-2028)

The program involves the development of technologies that address or prevent health effects leading to a disaster resilient and climate change adapted Philippines.

1. S&T based innovations in building resilient health systems during disasters
   a. Innovations for emergency medical care services, water, sanitation, hygiene (WaSH) and nutrition during disasters
   b. Technology development for search and rescue, triage and emergency health
   c. Post disaster solutions to access health care services, e.g. maternal, newborn and child health, sexual and reproductive health, food security, nutrition
2. Food Innovations to address the nutritional and health effects of disasters
   a. Development of ready to use therapeutic food (RUTF); emergency food for people with special dietary needs
3. Researches to ensure health consequences during disasters are reduced
   a. Environmental risk assessment studies and innovations to prevent adverse health effects during disasters
4. Climate Change Adaptation in Health
   a. Characterization of climate change sensitive diseases
   b. Researches which address adaptation gaps in health (heat and extreme events; climate sensitive infectious diseases, nutritional security)

PRIORITIES FOR 2023 – 2025

1. S&T based innovations in building resilient health systems during disasters
   a. Innovations for emergency medical care services, water, sanitation, hygiene (WaSH) and nutrition during disasters
   b. Technology development for search and rescue, triage and emergency health

c. Post disaster solutions to access health care services, e.g. maternal, newborn and child health, sexual and reproductive health, food security, nutrition

2. Food Innovations to address the nutritional and health effects of disasters
   a. Development of ready to use therapeutic food (RUTF); emergency food for people with special dietary needs
3. Researches to ensure health consequences during disasters are reduced
   a. Environmental risk assessment studies and innovations to prevent adverse health effects during disasters
4. Climate Change Adaptation in Health
   a. Characterization of climate change sensitive diseases
   b. Researches which address adaptation gaps in health (heat and extreme events; climate sensitive infectious diseases, nutritional security)

PRIORITIES FOR 2026 – 2028

1. S&T based innovations in building resilient health systems during disasters
   a. Innovations for emergency medical care services, water, sanitation, hygiene (WaSH) and nutrition during disasters
   b. Technology development for search and rescue, triage and emergency health
   c. Post disaster solutions to access health care services, e.g. maternal, newborn and child health, sexual and reproductive health, food security, nutrition
2. Researches to ensure health consequences during disasters are reduced
   a. Environmental risk assessment studies and innovations to prevent adverse health effects during disasters
3. Climate Change Adaptation in Health
   a. Characterization of climate change sensitive diseases
   b. Researches which address adaptation gaps in health (heat and extreme events; climate sensitive infectious diseases, nutritional security)

PROPOSED BUDGET FOR DRR-CCA IN HEALTH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
26 M	47 M	48 M	50 M	53 M	57 M	61 M

J. MENTAL HEALTH (2023 – 2028)

The program supports research on quality, effective, and culture-appropriate mental health R&D innovations.

1. Social Determinants for Health
   a. Research on tool development to be used for measurement and intervention for all regions
2. Inventory and Evaluation of Mental Health Interventions
   a. Research on community-based mental health facilities and services
   b. Research on effective interventions or services for special populations
3. Standardization of Mental Health Services
   a. Research on standardization of mental health services
4. ICT for Mental Health
   a. Evaluation and improvement of existing web and mobile based applications for mental health
5. Diagnostics and Omics Technology for Mental Health

    a. Research on the generation of new knowledge about mental health using omics technology
    b. Research on the use of diagnostic tools for the management of mental health
6. Evaluation and Development of Treatments for Mental Illnesses and Neurologic Disorders
    a. Research on the evaluation of existing local treatments
    b. Research on the development for improved treatments

PRIORITIES FOR 2023

1. Social Determinants for Health
    a. Research on tool development to be used for measurement and intervention for all regions
2. Standardization of Mental Health Services
    a. Research on standardization of mental health services
3. ICT for Mental Health
    a. Evaluation and improvement of existing web and mobile based applications for mental health

PRIORITIES FOR 2024

1. Inventory and Evaluation of Mental Health Interventions
    a. Research on community-based mental health facilities and services
    b. Research on effective interventions or services for special populations
2. ICT for Mental Health
    a. Evaluation and improvement of existing web and mobile based applications for mental health

PRIORITIES FOR 2025

1. Standardization of Mental Health Services
    a. Research on standardization of mental health services
2. Diagnostics and Omics Technology for mental health
    a. Research on the generation of new knowledge about mental health using omics technology
    b. Research on the use of diagnostic tools for the management of mental health

PRIORITIES FOR 2026 – 2027

1. Standardization of Mental Health Services
    a. Research on standardization of mental health services
2. Diagnostics and Omics Technology for Mental Health
    a. Research on the generation of new knowledge about mental health using omics technology
    b. Research on the use of diagnostic tools for the management of mental health
3. Evaluation and Development of Treatments for Mental Illnesses and Neurologic Disorders
    a. Research on the evaluation of existing local treatments
    b. Research on the development for improved treatments

PROPOSED BUDGET FOR MENTAL HEALTH (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
79 M	80 M	120 M	119 M	86 M	84 M	104 M

OTHER PRIORITY PROGRAMS

K. INTELLECTUAL PROPERTY AND TECHNOLOGY MANAGEMENT PROGRAM (pchrd TECHNOLOGY TRANSFER UNIT)

Highlighting the importance of R&D Utilization and Technology Transfer, the PCHRD Intellectual Property and Technology Management Unit will implement programs that will help develop health research technologies with high potential for commercialization and translation, strengthen technology transfer through protection and management of health research technologies, bring innovations to the market through pre-commercialization activities and partnerships, and eventually establish a harmonized and integrated technology transfer system in health S&T. Generally, these programs aim to address current need of fast-tracking technology transfer, particularly of health technologies, to contribute to overall economic growth and create valuable impact.

PRIORITIES FOR 2022

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
    a. Development of PCHRD Technology Management Portfolio
    b. Capacity Building on Technology Transfer (University Innovation Fellowship (UIF) Batch 1))
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management ff Health Research Technologies
    a. Intellectual Property Protection and Management of Health Research Outputs Program (IPROTECH Program)
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
    a. PCHRD Startup Research Grant Program
    b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 1)
    c. Technology Transformation and Empowerment of Knowledge Generators and Innovators in Health (TEKI in Health)
    d. Accelerating Commercialization of New and Viable Products through Efficient Research Translation (CONVERT)
    e. Philippine Health Research Innovations Matching Event (PHRIME)

PRIORITIES FOR 2023

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
    a. Development of PCHRD Technology Management Portfolio
    b. Capacity Building on Technology Transfer (UIF Batch 2)
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
    a. IPROTECH Program
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships

a. PCHRD Startup Research Grant Program
b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 2)
c. TEKI in Health
d. CONVERT
e. PHRIME

PRIORITIES FOR 2024

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
   a. Management of PCHRD Technology Management Portfolio
   b. Capacity Building on Technology Transfer (Expansion of the UIF Project in the Regional Health Research and Development Consortium (RHRDC))
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
   a. IPROTECH Program
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
   a. PCHRD Startup Research Grant Program
   b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 3)
   c. TEKI in Health
   d. CONVERT
   e. PHRIME

PRIORITIES FOR 2025

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaboration and Partnerships
   a. Management of PCHRD Technology Management Portfolio
   b. Capacity Building on Technology Transfer (Expansion of the UIF Project in the RHRDCs)
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
   a. IPROTECH Program
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
   a. PCHRD Startup Research Grant Program
   b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 4)
   c. TEKI in Health
   d. CONVERT
   e. PHRIME

PRIORITIES FOR 2026

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
   a. Management of PCHRD Technology Management Portfolio
   b. Capacity Building on Technology Transfer (Expansion of the UIF Project in the RHRDCs)
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
   a. IPROTECH Program

3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
    a. PCHRD Startup Research Grant Program
    b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 5)
    c. TEKI in Health
    d. CONVERT
    e. PHRIME
4. Establishing a Harmonized and Integrated Technology Transfer System in Health S&T
    a. Establishment of Health Startup Community Program
    b. Technology Transfer Centers in Health Program

PRIORITIES FOR 2027

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
    a. Management of PCHRD Technology Management Portfolio
    b. Capacity Building on Technology Transfer
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
    a. IPROTECH Program
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
    a. PCHRD Startup Research Grant Program
    b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 6)
    c. TEKI in Health
    d. CONVERT
    e. PHRIME
4. Establishing a Harmonized and Integrated Technology Transfer System in Health S&T
    a. Establishment of Health Startup Community Program
    b. Technology Transfer Centers in Health Program

PRIORITIES FOR 2028

1. Developing Market Ready-Products with High Potential for Commercialization Through Collaborations and Partnerships
    a. Management of PCHRD Technology Management Portfolio
    b. Capacity Building on Technology Transfer
2. Strengthening Technology Transfer Through Protection, Regulation, Evaluation and Management of Health Research Technologies
    a. IPROTECH Program
3. Bringing Health Innovations to the Market Through Commercialization and Partnerships
    a. PCHRD Startup Research Grant Program
    b. PCHRD Startup Mentorship Support Program (STARSHIP Program Batch 7)
    c. TEKI in Health
    d. CONVERT
    e. PHRIME
4. Establishing a Harmonized and Integrated Technology Transfer System in Health S&T
    a. Establishment of Health Startup Community Program
    b. Technology Transfer Centers in Health Program

PROPOSED BUDGET FOR TECHNOLOGY TRANSFER PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
108 M	295 M	300 M	448 M	494 M	614 M	714 M

L. CAPACITY BUILDING PROGRAMS

HUMAN RESOURCE DEVELOPMENT (HRD)

As the national coordinating body of health research in the country, the Philippine Council for Health Research and Development (PCHRD) is committed to develop and strengthen the capacity of health research. Through its Institution Development Division (IDD) – Human Resources Development (HRD) Unit, PCHRD develops and implements programs to develop a pool of high-quality human resources who will do health research relevant to the solution of current and future health problems. Several sub-programs are being implemented to support this strategy, including sponsorship of degree (MS/PhD) and non-degree programs, and provision of support for health researchers through various institutional and capacity building programs.

SCHOLARSHIP PROGRAM

The objectives of the graduate scholarship program are as follows:

a. Help improve the country's global competitiveness and capability to innovate through alternative approaches on Health Research Development in health S&T, and
b. Accelerate the production of high-level human resources needed for S&T activities particularly in the area of health research and development

1. Local Graduate Scholarship Program

a. MD-PhD in Molecular Medicine
b. MD-Master of Clinical Epidemiology
c. MD-MS: Health Informatics
d. MD-MS in Bioethics (NCR, Cebu, Davao)
e. MD-MS Biochemistry
f. PhD in Health Research
g. PhD in Epidemiology (NCR, Cebu, Davao)
h. MS in Molecular Medicine
i. MS in Data Science (NCR, Cebu, Davao)
j. MPH in Health Technology Assessment (HTA)

2. Assessment of Local Graduate Scholarship Program

A survey is aimed at tracking the scholar-graduates of the various scholarship programs being implemented by DOST-PCHRD. It seeks to assess the effectiveness of the scholarship programs being implemented and supported by DOST-PCHRD. The survey results will also define the regional distribution of scholars who can be tapped/engaged by DOST-PCHRD as advisors/mentors in the region.

3. Foreign Graduate Scholarship Program

To increase the number of researchers who can conduct cutting-edge health research in the country, the DOST-PCHRD partners with international institutions to offer foreign graduate scholarships to Filipino students. Scholars will have the opportunity to finish their graduate degrees and work with prominent scientists abroad. The program will enhance their knowledge and skills to help them pursue a career in academia and research. Likewise, the program will help prepare young researchers to become principal investigators in the future.

PhD, MS on the following identified priority areas:

a. Molecular Biomedicine - Hepatology
b. Biomedical Engineering
c. One Health
d. Biomedical
e. Health Informatics
f. Tropical Medicine
g. Health Technology Assessment
h. Epidemiology
i. Bioethics
j. Tuklas Lunas (Natural Products/Drug Discovery and Development)
k. Functional Foods, Nutrition and Food Safety
l. Re-Emerging and Emerging Diseases Program
m. Omic Technologies For Health
n. Diagnostics
o. Digital and Frontier Health Technologies
p. Disaster Risk Reduction and Climate Change Adaptation in Health
q. Mental Health

4. Research Enrichment Program (Rep)

The DOST-PCHRD supports the MD-PhD/PhD/MS scholars who have an approved research proposal and/or have completed their academic courses in any of the DOST identified local universities and intend to conduct their research work in a foreign university identified by/or acceptable to DOST.

The research work must be in any of the DOST priority areas of study, to be conducted for a minimum of three (3) months to a maximum of one (1) year.

The funding support shall be for the research proper only.

5. Thesis and Dissertation Grants

The program is available for qualified MS and PhD students studying in the Philippines, who wish to pursue his/her thesis/dissertation project locally, provided that the area of interest is aligned with the priority areas of DOST-PCHRD as stated in the NUHRA and HNRDA.

FELLOWSHIP PROGRAM

The DOST-PCHRD partners with host institutions abroad and/or local delivering institutions for the Research Fellowship Program. The program is designed to develop competency and expertise in health research on the following PCHRD's priority areas:

1. Local Fellowship Program

a. Epidemiology
b. Tuklas Lunas (Drug Discovery and Development)
c. Functional Foods, Nutrition and Food Safety
d. Re-Emerging and Emerging Diseases Program
e. Omic Technologies For Health
f. Biomedical Devices Engineering for Health Program
g. Diagnostics
h. Digital and Frontier Health Technologies
i. Disaster Risk Reduction and Climate Change Adaptation in Health
j. Mental Health

2. International Fellowship Program

a. Epidemiology
b. Health Technology Assessment
c. Health Informatics
d. Tuklas Lunas (Drug Discovery and Development)
e. Functional Foods, Nutrition and Food Safety
f. Re-Emerging and Emerging Diseases Program
g. Omic Technologies For Health
h. Biomedical Devices Engineering for Health Program
i. Diagnostics
j. Digital and Frontier Health Technologies
k. Disaster Risk Reduction and Climate Change Adaptation in Health
l. Mental Health

3. Assessment of Research Fellowship and Scholarship Program

A survey is aimed at tracking the scholars/grantees of various scholarship and fellowship programs being implemented by DOST-PCHRD and assessing the effectiveness of the programs. The results will also provide the regional distribution of scholars/fellows who can be tapped/engaged by DOST-PCHRD as advisors/mentors in the region.

SUPPORT FOR EARLY CAREER RESEARCHERS (TRAINING, PAPER PRESENTATION, PUBLICATION, ETC.)

To inspire the next generation of researchers and research leaders, PCHRD provides a variety of support for early career researchers ranging from participation in training and workshops abroad, paper/poster presentation to conferences abroad, and publication. Early career researchers are students/scholars who are graduate or postgraduate level up to 10 years post-PhD/MD.

These opportunities will help the young researchers enhance their knowledge and skills to ensure that our health research system stays abreast with the advances in health research. The program also aims to attract new researchers and retain the excellent researchers by offering these opportunities as we expand the country's pool of researchers.

OTHER CAPACITY BUILDING PROGRAMS

1. **Partnerships for Research Internship and Graduate Degree Education (Pride) Program**

   PRIDE provides financial and technical assistance to graduate students in conducting quality research in compliance with their approved thesis/dissertation project aligned with the priorities under NUHRA/Regional Unified Health Research Agenda (RUHRA) and HNRDA. Through a research mentor, graduate students will gain experience in conducting demand-driven research and development (R&D) projects while completing their academic requirements. The program aims to encourage graduate students to complete their degree program while undergraduate research assistantship. The program also aims to produce quality graduates proficient in research management and research implementation. This will be open to DOST-PCHRD scholars and non-scholars who are faculty/staff of RHRDC members.

2. **A Scholars Placement in Research Enhancement (Aspire) Program**

   The program aims to provide support for the employment of scholar graduates in various research institutions. The overarching objective of the program is to create a sustainable reservoir of highly skilled and competent health S&T professionals where DOST agencies and regional offices and other research and development institutions can tap and eventually absorb the scholar graduates for employment.

3. **Capacity Building Projects for Regional Health Research and Development Consortium (RHRDC)**

   a. PCHRD Twinning Project - Pairing of Strong and Junior Institutions in Health

      The project aims to develop and nurture capability of medical colleges and other training (satellite) institutions to implement and manage research and development activities. Specifically, it aims to do the following: 1) formulate strategies to develop and enhance health research capabilities; 2) implement capability development activities and approaches; and 3) to develop skills in research management and implementation. Five (5) senior twins will be tapped to assist the junior twins (satellite) in developing its research capability.

   b. Research Mentoring and Guidance in Research and Research Utilization (M-GURU) - Peer Mentorship

      Mentor/mentee pairings will be based on compatibility from application forms or targeted matches for beginning researchers. Peer mentorship will be a special partnership between two people based on commitment to the mentoring process, common goals and expectations, mutual trust and respect. The engagement will allow for transfer of knowledge and skills from senior to junior researcher. The success of mentoring will depend on clearly defined roles and expectations in addition to the participant's awareness of the benefits of participating in the mentoring program. Mentor/mentee can present an approved research plan and timelines (1-year project). The engagement will undergo evaluation based on defined deliverables. A follow-up evaluation after the completion of the program will be done to assess the success of the program. The evaluation can be an action point prior to the next program cycle. Criteria for mentor/mentee will also be developed in running the program.

c. Development of training modules (online) and conduct of training/workshops
Training modules on identified priority areas will be developed. These modules will be utilized in the conduct of online training programs (asynchronous/synchronous) in the regions by RHRDC local trainers and researchers.

Online courses will be made available to young researchers in the region to enhance their knowledge on research methods, data analysis, research techniques, technical report writing etc.

d. Establishment of Regional Training Centers/Hubs (at least 7 RTCs - NCR, North Luzon, South Luzon, Eastern Visayas, Central Visayas, Western Mindanao, Southern Mindanao)
A Training Hub is proposed to capacitate researchers in health priority fields/areas and guide them to conceptualize and implement/manage research. This can be a collaborative undertaking between the training institution and RHRDC to maximize resources (facilities and expertise) in the region. A researcher with an idea in mind can go to the hub and ask for guidance on any stage of the research process and where mentors/advisers (multi-disciplinary experts) are available for guidance (e.g. using blended platforms).

e. Capacity building program on Social Innovations in Health Research
The program aims to develop and implement a training program/curriculum to capacitate members of RHRDCs in supporting innovators for the conduct of research on social innovations in health.

f. Assessment of capacity building needs of NUHRA/RUHRA
To align investment in capacity building, assessment of the capacity building needs for health research will be done using as guide the updated NUHRA.

The NUHRA will be presented to selected experts and stakeholders from the public and private sectors to identify existing and needed experts in health priority fields/areas. The results of the assessment will serve as a guide in the Council's support for institutional and capacity building**.**

g. Capacity Building for Staff
The program aims to capacitate IDD staff on the following areas:
- Business Writing
- Technical Report Writing
- Leadership Development Program
- Project Management

PROPOSED BUDGET FOR HUMAN RESOURCE DEVELOPMENT

2023	2024	2025	2026	2027	2028
178.7 M	242.1 M	338 M	486.1 M	679.5 M	920.5 M

M. NETWORK INSTITUTION DEVELOPMENT (NID)

PROGRAMS:

REGIONAL HEALTH RESEARCH AND DEVELOPMENT CONSORTIA (RHRDC)

In line with the thrust of developing and encouraging institutional research activities, and in the interest of equity, the Council organized Regional Health Research and Development Consortia (RHRDC). The RHRDCs serve as the structures through which its institution development programs are to be implemented and as a mechanism by which to encourage and promote health research activities in the regions.

The Council's institutional development package in the regions includes administrative support for the operations of the RHRDCs, as well as support for the critical components of the research management program.

Institution development programs of the Council have zeroed in on institutions with existing potentials for health research activities, and in the establishment of regional systems through the RHRDC.

1. **RHRDC Operations and Support To RRF**
   PCHRD through IDD continually enriches the health research system in the country by providing leadership and supporting activities of RHRDCs which consist of member institutions. Through the RHRDC, IDD enhances cooperation between and among the organizations and networks within the PNHRS and encourages sharing and pooling of resources in health R&D. Beginning researchers are given support to enhance their skills in conducting health research aligned with NUHRA or RUHRA through the Regional Research Fund (RRF) Initiative. This initiative is viewed as a way to encourage beginning researchers to be actively involved in health research activities without having to compete with more experienced researchers. The experience obtained from implementing simple yet relevant health research projects is expected to build up capabilities of individual researchers in designing, implementing and managing health research projects.

2. **Support to Capacity Building of External Staff**
   The program aims to provide support to the RHRDCs' regional project staff who wish to pursue MS and PhD studies in the country.

   Qualified staff can also avail of short-term training/non-degree courses to develop their skills in health research and research management.

3. **Revisiting of Regional Unified Health Research Agenda** (**RUHRA)**
   The RUHRA presents the identified health research priorities at the regional level. It should guide researchers and funders alike in the development of more relevant health research in the region for a period of six (6) years. The revisiting of the RUHRA will enable the identification of health research priorities that are relevant in addressing regional problems for CY-2022 to 2028. The results of consultation/discussion meetings in the 17 regional consortia and selected cities in cluster regions (Luzon, Visayas and Mindanao) in coordination with RHRDCs will be documented in the development of the RUHRA.

4. **Support to Health R&D Facilities Through PCHRD's Joint Instrumentation Grant (JIGS) Program**

   JIGS shall cover provision of support for upgrading of research laboratories and facilities of academic and research institutions in areas identified as priorities in NUHRA/RUHRA and the Harmonized National R&D Agenda (HNRDA) where there is inadequacy of research expertise and/or facilities.

   It shall include upgrading and/or setting up of research laboratories, purchase of laboratory equipment (including highly specialized software)/facilities and small research grants aimed at developing research capabilities of researchers and research institutions.

   Grants will be given to RHRDC member institutions located in the following regions:
   - 1st Priority: VII, XI and National Capital Region (NCR)
   - 2nd Priority: II, IV-B and VIII

   This however should not limit other Consortium members to submit an application.

5. **RHRDC Assessment**

   For more than 10 years of operations, the RHRDC will be assessed to determine the success of the program, to identify new interventions/strategies in six PNHRS program areas (research agenda; capacity building; ethics; information and utilization; structure, organization, monitoring and evaluation and resource mobilization); and guide in the continuous operations of RHRDCs.

   The program will be assessed based on RHRDCs' accomplishments as well as their relevant contributions vis-à-vis expected outputs based on DOST 6Ps metrics (Publications, Patents/Intellectual Property, Products, People Services, Places and Partnerships, and Policy).

ETHICS

The Philippine Health Research Ethics Board (PHREB) is the policy making body on health and health-related research ethics in the country which ensures that all phases of such research adhere to the universal ethical principles for the protection and promotion of the dignity of human participants. Programs under ethics are as follows:

1. Formulation/updating of guidelines for the ethical conduct of human health research

   The National Ethical Guidelines for Health and Health-related Research is updated every five years. Major activities include updating and formulating new guidelines for the ethical conduct of health research in the country taking into consideration the scientific, technological and social advancements, developments and changes.

2. Capacity building programs on health research

   The Research Ethics Committees (RECs) in the country will be monitored continually by providing capacity-building activities in research ethics, such as:

   a. Online course on research ethics:
      - Basic Research Ethics Training
      - Good Research Practice Training
      - Continuing Research Ethics Training (2023-2025)
   b. Continuing education training for the PHREB Committee on Standards and Accreditation (CSA) and Committee on Information Dissemination, Training and Advocacy (CIDTA) and National Ethics Committee (NEC)

c. Establishment of Centers for Excellence for Bioethics Centers for Excellence for Bioethics will be established in the country starting with NCR in 2025, followed by Mindanao in 2028.
d. Call for Ethics Research Projects (capacity building: mentoring)
e. Training for Ethics Staff

3. Monitoring and evaluation of the performance of institutional ethics review committees
   The program aims to assist the research ethics committees (RECs) in the development of quality review through ethical review practices and to appraise the performance of RECs vis-à-vis the PHREB standards for accreditation. This involves other activities as follows:
   a. Impact assessment of PHREB Services (2 years)
   b. Clustering of Research Ethics Monitoring Board (2023-2025)
   c. Establishment of PHREP for the use of all accredited RECs (including staff and storage upgrades)

4. Forging partnerships
   Conferences and research ethics fora will be conducted to initiate and contribute to discussions on ethical issues and network with local, national, and international organizations.

5. Establishment of Office of Human Research Integrity
   The Office of Human Research Integrity will be established in 2024 to further the fundamentals of research integrity and protect the welfare of researchers and research participants. In addition, the Philippine Health Research Portal will also be updated.

BALIK SCIENTIST PROGRAM

The Balik Scientist Program (BSP) aims to tap into the ingenuity and expertise of Filipinos abroad to strengthen the S&T capabilities of local researchers in the academe, public and private sectors, and industry to accelerate the flow of new strategic technologies that are vital to national development.

BSP will continue to address urgent concerns consistent with S&T priorities to contribute to the NUHRA and HNRDA-identified research priority areas. Balik Scientists will focus their activities on the following health research priorities:

- Drug discovery and development
- Diagnostics
- Functional foods
- Hospital equipment and biomedical engineering devices
- Information and communication technology for health
- Dengue and other arboviruses
- Disaster risk reduction
- Climate change adaptation in Health
- Artificial Intelligence
- Big Data Analytics
- Nuclear Medicine
- Omics Technologies for Health and Wellness
- Other priority areas such as mental health, geriatric care, nutrition, food safety

1. **BSP Engagements and Support to Capacity Building Activities**
   Balik Scientists will undergo evaluation before being awarded, will receive benefits, incentives and privileges and will be monitored and evaluated throughout their stint in accordance with RA 11035 or the Balik Scientist Act. Balik Scientists will engage with Host Institutions across the different regions on Short-term, Medium-term and Long-term engagements, wherein there will be continued support to capacity building activities.

2. **Balik Scientist Program Achievement Award**
   With the aim to ultimately get Balik Scientists to return and contribute significantly to S&T advancement and further encourage them to serve on a longer duration or better yet repatriate back in the Philippines and dedicate more time in creating impact to socio-economic development, the program shall also conduct annual awarding of Balik Scientist Achievement Award for outstanding completion of engagements.

   A Short-term and Medium-term Balik Scientist recognized as Balik Scientist Achievement Awardee will be provided with one-time incentive of P250,000, while a Long-term Balik Scientist recognized as Balik Scientist Achievement Awardee will be provided with one-time incentive of P500,000, as evaluated by the National Academy of Science and Technology (NAST).

PROPOSED BUDGET FOR NETWORK INSTITUTION DEVELOPMENT

2023	2024	2025	2026	2027	2028
239.4 M	229.8 M	244.7 M	281.3 M	289.7 M	301.9 M

III. ROADMAPS

(Please click the link below to open the Health Roadmaps)

https://drive.google.com/file/d/1s97DwGx1dj-EBp7gRX6ana6ymXYtR-cG/view?usp=sharing

SECTION 3

AGRICULTURE, AQUATIC AND NATURAL RESOURCES (AANR) RESEARCH AND DEVELOPMENT AGENDA 2022 – 2028

I. INTRODUCTION

This Updated Harmonized National Research and Development Agenda in Agriculture, Aquatic and Natural Resources (HNRDA-AANR) for 2022-2028, formulated through a consultative process, is an integration of the priority agenda of government agencies under the Departments of Agriculture, Environment and Natural Resources, and Science and Technology that are mandated to finance, conduct and/or monitor R&D in the AANR sector. The agenda will serve as core guidance in the convergence of national R&D efforts for the development of the sector.

The Updated HNRDA-AANR aims to: a) Guide the national R&D system in the formulation of programs/projects to support AANR development; b) Encourage complementary and purposeful collaborations/partnerships; c) Mobilize and ensure effective and efficient use of resource; and d) Provide a framework for developing R&D capacity and expertise.

The agenda hereinunder listed support the development thrusts in the sector including a) Food security; b) Value chain development for livelihood and income generation; c) Building resilience to climate change and other natural shocks; and d) Sustainable environment and natural resources.

The HNRDA-AANR adopts the following general principles:

1. The HNRDA-AANR adopts the whole-of-government approach. Addressing the agenda herein specified shall be the joint undertaking of public agencies involved in the development of the AANR sector, including the line departments and their concerned attached agencies, and research and development institutions (RDIs).
2. The HNRDA-AANR espouses all national strategies, programs and initiatives of the government for the sustainable development of a resilient AANR sector, such as the Philippine Biodiversity Strategy and Action Plan 2015-2028, the Science for Change Program of the Department of Science and Technology; the Plant, Plant, Plant Program and High Value Crops Program of the Department of Agriculture; the National Greening Program of the Department of Environment, and the Agribusiness Roadmaps of the Department of Trade and Industry, among others.
3. The HNRDA-AANR supports Agriculture 4.0 that is smart, green and S&T-based. Consistent with existing rules and regulations and cultural values, it shall support the following:
    a. Different farming techniques such as smart farming, urban farming, urban forestry, organic farming, halal farming
    b. Biotechnology and omics sciences such as genomics, transcriptomics, proteomics, metabolomics and viromics
    c. Other frontier technologies such as nanotechnology, nuclear analytical techniques, artificial intelligence, drone technology, big data analytics, Internet of things technologies

d. Farm mechanization, as mandated by RA 10601, otherwise known as the Agricultural and Fisheries Mechanization Law

4. The HNRDA-AANR supports regional R&D agenda to promote regional AANR productivity, competitiveness and sustainability in order to engender human, environmental and economic resilience.

II. THE HNRDA IN AANR

The AANR sector plays multifunctional roles in economic development. Aside from the production of food for food security, fiber and raw materials with forward linkage to industries, it has central roles in rural employment, tourism, health, environmental protection, provision of ecosystems services, biodiversity and many others. Key challenges that the sector faces to accomplish these functions include, among others: limited areas for cultivation; increasing population; climate change impacts; and natural resource degradation.

A. CROPS R&D AGENDA

In the crops sector, considering that the cultivation frontier has been reached, increasing production to satisfy the increasing needs for food and demand of industries will increasingly be a function of crop productivity and efficiency, sustainable production systems, and efficient product value chain. The following R&D agenda will be pursued.

1. Germplasm evaluation, conservation, utilization and management
2. Varietal improvement and selection
3. Production of certified good quality seeds and planting materials
   a. Development/optimization of seed production protocols
   b. Innovations in seed systems
4. Cultural management practices (pest, water, soil and nutrient management)
   a. Optimization of nutrient and water management
   b. Optimization of integrated pest and disease management
   c. Organic Agriculture
5. Crop production systems
   a. Smart farming approaches
   b. Off-season production and cultivation
   c. Urban farming
   d. Development of climate-resilient technologies
   e. Intercropping and integrated farming systems
6. Postharvest, primary processing and product development
7. Decision support systems

PRIORITY PROJECTS FOR 2022 – 2028

1. Crop improvement through conventional and new breeding techniques (NBT)
2. Field verification and adaptability trials of improved crop varieties and/or technologies
3. Surveillance and management of pests and diseases of selected crops
4. Postharvest innovations to extend the shelf life of priority crops
5. Product development and value addition
6. Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines (SARAI)
7. Roll out of mature technologies

PROPOSED BUDGET FOR CROPS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
2,945 M	5,285 M	7,551 M	10,798 M	14,798 M	19,321 M	28,945 M

B. LIVESTOCK R&D AGENDA

The following livestock R&D agenda aim to increase the productivity and profitability of livestock food systems by improving livestock species using new and emerging techniques, promoting animal health, developing new products for improved livelihood opportunities, and developing support systems for information-based decision making.

1. Breed development and genetic improvement
2. Reproductive biotechniques for priority livestock species
3. Nutrition, feeds and feeding system
4. Conservation and improvement of native animals
5. Vaccine, biologics and diagnostics development
6. Food quality and safety assurance
7. Disease control and anti-microbial resistance management
8. Production and management decision support systems
9. Product development and processing
10. Emerging technologies on breeding techniques

PRIORITY PROJECTS FOR 2022 – 2028

1. Native Animal R&D Program (Pig, Poultry (Itik Pinas, Muscovy duck, Chicken, Cattle)
2. Halal Goat R&D Program
3. Animal genetic improvement
4. Reproductive biotechnologies
5. ASF diagnostics, surveillance and vaccine development
6. Early detection technologies for emerging animal diseases
7. Breed registry and traceability systems
8. Innovative food/feed product development
9. Forage and pasture development

PROPOSED BUDGET FOR LIVESTOCK (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,472 M	2,643 M	3,461 M	4,494 M	7,721 M	11,041 M	15,788 M

C. AQUATIC R&D AGENDA

The aquatic R&D agenda hereunder aim to improve the productivity and profitability of aquatic species through more efficient and more sustainable aquaculture production practices.

1. Application of genomics in the study of diseases of aquatic species and fish resistance to climate change; molecular phylogenetics; population genetics
2. Physiological and ecological studies of aquatic species

3. New species for culture
4. Culture systems (broodstock management, hatchery, nursery, grow-out)
5. Fish health, disease diagnostics and disease management
6. Nutrition, feeds and feeding system
7. Postharvest handling, processing and new product development
8. Mechanization and automated systems for feeding, water and culture management, and post production
9. Production and management decision support systems

PRIORITY PROJECTS FOR 2022 – 2028

1. Aquatic Genomics R&D
2. Pilot testing of technologies, systems and other products of aquatic research
3. Fish disease diagnostic tools and vaccines
4. Alternative feeds and feed additives for improved nutrition of aquatic species
5. Product development from various aquatic species (including marine toxins)
6. Rollout/commercialization of aquatic technologies

PROPOSED BUDGET FOR AQUATIC (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,740 M	3,083 M	4,405 M	6,749 M	10,938 M	16,561 M	26,313 M

D. FORESTRY R&D AGENDA

The following agenda aims to expand economic opportunities from forestry species as well as to support the National Greening Program.

1. Physiological and ecological studies
2. Varietal improvement of priority agroforestry/non-timber and forestry species
3. Sustainable production, management and processing of priority agroforestry/non-timber and forestry species
4. Innovative product development
5. Decision support systems

PRIORITY PROJECTS FOR 2022 – 2028

1. Selection and production of superior genetic materials of selected agroforestry, non-timber and forestry species
2. Livelihood opportunities for upland communities
3. Urban Forestry Species for the regreening program
4. Sustainable agroforestry models including, but not limited to silvopasture models
5. Innovative techniques for processing of timber and non-timber species
6. Industrial uses of bamboo, cacao, rubber and ITPs
7. Decision tools for forest tree plantation management and marketing

PROPOSED BUDGET FOR FORESTRY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,606 M	2,422 M	3,776 M	5,399 M	7,721 M	10,650 M	11,841 M

E. NATURAL RESOURCES AND ENVIRONMENT R&D AGENDA

A sustainable natural resources and environment sector is central to the proper functioning of production systems, whether on land or under water. It is important to ensure the integrity of the sector and the ecosystem services that it provides are protected for the future.

1. Conservation, sustainable utilization, and management of biodiversity in terrestrial, freshwater and marine ecosystems
2. Sustainable inland and coastal watershed management and utilization
3. Management and rehabilitation of degraded and polluted agricultural soils
4. High-value product development from agricultural and forests wastes
5. Strategies/decision management tools for climate change resilient environment
6. Resource and ecosystems assessment and monitoring
7. Habitat management for fishery and ecosystem sustainability
8. Marine environmental management (Harmful Algal Blooms, coastal integrity/erosion and eutrophication)
9. Fish kill warning and mitigation systems
10. Application of innovative monitoring and management systems and technologies for environment and natural resources management
11. Ecotourism management
12. Development of blue economy including the application of innovative technologies in the fisheries and aquatic sector and assessment of ecological limits and other sustainability parameters
13. Natural capital accounting
14. Assessment of natural resource carrying capacity/ecological limits

PRIORITY PROJECTS FOR 2022 – 2028

1. Biodiversity R&D Program
    a. Conservation, sustainable utilization and management of endangered, threatened and endemic terrestrial and aquatic species
    b. Biodiversity, vulnerability and climate risk assessment of terrestrial and aquatic ecosystems, including marine protected area networks
    c. Genetic diversity conservation and dynamics in various ecosystems, including wealth generation and sustainable diets
    d. Establishment of National Integrated Sharing Network for plant genetic resources for food and agriculture
2. Baselining and assessment of fish stock and other coastal and marine resources and ecosystem conditions in Fisheries Management Areas
3. Ocean studies (ocean currents, waves, dynamics, plate tectonics, hydrology and offshore energy)
4. Integration of ecosystem services in the Philippine Environmental Impact Statement System
5. Valuation and payment, including development of financing instruments, for ecosystem services of watersheds and other resources
6. Knowledge management for enhancing science, policy and practice of watersheds
7. Coastal habitat (reef, mangrove, seagrass) assessment, monitoring and conservation
8. Control and management of risks and hazards in coastal and marine and freshwater ecosystems
9. R&D on ecological footprint vis-a-vis biocapacity

10. Updating the country's material flow accounts (domestic material consumption and material footprint)

PROPOSED BUDGET FOR NATURAL RESOURCES AND ENVIRONMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,339 M	2,863 M	4,405 M	6,749 M	8,364 M	11,155 M	14,472 M

F. CLIMATE CHANGE ADAPTATION AND MITIGATION AND DISASTER RISK REDUCTION

The Philippines is one of the countries that are most affected by extreme weather events. According to Germanwatch, the country ranks 4th among countries that are recurrently affected by catastrophes based on long-term Global Climate Risk Index using 2000-2019 data.

Among the economic sectors, the AANR is most adversely affected as extreme weather events threaten agricultural productivity and output and, consequently, the livelihood and incomes of farmers and fisherfolk. The following agenda focus on empowering farmers and fisherfolk to make them resilient to climate change impacts.

1. Mitigation and adaptation studies of vulnerable communities and ecosystems
2. Smart farming approaches and other climate-resilient agricultural production technologies
3. Strategies/decision management tools for climate change- and disaster-resilient environment
4. Sustainable development through lifescape – landscape/seascape approach

PRIORITY PROJECTS FOR 2022 – 2028

1. Technology development for resilient and adaptive communities and ecosystems
2. Enhancement of adaptation and mitigation capacity of vulnerable communities
3. Knowledge management portal for information and resources on climate change adaptation
4. S&T Action Frontline for Emergencies and Hazards (SAFE)
5. Online EWS (Early Warning Systems) for key agricultural commodities
6. Rehabilitation and climate change proofing of vulnerable agri-aqua and natural resource areas
7. Identification/Mapping/Biophysical Profiling of vulnerable ecosystems
8. Inclusive Science for Livelihood in the Agri-aqua Sector (ISLAs)
9. Quick response S&T- based assistance to AANR communities affected by hazards
10. Carbon neutral technologies
11. Role of forestry in disaster risk reduction

PROPOSED BUDGET FOR CLIMATE CHANGE ADAPTATION AND MITIGATION, AND DISASTER RISK REDUCTION (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
535 M	661 M	1,259 M	1,800 M	3,217 M	4,775 M	7,894 M

G. TECHNOLOGY TRANSFER

The following agenda aim to enhance technology transfer systems to address perceived gaps between technology generation and adoption, ensuring that products of R&D reach their intended users while promoting resilience and entrepreneurship.

1. Innovative and improvement of traditional extension modalities for the efficient transfer of technologies to end-users
2. Upscaling and outscaling of agricultural technology transfer and commercialization through various modalities
3. Leveraging technologies for building resilience and supporting economic recovery

PRIORITY PROJECTS FOR 2022 – 2028

1. Improving capacities in the AANR Sector on IP management and Technology Transfer
2. Agri-Aqua Technology Business incubators
3. S&T Community-Based Program for Inclusive Development
4. Science for the Convergence of Agriculture and Tourism
5. Good Agri-Aqua Livelihood Initiatives towards National Goals (GALING)-PCAARRD
6. Regional Agri-aqua Innovation System Enhancement (RAISE) Program
7. Technology commercialization programs

PROPOSED BUDGET FOR TECHNOLOGY TRANSFER (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,874 M	2,643 M	3,776 M	4,499 M	6,434 M	9,830 M	9,210 M

H. SOCIO-ECONOMICS, POLICY RESEARCH AND GOVERNANCE

The following agenda aim to study related socio-economic, institutional and policy issues with a view to ensuring that an enabling environment is in place for S&T and AANR development.

1. Agriculture and resource economics studies such as but not limited to market research, agrarian/asset reform, environmental valuation, economies of scale/collective farming
2. Supply/value chain development of selected AANR industries and other agribusiness-related initiatives
3. Impact assessment of mature technologies, AANR programs and projects
4. Policy research and advocacy on natural resources/environment-related issues, agricultural trade, supply chain/value chain related issues, standards and regulations, compliance to standards across the value chain, and R&D governance and other cross-cutting policy concerns
5. Integrating gender and development (GAD) in AANR programs and projects
6. Software technologies towards better foresight and strategic insights

7. Applied rural sociology studies covering but not limited to characterization and understanding rural communities; demographic and intergenerational changes of AANR stakeholders (e.g. farmers, fishers, indigenous people); social practices and behavior and their implications to technology adoption; role of social institutions and institutional arrangements.

PROPOSED BUDGET FOR SOCIO-ECONOMICS, POLICY RESEARCH AND GOVERNANCE (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
1,606 M	1,982 M	2,202 M	3,149 M	3,860 M	6,592 M	14,472 M

I. HUMAN DEVELOPMENT, SCIENCE COMMUNICATION AND KNOWLEDGE MANAGEMENT

The following agenda aim to build stronger knowledge and intellectual capabilities and create, in the longer term, effective agricultural workforces for knowledge-based societies.

1. Efficient and impactful AANR human development programs such as, but not limited to: understanding 21st century skills and competencies for the new agricultural workforce; development of IR 4.0 technologies and mechanisms for alternative certification and delivery of lifelong learning opportunities in agricultural education
2. Public engagement and communicating AANR R&D to build vibrant communities in a science-oriented nation such as, but not limited to: evidence-based approaches and strategies for effective media coverage and public engagement of agricultural topics; Methods of evaluating science communication in AANR
3. Systems approach to knowledge management and cross R&D collaborations such as, but not limited to: innovation management based on data analytics; Enhancing decision-making and problem-solving abilities within and among the AANR sector

PROPOSED BUDGET FOR HUMAN DEVELOPMENT, SCIENCE COMMUNICATION AND KNOWLEDGE MANAGEMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
268 M	440 M	629 M	900 M	1,287 M	2,080 M	2,631 M

PRIORITY COMMODITIES

AGRICULTURE		AQUATIC	NATURAL RESOURCES AND ENVIRONMENT
Crops	Livestock		
Abaca and other fiber crops Coconut Rice Corn and Other Grains Fruit Crops - Mango - Banana - Other tropical fruits (e.g. durian, jackfruit, pummelo, papaya, pineapple, citrus) Legumes (e.g. mungbean, peanut and soybean) Natural Sources of Dye Pili and Cashew Ornamentals (e.g. cutflowers and foliage) Medicinal Plants Plantation Crops - Cacao - Coffee - Oil Palm - Rubber - Sugarcane Rootcrops (e.g. sweet potato, cassava) Sericulture and Apiculture Vegetables (e.g. tomato, white potato, mushroom)	Livestock - Swine - Goat - Sheep - Cattle (dairy and meat) -Carabao (dairy and meat) -Rabbit Poultry - Chicken (meat and egg) - Duck (meat and egg) - Quail Native animals - Chicken - Duck - Swine - Goat Feed Resources	Crabs - Mangrove crab - Blue swimming crab Shellfish - Abalone - Mussel - Oyster Finfishes - Milkfish - Tilapia - Endemic species - Sardines - Tuna Shrimp Seaweeds Sea cucumber Cephalopods - Cuttlefish, Octopus, Squid Aquafeeds	<u>Timber</u> Tree plantations (e.g. yemane, falcata) <u>Non-Timber</u> Bamboo Rattan Sago Tiger grass Vines and other non-timber Biodiversity * Ecosystem (e.g. mangrove, marine, freshwater) * Microbial * Flora and Fauna * Ecotourism Climate change adaptation and disaster risk reduction

INSTITUTIONAL DEVELOPMENT PROGRAMS OF DOST-PCAARRD IN SUPPORT OF THE HNRDA-AANR

The DOST-PCAARRD's Institution Development Division oversees two major components – the Facilities Development Management, and the Human Resources Development for the NAARRDN.

J. FACILITIES DEVELOPMENT MANAGEMENT PROGRAMS

FACILITIES DEVELOPMENT FOR THE NAARRDN

One of PCAARRD's policies is to strengthen the institutional R&D capability of the National Agriculture, Aquatic and Natural Resources R&D Network (NAARRDN) or the regional R&D partners. The Facilities Development for the NAARRDN Program addresses the partner's needs in terms of infrastructure upgrading and acquisition of equipment used in R&D through the release of a financial assistance in the form of a grant. The R&D partner submits a project proposal for evaluation and approval prior to the release of funding support. The facilities improvement or upgrading proposal must be supportive of an ongoing, in the pipeline or future R&D projects/programs being funded by DOST-PCAARRD, upgrading to Agriculture 4.0 – ready facilities, and ICT infrastructure for the Regional Consortia and its member agencies.

FACILITIES DEVELOPMENT FOR THE SECRETARIAT

PCAARRD must ensure that its workers are provided with better and safer working environment so that the organization will continuously provide efficient services to its partners. Thus, buildings, land, machineries, and equipment are always properly maintained to make sure there is minimal or zero stoppage in operation while maintaining a healthy working environment to all employees and visitors.

PROPOSED BUDGET FOR FACILITIES DEVELOPMENT MANAGEMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
150 M	154 M	160 M	164 M	165 M	166 M	170 M

K. HUMAN RESOURCE DEVELOPMENT PROGRAMS OF DOST-PCAARRD

IN-COUNTRY GRADUATE THESIS/DISSERTATION ASSISTANCE PROGRAM

The program aims to enable graduate students to contribute in addressing the priority research areas of DOST-PCAARRD. The beneficiaries are Masters and PhD students pursuing graduate degree program at DOST-Science Education Institute-accredited State Higher Education Institutions (HEIs) evaluated by the Commission on Higher Education (CHED) as Centers of Excellence. The grant has a maximum financial support of Php100,000 for PhD students and Php50,000 for MS.

GRADUATE RESEARCH AND EDUCATION ASSISTANTSHIP FOR TECHNOLOGY (GREAT) PROGRAM

Innovative way to support qualified graduate students in completing their degree programs by providing sufficient financial and technical support, particularly in the conduct of their research/thesis/dissertation. The thesis/dissertation of the successful applicant will be anchored on a DOST-PCAARRD funded project. Graduate studies taking PhD by Research may now apply for the GREAT Program. GREAT alumni are also entitled to a re-entry grant with a maximum amount of Php5M.

RE-ENTRY GRANT

Enables newly graduated DOST-PCAARRD thesis/dissertation grantees to pursue, in their mother agency, an R&D project related to their thesis/dissertation and in support of DOST-PCAARRD research priority areas. The re-entry project aims to assist the grantee to jumpstart his/her career towards the research career path.

PUBLICATION INCENTIVES

Promotes scientific productivity, knowledge sharing, and eventually application of R&D results by encouraging and rewarding NAARRDN researchers and scholars to publish, as principal authors, their research results in approved local and international refereed journals. Successful applicant will be provided with a grant ranging from Php25,000 to Php80,000, depending on the journal's impact factor.

BALIK SCIENTIST PROGRAM

In support of the Department of Science and Technology's "Balik Scientist Program", the DOST-PCAARRD component taps the ingenuity of scientists and experts residing and working abroad and of Filipino-descent, to strengthen the S&T capabilities of local researchers and scholars in addressing critical and emerging concerns in the agriculture, aquatic and natural resources (AANR) sectors. The Balik Scientist may engage and assist the host institution in capacitating their agency remotely or on-site for a maximum duration of three years.

NON-DEGREE TRAINING PROGRAM

Strengthens the critical competencies of research managers, researchers, and scholars in the implementation and management of AANR R&D initiatives through the development and conduct of strategically identified enhancement courses. The PCAARRD Advanced Learning Management System (PALMS) is the Council's online platform which houses training and other science-based learning materials.

DOST-PCAARRD SANDWICH PROGRAM GRANT FOR GRADUATE RESEARCH IN THE AANR

Open to graduate students enrolled in the fields related to AANR sectors from DOST-PCAARRD accredited universities who need to conduct their research in reputable foreign universities and research institutions to avail of the host institution's facilities and research expertise.

SPECIALIZATIONS NEEDED FOR THE IMPLEMENTATION OF HNRDA 2022-2028

R&D Agenda	Program	Specializations needed
Crops R&D	Germplasm evaluation, conservation, utilization and management	Agronomy Horticulture Plant Breeding and Genetics Biotechnology/ Molecular Biology/ Agricultural Biotechnology Entomology Plant Pathology Plant Genetic Resources Conservation and Management Biochemistry Nanotechnology Organic Agriculture Electronics and Communications Engineering (ECE) Computer Engineering Computer Science (Smart Farming- Artificial Intelligence and Internet of Things) Digital Agriculture Robotics Mechatronics Information Communication Technology
	Varietal improvement and selection	
	Production of good quality seeds and planting materials	
	Cultural Management Practices	
	Crop production systems research	Agrometeorology Water Resources Management Soil Science Farming Systems Crop Protection IT/ICT Socio-economics Nanotechnology Agricultural Economics Electronics and Communications Engineering (ECE) Computer Engineering Computer Science (Smart Farming- Artificial Intelligence and Internet of Things)
	Postharvest, processing and product development	Agricultural Engineering Post-harvest Technology Food Science Agricultural mechanization Post harvest Food processing Robotics

R&D Agenda	Program	Specializations needed
Livestock R&D	Breed development and genetic improvement (for meat, dairy and draft)	Animal Science/Breeding
	Reproductive biotechniques for priority livestock species	Animal Science/Breeding
	Nutrition, feeds and feeding system	Animal Nutrition
	Conservation and improvement of native animals	Animal Science/Breeding
	(Vaccine) Biologics and diagnostics development	Veterinary Medicine Analytical Chemistry
	Detection of chemical residues and anti-microbial resistance	Molecular Biology/ Biotechnology Biochemistry
	Production and management decision support systems	IT Animal Science (Animal Production)
	Product development and processing	Food Science and Technology Meat Science
Aquatic R&D	Application of genomics in the study of diseases of aquatic species, improving fish resistance to climate change; molecular phylogenetics; population genetics,	Marine Science Molecular Biology/Biotechnology Genetics and Breeding
	New cultivable species for culture	Aquaculture/Fisheries Marine Biology Marine Science
	Development/Refinement of culture systems (broodstock management, hatchery, nursery, grow-out)	Aquaculture/Fisheries
	Fish health, disease diagnostics and disease management	Health Management in Aquaculture/Fisheries/ Fish Diseases Veterinary Medicine
	Nutrition, feeds and feeding system	Aquaculture/Fisheries; Fish Nutrition
	Postharvest handling, processing and new product development water and culture management, and post production	Fish Processing Technology Food Science
	Mechanization and automated systems for feeding, water and culture management, and post production	Aquaculture/ Fisheries Agricultural and biosystems engineering Aquaculture Engineering
	Fishkill warning and mitigation systems and environmental management for sustainable aquaculture	Fisheries Marine Biology Marine Science Environmental Science

R&D Agenda	Program	Specializations needed
	Management of fisheries	Aquaculture/Fisheries
Forestry R&D	Development of sustainable management practices	Natural Resources Conservation Forest Resources Management Social Forestry and Governance
	Development of high yielding varieties of priority timber species with superior traits	Silviculture and Forest Influences Forest Biological Sciences Forest Biotechnology Forest Genetics and Tree Breeding Forest Tree Improvement
	Production protocols for the propagation of quality timber and non-timber forest planting materials	Silviculture and Forest Influences Forest Biological Sciences Forest Biotechnology
	Development of sustainable harvesting and postharvest techniques/technologies and marketing strategies for timber and non-timber forest species/products	Forest Resources Management Watershed Management Sustainable Forest Products Utilization and Marketing Forest Policy and Governance
Natural Resources and Environment	Sustainable utilization, conservation and management of biodiversity in terrestrial, freshwater and marine ecosystems	Environmental ScienceMarine Biology/ Marine Science Fisheries Oceanography Environmental Science Socio-Economics
	Sustainable watershed management and utilization	Agricultural Engineering Forest Resource Management Environmental Science Soil Resources Management Development Communication Environment Management Resource Economics Watershed Management Agricultural and Biosystems Engineering (Hydrology)
	Management and rehabilitation of problem, degraded and polluted agricultural soils through remediation	Agricultural Engineering Environmental Engineering Soil Resources Management Water resources management Agricultural Chemistry
	Development of high value products from agricultural and forest wastes	Agricultural Engineering Forest Product Development

R&D Agenda	Program	Specializations needed
	Strategies/decision management tools for climate change resilient environment	Agrometeorology Environmental Science Fisheries/ Marine Science Biology ICT Environmental Engineering
	Resource and ecosystems assessment and monitoring	Fisheries/ Marine Science Biology Environmental Science
	Habitat management for fishery and ecosystem sustainability	Fisheries Marine Biology/ Marine Science/ Oceanography Environmental Science
	Marine environmental management (to include Harmful Algal Blooms, coastal integrity/erosion, fish kills and eutrophication)	Marine Science/Fisheries Environmental Science/ Biology
	Innovative management systems for unique landscapes and ecosystems	Environmental Science
Climate Change Adaptation and DRR	Mitigation and adaptation studies (including protected agriculture, vertical agriculture)	Agrometeorology Environmental Science Agricultural and Biosystems Engineering Crop Science
	Development of smart farming approaches (including organic agriculture, integrated farming, ICT application) and other climate-resilient agricultural production technologies	Agronomy Horticulture Agrometeorology Agricultural and Biosystems Engineering Electronics and Communications Engineering Environmental/Natural Resources Economics Computer Science/Computer Engineering/Information Technology Statistics/Applied Math Environmental Engineering Environmental Science
	Development of strategies/decision management tools for climate change resilient environment (e.g. farm diversification)	
	Enhancing sustainable development through lifescape-landscape approach	Environmental Science

R&D Agenda	Program	Specializations needed
Technology Transfer	Development of innovative and improvement of traditional extension modalities for the efficient transfer of technologies to end-users	Forestry (Social Forestry) Agricultural Extension Extension Education Agriculture Sociology Technology Management Development Management Agribusiness Management Agricultural Economics/ Economics Aquaculture/ Fisheries
	Upscaling of agricultural technology transfer and commercialization	Technology Management (to include technology assessment and technology valuation) Agribusiness Management Intellectual Property Management Development Communication Knowledge Management Technology Negotiation Technology Business Incubation Agriculture Agricultural Extension Extension Education Agricultural Economics/ Economics Aquaculture/ Fisheries Sociology
Socio-economics and Policy Research	Continuing review of existing policies affecting the AANR sectors	Agricultural Economics Economics Development Studies Agribusiness Management Development Management and Governance Sociology Anthropology Gender and Development/ Women Study Development Communication Public Administration Fisheries Economics
	Policy research on natural resources/ environment-related issues, agricultural trade, supply chain/value chain related issues and R&D governance, compliance to standards across the value chain	
	Impact assessment of technologies, AANR programs and projects	
	Socio-economic studies on production and marketing efficiencies, role of social institutions in technology adoption, labor migration, development of social enterprise models, gender and development	
	Agriculture and resource economic studies including market research, agrarian/asset reform, environmental valuation, economies of scale/collective farming	
	Policy studies on global competitiveness of Philippine AANR sector	

PROPOSED BUDGET FOR HUMAN RESOURCE DEVELOPMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
66.3 M	74.3 M	77.9 M	79.0 M	82.9 M	86.0 M	90.6 M

III. FUNDING REQUIREMENTS AND SOURCES

The agenda herein specified will be funded by the concerned agencies' annual General Appropriations, R&D allocations from policy pronouncements such as the use of the Coconut Levy Fund and intra-government agreement with the National Security Council on marine research, and grants from international R&D organizations.

The estimated funding requirement of the HNRDA-AANR 2022-2028 amounts to a total of P400 Billion.

IV. ROADMAPS

(Please click the link below to open the AANR Roadmaps)

https://drive.google.com/file/d/19RJcAlRZAJ-t54_kInQZATzqhf_smOmZ/view?usp=sharing

SECTION 4

INDUSTRY, ENERGY AND EMERGING TECHNOLOGY RESEARCH AND DEVELOPMENT AGENDA 2022-2028

I. INTRODUCTION

The Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) is mandated to formulate national policies, plans, programs and implementing strategies for industry, energy and emerging technology. Since its creation in 2010, PCIEERD has been supporting programs and projects related to its sixteen (16) priority sectors. Four (4) areas namely: Data Science, Artificial Intelligence, Human Security, and Creative Industries, were added as PCIEERD's priority concerns in 2017. Said areas were identified to ensure that S&T solutions and innovations are available to help create and sustain competitive industries.

The Harmonized National R&D Agenda (HNRDA) for the Industry Sector for 2022-2028 is formulated through targeted consultations with the private sector, National Government Agencies (NGAs) and the academe. They are aligned with national priorities and global advancements. The identified research priorities are contained in the roadmaps for each of the sector the Council's supports. The Roadmaps serve as a guide and strategy intended to achieve a particular vision or goal in 2028.

Roadmapping involves a series of consultations through Focus Group Discussions with stakeholders such as target users, technology adoptors, manufacturers, other relevant government agencies who can help implement research results through policies as well as R&D institutions (RDIs) and higher education institutions (HEIs) who have the competence to implement research/S&T activities. Also, prior to these consultations, the Council conducts environment scanning, strength, weakness, opportunity and threat (SWOT) analysis, trend analysis, and review of existing roadmaps for each of its sector.

After roadmaps are set, the Council holds Action Planning workshops with possible research/S&T activity implementors to identify specific S&T program areas (e.g. target technological developments/S&T intervention for the industry/sector) and corresponding timelines and budget to be able to operationalize these roadmaps.

The Council coordinates, consults, and collaborates with other agencies involved in performing R&D functions and agrees with these agencies on the possible delineation of the focus of their respective R&D agenda to promote convergence and complementation in R&D initiatives, avoid duplication of R&D efforts, optimize the use of available resources of the government, and mainstream/institutionalize the use of technologies developed.

These agencies include the following:

- Department of Trade and Industry (DTI)
- Department of Education (DepEd)
- Department of Interior and Local Government (DILG))
- Department of Information and Communications Technology (DICT)
- Department of Environment and Natural Resources (DENR)

- Philippine Space Agency (PhilSA)
- DOST and National Security Council
- DOST and Department of National Defense
- PCIEERD and Philippine Academe and Technology R&D for Internet of Things (PATRIoT) Consortium
- Department of Budget and Management (DBM)
- Philippine National Police
- DTI and Board of Investments (BOI)
- National Commission for Indigenous Peoples
- Komisyon ng Wikang Filipino
- Semiconductor and Electronics Industries in the Philippines Foundation, Inc. (SEIPI)
- Electronics Industries Association of the Philippines (EIAPI)

The identified gaps and challenges aimed to be addressed in this agenda include the following:

- **Resources and Infrastructure**
  Research and development equipment availability and access: This issue is relevant especially in the first phases of development, which are ideation and prototyping. As R&D begins, execution becomes a challenge as there are inadequately equipped laboratories, inaccessible laboratories that have unideal locations or are too far from universities, and limited access to prototyping equipment for certain types of manufacturing (i.e. electronics/semiconductors). Moreover, there is also a lack of facilities for Visayas and Mindanao as most of these are in Metro Manila, limiting R&D that can happen outside the capital. Lastly, there are also equipment that are no longer functional.

- **Talent availability:** Similar to R&D equipment availability and access, the lack of talent availability is crucial for the phases of ideation and prototyping. There is a lack of experts who can train students/researchers in advanced technologies, techniques or concepts that can upgrade R&D initiatives. In the same light, there are also a lack of experts who can use the equipment available and analyze the results. This limits the industry to capture higher-value segments in R&D (i.e. design).

- **Production equipment availability and access:** Small-scale enterprises and producers do not have the facilities to adopt the technologies developed. There is a lack of small-scale fabrication capability for SMEs and no access to small-scale production equipment for certain types of manufacturing (i.e. electronics, semiconductors). This limits the potential of technologies to be adopted for commercial and industrial use.

- **Funding:** Researchers performing fundamental research find difficulty in securing funds to do research since the outputs are non-commercializable though they have strategic and capacity-building benefits. There is also difficulty in securing funding without industry partners. This is exacerbated by the fact that there are no incentives or funding for companies to engage in R&D.

- **Policy**
  Procurement Policy: Government procurement process is slow and tedious since it requires many documents and approvals before the actual acquisition can be done. The long time-horizon needed for procuring the equipment may cause project timelines to be extended.

- **IP Policy:** Researchers are not knowledgeable enough about business and regulatory requirements for procuring IP and thus might not be able to obtain reasonable terms in industry partnerships since industry partners want as much control and monetization rights as possible over technology.

- **Standards and Certification:** Users and mass producers are apprehensive about adopting new technology without safety standards/certification that give some assurance that population, potential users are not at risk (i.e. nanotech for food applications, effects of nanotech on environment).

- **Ecosystem**
  Weak linkages between Industry and Academe/Researcher:
  Collaborations between industry developers and the academe usually arise from informal channels such as personal contacts, conferences, etc. There is no available ground to facilitate connection between the industry and the academe. The weak linkage causes R&D and skill development to be performed independently from industry outputs, causing low adoption of research results and skill mismatches.

  Weak linkages between government agencies on innovation ecosystem:
  There is not enough collaboration between different government agencies for R&D and innovation needs of researchers and private/public adopters.

  Weak linkages with international research community:
  There is a lack of collaborative research and technology transfer between foreign players/experts and local researchers.

- **Culture**
  Culture mismatches: The difference in cultures of researchers, academicians and industry players make collaboration among the parties difficult since there are often disagreements on the needs, timeline, and other aspects of cooperation that discourage the different parties from working together.

- **Lack of Industry Knowledge/Trust in R&D:**
  Industry is apprehensive and hesitant to adopt or make investments in technologies that have not yet been fully tried and tested. There is a lack of awareness on the benefits of technology developed which is caused by limited visibility to the functionalities and usefulness of these technologies and R&D to their productions and processes. Upon a comprehensive review and understanding of both the local and global landscapes of the sectors, there are a lot of opportunities where the Philippines can progressively develop its infrastructural capabilities and the skills of its people. Although some difficulties still persist, we cannot disregard the potential of growth and expansion of local talent and expertise. To make this happen, the different stakeholders involved must be able and willing to contribute their resources and be open for collaboration with the others – thereby ensuring an environment that does not always just try to catch up with its peers, but stands out and flourishes in the global paradigm.

II. THE HNRDA IN INDUSTRY, ENERGY AND EMERGING TECHNOLOGY

A. ADDITIVE MANUFACTURING (AM)

Today's Additive Manufacturing is already varied to include the ability to 3D print clothing, basic electronics, enterprise grade industrial components and machinery, human organs, lighting systems, solar cells, synthetic stem cells, vehicles and much more.

The future for Additive Manufacturing is limitless. Over the next decade, as the components and processes that underpin the technology mature and become increasingly accessible, affordable, capable, and reliable, the rate of expansion and emergence of new specialist sub-categories 3D and 4D Printing, and Nano-Manufacturing will continue to accelerate.

From 2017 to 2022, the major accomplishments of the agenda include the establishment of the Additive Manufacturing Center or AMCEN wherein Multiple Materials Platform for Additive Manufacturing was developed and research on advance prototyping for product innovation and development using additive manufacturing technologies were conducted.

PRIORITIES FOR 2023

1. Accessible three-dimensional (3D) Printers (low-cost for small-scale manufacturers)
2. Materials for electrostatic discharge (ESD) (Semiconductor)
3. Policy/paper on AM in the Philippines
4. Localized metal powder for AM
5. Multiple materials platform for AM
6. Temperature sensors and other basic healthcare devices
7. Patient specific knee implant, spine implant
8. Metal materials for medical ultrasound impedance matching complementary metal-oxide-semiconductor (CMOS)
9. Development of sharing platform for 3D Concrete Printing (3DCP)
10. Local fibers for bicycle parts and helmet liners

PRIORITIES FOR 2024

1. Database of developed raw materials for AM
2. Prototype products of multiple material AM
3. Raw materials for AM
4. Minimally-invasive surgical devices
5. Database of developed raw materials for 3DCP
6. Solar water evaporation for clean water production from sea and wastewater for inland and remote communities (porous membranes –polymer, support layer for biomass materials system)

PRIORITIES FOR 2025

1. Solar-photovoltaic integrated membrane distillation for water purification (active system with pumps using hydrophobic membranes)
2. 3D-printed skin for burn patients
   Database/mapping of available equipment in fablabs/centers nationwide
3. Upgrading of local printers, laser-based localized printers

PRIORITIES FOR 2026

1. Inkjet printing for membrane modification (nanofiltration membrane)

PRIORITIES FOR 2027

1. Actual application of 3DCP in construction projects
2. Conduct of impact study of the success in adoption of AM in construction
3. Comparative assessment of 3DCP to traditional and modular construction methods used locally
4. 3D-printed membranes for electrochemical energy systems (fuel cells, electrolyzers, batteries)
5. 3D printing of health food for personalized nutrition
6. Locally-established biomedical industry –biomedical instruments and implants

PRIORITIES FOR 2028

1. 3D Holographic Printing
2. 3D Bio-Printing
3. 3D Ultrasonic Printing
4. Cold Forming
5. DNA Nanoscience
6. Extreme UV Lithography
7. Screen Printing

PROPOSED BUDGET FOR ADDITIVE MANUFACTURING (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
171.25 M	171.25 M	171.25 M	171.25 M	40 M	40 M	40 M

B. ADVANCED MATERIALS

The sectors of Advanced Materials, Nanotechnology and Photonics are all intermediate sectors, which means that their value is as input or enablers in the industry and will not be for immediate consumption by ordinary users. Thus, these sectors cannot be treated in the same way as other technologies, which are mainly product-based and therefore easier to transition towards commercialization.

From 2017 to 2022, the major accomplishments of the agenda include the design guideline using finite element analysis for semiconductor packages and expansion of the advanced device and materials testing laboratory towards long term competitiveness and sustainability of the semiconductor, electronics and other related industries towards Industry 4.0.

PRIORITIES FOR 2023

1. Development of smart materials for biodegradable packaging and anti-corrosion coatings
2. Deployment for energy generation and storage
3. Development of composite super capacitors from conductive polymer and nano metal-oxide composites

PRIORITIES FOR 2024

1. Adoption of advanced materials such as intermetallics, nanoclays and smart fibers
2. Flexible solid-state and composite supercapacitors for electronics manufacturing

PRIORITIES FOR 2025

1. Graphene based sensors for smart phone;
2. Ultrasound/Piezoelectric Micromachined Ultrasonic Transducers (PMUT) for automobile industry (for hand gesture recognition, vehicle)
3. Sensors for harsh environment: Gallium oxides, nitrides, silicon carbides
4. Chemical and biosensors for occupational health and environmental monitoring
5. Rapid disease diagnostics and enhancement of plant's capacity to absorb nutrients for agriculture and food industry

PRIORITIES FOR 2026

1. Aerogels
2. Atomic Knots
3. Bio-Materials
4. Bio-Mineralisation
5. Digital Metamaterials
6. Infinitely Recyclable Plastics
7. Living Materials
8. Metal Organic Frameworks
9. Metalenses
10. Polymorphic Liquid Metals
11. Programmable Matter
12. Reprogrammable Inks/Materials
13. Reactive Materials
14. Room Temperature Superconductors
15. Shape Changing Materials
16. Shape Memory Alloys
17. Sound Membranes Super Alloys

PRIORITIES FOR 2027

1. Bio-Ceramics
2. Bio-Compatible Materials
3. Bio-Glass
4. Bio-Inks
5. Bio-Plastics
6. Carbon Fixing Materials
7. Embedded Logic Materials Hydrogels
8. Liquid Armour
9. Liquid Magnets
10. Liquid Metal
11. Thermo Bimetals
12. Thermoplastic Polyurethane
13. Transparent Alumina

PROPOSED BUDGET FOR ADVANCED MATERIALS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
100 M	100 M	100 M	100 M	100 M	100 M	100 M

C. MATERIALS FOR ENERGY

Electrical energy storage (EES) systems constitute an essential element in the development of sustainable energy technologies. Electrical energy generated from renewable resources such as solar radiation or wind provides great potential to meet our energy needs in a sustainable manner. However, these renewable energy technologies generate electricity intermittently and thus require efficient and reliable electrical energy storage methods. For commercial and residential end-use, electricity must be reliably available at any time of the day. Second-to-second fluctuations can cause major disruptions at huge costs annually. Thus, the development of new EES systems will be critical in in electricity generation. Moreover, greatly improved EES systems are required to enable the widespread use of hybrid electrical vehicles (HEV), plug-in hybrids, and all-electric vehicles. Improvements in EES performance, reliability, and efficiency are needed in the development of modern portable electronic devices such as laptops and smart phones. Metal-ion batteries and supercapacitors, as well as fuel cells, are also playing an important part in our modern lives and have been commercially used as portable and stationary power sources for electronic devices.

PRIORITIES FOR 2023

1. Design and development of components: electrode, flow field, electrocatalysts, electrolyte, ionomer, membrane, hydrogen and liquid fuels, catalyst support
2. Platinum-free (Pt-free) and metal-free catalysts
3. Reduction of Frictional Losses/Cost Reduction of Flywheel
4. New catalyst with low overpotentials for oxygen reduction to make the system more efficient, cost effective, and bifunctional
5. Air electrodes with high electrochemical activity and lower polarization/resistance
6. Low-cost organometallic catalysis for air electrodes

PRIORITIES FOR 2024

1. Development of energy storage devices
2. Hybrid capacitors (composite hybrids and battery type)
3. Advanced technologies on Lead-acid and Lithium-ion (Li-ion)
4. Mobile energy source (wearables, ambient energy harvester)

PRIORITIES FOR 2025

1. Fabrication and testing of single cell, fuel cell, electrolyser, metal-air battery
2. Upscale production of components
3. Design and integration of fuel stack
4. Development of non-aqueous flow battery systems with wider cell operating voltages to improve efficiency

PRIORITIES FOR 2026

1. Upscale production of components; Design and integration of fuel stack

PRIORITIES FOR 2027

1. Development of Smart Energy Systems

PRIORITIES FOR 2028

1. Post Li-ion batteries (multivalent element, Sodium-ion (Na-ion) batteries, solid-state batteries)
2. Post silicon semiconductor substrates including silicon carbide (SiC) and Gallium Nitride (GAN)

PROPOSED BUDGET MATERIALS FOR ENERGY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
100 M	100 M	100 M	100 M	100 M	100 M	100 M

D. NANOTECHNOLOGY

The priorities for Advanced Materials and Nanotechnology define the path at which its unique potentials can be harnessed to enable various applications in industries such as semiconductor and electronics, food and agriculture, smart energy systems, among others. It lays out innovative plan to integrate all the resources and efforts to boost the country's competitiveness in the sector.

From 2017 to 2022, the major accomplishments of the agenda include the development of nanofibrous scaffolds from natural fibers as platforms for stem cell growth and differentiation natural fiber natural biomaterials for tissue engineering and cancel stem cell culture. Natural kapok fibers were used for water and wastewater treatment and for energy applications. While physical properties of metal oxide single nanowires and nanoparticles for bionanosensing were also studied. Environmental, health and safety research in the risk assessment of nanomaterials was also supported.

PRIORITIES FOR 2023

1. Coatings of nanomaterials for lightweight and strength applications
2. Smart packaging
3. Strong and light-weight materials from nanocomposites, nanocement, magnesium-alloys, etc.
4. Nanodelivery – Applications
5. Nanosensors – Applications
6. Nanodiagnostic devices
7. Nanotech-enabled solutions addressing climate change (e.g. more efficient materials—light harvesting coatings, green technology, etc.)
8. Nanodevice fabrication for drug delivery and diagnostics (nanobots)
9. Agricultural detection of pathogens, pesticide residues and determination of crop quality

PRIORITIES FOR 2024

1. Nanofabrication techniques for electronics and materials manufacturing (NEMS, memory
   tech, blow spinning)

2. Adoption of advanced materials such as intermetallics, nanoclays and smart fibers

PRIORITIES FOR 2025

1. Nanofabrication techniques for electronics and materials manufacturing (NEMS, memory tech, blow spinning)
2. Adoption of advanced materials such as intermetallics, nanoclays and smart fibers
3. Development of nanostructured materials for efficient energy conversion and storage devices
4. Development of smart energy systems (nano engineering of highly efficient conductors and superconductors)
5. Development of nanostructured aerogels (applications in insulation, energy and environment)
6. Graphene R&D
7. Nano-photonic materials

PRIORITIES FOR 2026

1. Development of nanogenerators
2. Development of blue nanotech (development of blue nanomaterials, applications in consumer electronics, Carbon dioxide (CO_2) to Carbon nanotubes conversion)
3. Nano Biomimicry (applications on wave and tidal energy, sensing, bioluminescent household and street lighting)
4. Nanomaterials for efficient energy conversion and storage devices (hydrogen energy storage, solar energy conversion)
5. Deployment of smart energy systems (nano engineering of highly efficient conductors and superconductors)
6. Development of nanostructured aerogels (applications in insulation, energy and environment)
7. Graphene R&D (applications in flexible electronics, solar energy, sensors, bioimaging)
8. Nano-photonic materials

PRIORITIES FOR 2027

1. Assembly and deployment of Nanogenerators
2. Blue nanotech systems (development of blue nanomaterials, applications in consumer electronics, CO_2 to carbon nanotubes conversion)
3. Nano Biomimicry (applications on wave and tidal energy, sensing, bioluminescent household and street lighting)
4. Graphene-enabled consumer products (solar panels, flexible displays, sensors, imaging devices)

PRIORITIES FOR 2028

1. Convergence of Nanotechnology and Big Data analysis
2. Graphene-enabled consumer products (solar panels, flexible displays, sensors, imaging devices)

PROPOSED BUDGET FOR NANOTECHNOLOGY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
187.5 M	187.5 M	187.5 M	187.5 M	150 M	150 M	150 M

E. OPTICS AND PHOTONICS

Photonics is the physical science of light (photon) generation, detection, and manipulation through emission, transmission, modulation, signal processing, switching, application and detection/sensing. Photonics technology detects light emission, then converts lights into electric signals through integrated fiber optics. The global photonics market has reached more than $600 billion and is continually growing. Countries such as Europe, United States, China, Singapore and Taiwan have heavily invested in photonics to further their economic development through science and technology. Given its current local capacity, the Philippines can benefit from the use of photonics. Our primary industries in agriculture, manufacturing and services as well as public goods such as utilities, environment and healthcare have photonics applications.

From 2017 to 2022, the major accomplishments of the agenda include the development of novel materials as emitters and detectors for (sub)-terahertz time-domain spectroscopy carrier dynamic studies and; development of Intelligent Data Analysis System (IDAS) for drug trafficking investigation in the Philippines with application of predictive data analytics on multivariate analysis of Methamphetamine-HCL chemical fingerprint and stability assessment.

PRIORITIES FOR 2023

1. Photonic integrated circuits terahertz (THz) spectroscopy, devices and applications
2. Laser specific materials development
3. Adjusted light for urban farming (Special light-emitting diodes (LEDs), ultraviolet (UV) LEDS), Optical metrology
4. Manufacturing: light sources from indigenous materials, space division multiplexing, Neutron imaging and far-infrared radiation (FIR) imaging for wear and tear testing

PRIORITIES FOR 2024

1. Delivery of Information: Optical Fiber Networks, Optical Wireless Access, Optical cross-connects
2. Imaging: Photodetectors, photosensors, ranging, visual sights, periscopes
3. Information Processing: Optical Field Programmable Gate Arrays
4. Manufacturing: photolithography, optical amplifiers, holographic interferometry, neutron scattering

PRIORITIES FOR 2025

1. Imaging: Beam shaping (besselbeam)
2. Information Processing: Photonic neural networks; Ultra dynamic photonic devices, Optical packet switching;
3. Photonic Integrated Circuits, Monolithic Integration Manufacturing: materials synthesis through high flux radiation, solar cells with nanostructures for solar power harvesting

PRIORITIES FOR 2026

1. Light Fidelity (LiFi), optical beamforming and steering, analog radio over fiber
2. Imaging and Image Processing, THz imaging, Nuclear Imaging

PRIORITIES FOR 2027

1. Laser beam distribution, parallelized beam sources, laser beam sources (diode, solid state, high-energy), beam guidance, beam shaping, optimization by multi-space algorithms
2. Nuclear Science applications
3. Aerospace instrumentation

PRIORITIES FOR 2028

1. Information Processing: Quantum communication, computing, and cryptography
2. Neuromorphic photonics
3. Nuclear Science applications

PROPOSED BUDGET FOR OPTICS AND PHOTONICS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
110 M	110 M	110 M	110 M	40.33 M	40.33 M	40.33 M

F. ELECTRONICS INDUSTRY

The Philippine electronics industry is the largest contributor to the country's manufacturing sector. The potential for the industry remains high as local firms intend to move to higher value-added manufacturing to meet global demand. According to the Semiconductors and Electronics Industries in the Philippines Foundation Inc. (SEIPI), member companies plan to improve current production capacities, to expand current research and development and design capabilities, and to further develop the labor force over the next several years. To support this, the industry recommends that the government shall continue with its programs in improving the country's business environment, conducting R&D capability development, and aggressively promoting local industries and SMEs. Hence, PCIEERD plan was crafted in support of achieving the vision of carving a niche in the global electronics market, building a "Made in the Philippines" brand that will capture market opportunities among end-product manufacturers and end-users.

The main objective is to support R&D projects in electronics industry particularly in integrated circuit design, robotics, consumer electronics, and medical electronics.

From 2017-2022, major accomplishments of the agenda include the integrated circuits program, development of bomb removal automated vehicle, and establishment of the Electronics Product Development Center (EPDC) and Electronics Product Inclusive Innovation Center (EPIIC).

PRIORITIES FOR 2023

1. Establishment of Center for Integrated Circuits and Devices Research
2. Development of reconfigurable, self-healing, batteryless electronics
3. Adoption of device architecture for CMOS (fully depleted Silicon on insulator (FDSOI))
4. Prototyping of integrated and intelligent sensors and actuators

PRIORITIES FOR 2024

1. Establishment of Wafer Fabrication Laboratory
2. Development of flexible and paper-based electronics
3. Advancement in dynamic random-access memory (DRAM) and Flash memory tech
4. Adoption of device architecture for CMOS (fin field-effect transistor (FinFET))
5. Development of smart wearables
6. Development of advanced driver assistance systems

PRIORITIES FOR 2025

1. Prototyping of collaborative robots and implementation of robot-as-a-service
2. Prototyping of digital and handheld medical devices
3. Development of advanced sensors (biomimetic, hyperspectral)

PRIORITIES FOR 2026

1. Development of biological and biocompatible electronics
2. Development of prototypical non-volatile memory devices (NVM) (Ferroelectric random-access memory (FeRAM), Magnetoresistive RAM (MRAM), Phase change RAM (PCRAM), Resistive RAM (ReRAM)
3. Adoption of device architecture for CMOS (Carbon nanotube field-effect transistor (CNT FET), Tunneling field-effect transistor (TFET), two-dimensional channel field-effect transistor (2D Channel FET))
4. Development of local smart phones, smart batteries, and EV chargers

PRIORITIES FOR 2027

1. Prototyping of robots (micro, swarm, exo-suits, general)
2. Prototyping of electronic components for autonomous vehicles
3. Development of advanced sensors (event-based, nano, lenseless)

PRIORITIES FOR 2028

1. Development of liquid, transparent, transient, edible, and epidermal electronics
2. Development of emerging NVM (Oxide-based Resistive RAM (OxRAM), conducting bridge-based RAM (CBRAM), Polymer, Mott, and DNA-based massive storage devices)
3. Adoption of device architecture for CMOS (Gate-all-around nanowire field-effect transistor (GAA-NW FET))
4. Development of Beyond-CMOS devices for More-than-Moore Applications including physically unclonable functions (PUFs) and random number generators (RNGs)
5. Prototyping of robots (soft, inflatable, shape shifting, molecular, bio-hybrid, and evolutionary)
6. Development of advanced sensors (smart dust, sensor fusion, quantum, and living)

PROPOSED BUDGET FOR ELECTRONICS INDUSTRY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
20 M	300 M	500 M	200 M	400 M	350 M	300 M

G. ICT INNOVATIONS

Information and communication technologies (ICT) are key enablers of innovation and encompass a broader array of activities. The overall strategies outlined in the roadmap are fundamentals in attaining the Networked Society. The key technology trends or R&D solutions that will stimulate innovations within the ICT industry in the coming years will create new value streams for consumers, government, industry and society. A technology-enabled ecosystem made possible through a universal, horizontal and multipurpose communications platform.

The R&D technologies in ICT Innovations combined with the next generation of networks such as 5G provide support to IoT, creation of cyber driver dynamic content, retrieval and analysis, among other applications.

5G is a revolutionary technology envisioned that will eliminate the bounds of access, bandwidth, performance, and latency limitations on connectivity worldwide. 5G has the potential to enable fundamentally new applications, industries, and business models and dramatically improve quality of life around the world via unprecedented use cases that require high data-rate instantaneous communications, low latency, and massive connectivity for new applications for mobile, eHealth, autonomous vehicles, smart cities, smart homes, and the IoT (https://futurenetworks.ieee.org/).

PRIORITIES FOR 2023

1. Cloud Computing
2. Data Centers
3. Hybrid cloud infrastructure
4. Data fabric
5. Graph databases
6. Internet of Things
7. Wireless networks
8. Sensors and actuators
9. Smart electronics
10. Smart meters and grids
11. Cyber Resilience/Cyber Security

PRIORITIES FOR 2024

1. 5th Generation (5G)/6th Generation (6G) Technology
2. Orthogonal frequency-division multiplexing (OFDM)
3. 5G new radio (NR) air interface
4. Bandwidth technologies (sub-6 GHz and mm-Wave)
5. Fiber Optic Technology

PRIORITIES FOR 2025 – 2026

1. Orbital angular momentum multiplexing (nanophotonics)
2. Radio over fiber upgrades
3. Satellite Communication Bands

PRIORITIES FOR 2027

1. Establishment of a 5G/6G ecosystem innovation center
2. Development of new technologies for use of higher bandwidths (Ku-, K-, Ka-bands)

PRIORITIES FOR 2028

1. Development of a single core (nanocore) wireless mobile communication service

PROPOSED BUDGET FOR ICT INNOVATIONS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
9.75 M	9.75 M	9.75 M	9.75 M	75 M	75 M	75 M

H. INDUSTRY 4.0

Industry 4.0 requires the convergence, interoperability, and connectivity of various emerging technologies including 3D printing, AI, Internet of Things, Cloud Computing, Augmented Reality, Blockchain, and many others. Industry 4.0 does not just involve smart factories and manufacturing, it also includes the concept of smart city and society with people at its center. However, the implementation of Industry 4.0 is difficult because of the numerous aspects that compose it. Not only must factories and cities adopt modern technologies, but people need to also be trained and prepared to use these technologies. All this would require new and updated policies to handle cybersecurity, IP, and education issues. To address these issues, the plan for Industry 4.0 by focuses on three key elements: Connectivity, interoperability, and convergence.

PRIORITIES FOR 2023

1. Sensors and actuators
2. Systems for degradation, performance, and predictive maintenance
3. Systems for shop floor connectivity, automation, and intelligence
4. Architecture Analytics and intelligence
5. Connectivity, Data and Cybersecurity
6. Integrated simulation and synthesis

PRIORITIES FOR 2024

1. Establishment of an Industry 4.0 Demo Lab/Factory
2. Product life cycle study
3. Integration of vertical and horizontal value chains
4. Development of the asset administration shell (AAS) as the interface of the digital and real machines
5. Development of generic cloud-based Manufacturing Execution System (MES) for smart manufacturing
6. Development of Supervisory, Control and Data Acquisition (SCADA) or automation system that can connect factory equipment
7. Development of modules on SCADA to accelerate connectivity and automation
8. Develop digital transformation model for electronics industry companies

PRIORITIES FOR 2025

1. Industry 4.0 demo lab

2. AAS applications
3. MES for smart manufacturing
4. SCADA or automation system
5. Digital transformation model

PRIORITIES FOR 2026

1. Process visualization through augmented reality (AR)/virtual reality (VR)
2. Development of cyber-physical production systems
3. Development of networked production and collaborative diagnostics and decision-making

PRIORITIES FOR 2027 – 2028

1. Advanced production processes utilizing AR/VR
2. Industry 4.0 Architecture adoption for pilot factories in the regions
3. High-level Cyber-Physical Production Systems
4. Self-configuring, self-adjusting, self-optimizing systems
5. Intelligent Applications AI for industrial design Information Processing

PROPOSED BUDGET FOR INDUSTRY 4.0 (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
50 M	50 M	200 M	50 M	300 M	300 M	350 M

I. QUANTUM TECHNOLOGY

Quantum Technology is an emerging field that has caught the attention of many different nations due to its potential to revolutionise the current technologies we enjoy today. PCIEERD aims to jumpstart and sustain Quantum Technology Research and Development in the Philippines to be able to utilize and benefit from its wide-range applications when the field matures enough for practical use. As evident in the roadmap of Quantum Technology, the mid to long-term goal of PCIEERD is the eventual establishment of the *Quantum Innovation Laboratory*. This facility will merge a wide range of scientific and engineering fields and will serve as a center of excellence in Quantum Technology of the Philippines.

PRIORITIES FOR 2023

1. Quantum Circuit Simulation (high-performance computing (HPC))
2. Capacity Building of Local Scientists by Core Group

PRIORITIES FOR 2024

1. Establishment of Quantum Tech R&D Center
2. Establish a connectivity infrastructure for remote Quantum Computer
3. Development of quantum processor architectures
4. Creating experimental platforms for quantum simulation

PRIORITIES FOR 2025

1. Establishment of a Design, Fabrication, and Characterization Facility for materials

2. Prototyping of quantum memory storage device, quantum repeater, quantum random number generator, quantum simulators, and quantum-enhanced sensors

PRIORITIES FOR 2026

1. Development of algorithms for quantum networks
2. Application of quantum cryptography
3. Implementation of error-corrected logical qubits with fault-tolerant gates

PRIORITIES FOR 2027

1. Development of quantum key distribution system
2. Design and prototyping of a local quantum computer
3. Development of verification tools for quantum simulators

PRIORITIES FOR 2028

1. Expansion of metrology for quantum communication and sensing
2. Development of satellites and high-altitude platform stations
3. Development of quantum software and quantum web
4. Development of protocols and standards

PROPOSED BUDGET FOR QUANTUM TECHNOLOGY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
20 M	30 M	50 M	100 M	150 M	300 M	200 M

J. SMART CITIES

The Department of Science and Technology aims to address challenges of urban and regional life in cities through the use of science, technology and innovation to enhance opportunities and address challenges relating to sustainable urban development against disasters.

The DOST Smart and Sustainable Communities and Cities Framework aims to enhance research collaboration and to fund excellent research with lasting impact. The specific objective is to fully exploit the potential of the regions talent pool and maximize the benefits of an innovation- led economy with the following perspectives:

- Integration of different dimensions of urban sustainability in the framework of the UN Sustainable Development Goals.
- Co-production - a way to extend research activities to bridge gaps between knowledge, understanding, and action

PRIORITIES FOR 2023

1. Creation of Digital twin
2. Big Data, Data Mining, and Data Analytics
3. Service delivery optimization
4. Smart surveillance
5. Public sensor networks for situation monitoring
6. Multi-dimensional data correlation

PRIORITIES FOR 2024

1. Integrated simulation and synthesis
2. Remote management
3. Internet of Things and Smart Systems
4. Collaborative diagnostics and decision-making
5. Smart grids
6. Decision intelligence
7. Prescriptive Analytics
8. Multi-dimensional data correlation
9. Earth Observation (EO) solutions in public services

PRIORITIES FOR 2025

1. Smart grids
2. Decision intelligence
3. Prescriptive Analytics
4. Multi-dimensional data correlation
5. EO solutions in public services

PRIORITIES FOR 2026

1. Decision intelligence
2. Prescriptive Analytics
3. Recommender systems
4. Financial securities recommendations
5. Intelligent Applications
6. Image and Video Recognition
7. Situation interpretation through heterogeneous sensors

PROPOSED BUDGET FOR SMART CITIES (2022 – 2026)

2022	2023	2024	2025	2026
20 M	50 M	100 M	150 M	150 M

K. ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is one of the most prominent technologies nowadays and emerging its way to solve the problems of today with Information and Communications Technology (ICT) providing the infrastructure needed to support it.

AI is tagged as one of the important technologies that will usher the country to the fourth industrial revolution. Although considered as powerful agent for good, AI can also disrupt traditional business models and processes, thereby making it a threat. In order to maximize the benefits of AI, there is a need to develop the country's capability in this area.

In the 2019 Asia Pacific AI Readiness Index Report, the Philippines earned an overall readiness score of 44.2 out of a hundred, ranking sixth among other countries including Singapore, Hong Kong, India, Malaysia, Thailand, and Indonesia.

To start with the goal of building a community of skilled experts that can increase the country's global competitiveness in the field, PCIEERD initiated its series of training courses

on data science, machine learning, deep learning, and AI in general. This was done in partnership with MOOCs PH, Coursera, Google Philippines, Thinking Machines, Inc. and the PCIEERD AI Board of experts. To date, two (2) AI R&D projects were completed and twelve (12) more are being supported by DOST and PCIEERD. Some of which include the capability building in Artificial Intelligence (AI) through training and acquisition of High Performance Computing (HPC) device; enhancement of man-machine interaction through intelligent conversational agents; development of autonomous societally-inspired mission oriented vehicles; automated labelling machines and; other AI mission-oriented applications to help address pressing national problems like marine litter and traffic.

With a roadmap that emphasizes allocation for basic research with industry-driven approach, researchers would be better guided and organized as to where their research will be directed and eventually used.

PRIORITIES FOR 2023

1. Recommender systems
2. Financial securities recommendations Intelligent Applications
3. Image and Video Recognition
4. Situation interpretation through heterogeneous sensors

PRIORITIES FOR 2024

1. Reinforcement learning
2. Supervised, Unsupervised Learning
3. Cognitive Computing

PRIORITIES FOR 2025

1. Cognitive Computing – advanced intelligent applications such as virtual assistants and smart robots
2. Artificial General Intelligence

PRIORITIES FOR 2026

1. Artificial Narrow Intelligence
2. Creative Machines
3. Diffractive Neural Networks
4. Technologies on data privacy and security
5. Cyber Defense Build-up

PRIORITIES FOR 2027 – 2028

1. Artificial Super Intelligence
2. Simulation Engines
3. Swarm Artificial Intelligence
4. Quantum Deep Learning
5. Smart Data

PROPOSED BUDGET FOR ARTIFICIAL INTELLIGENCE (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
110 M	110 M	110 M	110 M	403.33 M	403.33 M	403.33 M

L. CREATIVE INDUSTRIES

Creative Industries are considered as one of the fastest growing sectors in the global economy, which contribute significantly to Gross Domestic Product (GDP) of developed countries. The Philippines is among the developing countries with rich cultural heritage and pool of creative talents that can potentially boost the economy through its creative goods. The country has the potential to be a creative hub in Asia through developing the different creative industries including the game, animation, and film.

In 2021, the Philippines ranks 65th among the 132 economies featured in the Global Innovation Index in terms of creative outputs. To improve the ranking in this pillar, innovation investments must be effectively translated into more and higher-quality creative outputs including intangible assets, creative goods and services, and online creativity. To achieve this, the Council will support applied research and development projects that will address pressing concerns and strengthen the current capabilities of the local creative industries, particularly the footwear, furniture, game, animation, and film cluster. This is to finally achieve the vision of making the country the top creative economy in ASEAN in terms of size and value driving competitiveness and attractiveness of the local creative talent and content in the international market.

From 2017-2022, major accomplishments of the agenda include the development of a community-built, mobile phone-based online web dictionary for Philippine languages; conduct of industry-defined 2D basic animation course; development of android / web-based student response and understanding visualizer, Philippine Indigenous Instrument Sounds Database, Philippine music instrument sample database, and original content development for animation.

FUNCTIONAL AND AESTHETIC CREATIONS: FOOTWEAR

PRIORITIES FOR 2023 – 2025

1. Sustainable Textiles for Footwear Applications
2. Filipino Fit and Sizing

PRIORITIES FOR 2023 – 2028

1. 3D application technologies for Footwear Creative Machines

PRIORITIES FOR 2024 – 2028

1. AI-based solutions for Footwear
    a. IoT-enabled technologies
    b. Software and tools for Design
2. Specialized Footwear Design and Technologies

PRIORITIES FOR 2025 – 2028

1. Prosthetics for Asian Fit

PRIORITIES FOR 2026 – 2028

1. Sustainable local materials for footwear applications
2. Local Materials for adaptive clothing/footwear technologies
3. Smart Shoe Design
4. Creative Design for Industry 5.0

PROPOSED BUDGET FOR CREATIVE INDUSTRIES: FOOTWEAR (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
43 M	132 M	40 M	15 M	20 M	25 M	30 M

FUNCTIONAL AND AESTHETIC CREATIONS: FURNITURE

PRIORITIES FOR 2023 – 2025

1. Sustainable Local Materials from Wood/Non-Wood
2. Asian-based ergonomic design furniture

PRIORITIES FOR 2023 – 2028

1. 3D application technologies for furniture products and parts

PRIORITIES FOR 2024 – 2026

1. Specialized Furniture for the New Normal

PRIORITIES FOR 2024 – 2027

1. Green and smart furniture technologies

PRIORITIES FOR 2024 – 2028

1. AI-based solutions for Furniture Design
    a. IoT-enabled technologies
    b. Software and tools for Design and Makers

PRIORITIES FOR 2025 – 2028

1. Woodcarving technologies for furniture applications and unique/new designs for furniture

PRIORITIES FOR 2026 – 2028

1. Sustainable local natural materials and design for furniture applications
2. R&D on Sustainable and Biodegradable Packaging Materials
3. Asian-based ergonomic design furniture

PROPOSED BUDGET FOR FUNCTIONAL AND AESTHETIC CREATIONS: FURNITURE (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
10 M	86 M	20 M	30 M	20 M	10 M	30 M

CREATIVE INDUSTRIES: GAME, ANIMATION AND FILM

PRIORITIES FOR 2023

1. Establishment of "Pugad Sining"/Creative Innovation Hub for Graphics Design, Motion Capture, and Audio Post-Production
2. Development of serious games and gamification apps for tertiary education, and corporate sector
3. Development of proprietary software and software/platform-as-a-service
4. Development of algorithmic video editing
5. Automatic music generation and AI-assisted sound engineering

PRIORITIES FOR 2024

1. Establishment of Extended Reality Laboratory
2. Industry-defined training on game theory and game design
3. Advancement in human-to-computer interfaces
4. Utilization of extended reality in mobile gaming applications

PRIORITIES FOR 2025

1. Establishment of Interactive Moviemaking Facility
2. Development of interactive moviemaking technology

PRIORITIES FOR 2026

1. Capability and capacity building to produce hardware prototypes
2. Prototyping of advanced gaming devices and animation tools

PRIORITIES FOR 2027

1. Prototyping of advanced hardware for animation and film development

PRIORITIES FOR 2028

1. Intelligent screenplay writing
2. Development of autonomous drone cinematography system
3. Development of policy on blockchain
4. Application of blockchain in gaming industry
5. Establishment of Holographic Environment Simulator
6. Establishment of a creative city for game, animation, and film

PROPOSED BUDGET FOR CREATIVE INDUSTRIES: GAME, ANIMATION AND FILM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
70 M	150 M	150 M	150 M	150 M	150 M	150 M

M. SPACE TECHNOLOGY APPLICATIONS (STA)

In the Philippines, the space sector operates predominantly in contribution to local disaster risk management (DRM) and environmental management projects.

In the past years, DOST and PCIEERD funded various STA projects for disaster preparedness and mitigation, resources assessment (agriculture, coastal, forest, watersheds, and renewable energy), drought and crop assessment and forecasting to help mandated agencies in delivering key services for the Filipino people.

From 2017-2022, the major accomplishments of the agenda are as follows:

- Flood Risk Assessment and Mitigation thru Engineering Response (FRAMER) of Riverine Town in Selected Riverbasins in Cavite, Batangas and Quezon provinces using most recent DEM such as LIDAR and IFSAR
- Coastal Sea Level Rise in the Philippines (CSLR-Phil)
- Geospatial Assessment and Modelling of Urban Heat Islands in Philippine Cities (Project GUHeat)
- Remote Sensing and Data Science (DATOS) Help Desk
- Geospatial Monitoring System for High Value Projects funded by DBM
  - DIME Project 1. Monitoring and Assessment of Planting Activities (MAPA)
  - DIME Project 2. Geospatial Monitoring System for National and Communal Irrigation Systems (NCIS)
- Synthetic Aperture Radar (SAR) and Automatic Identification System (AIS) for Innovative Terrestrial Monitoring and Maritime Surveillance (SAR+AIS)
- STAMINA4SPACE Project 1. Optical Payload Technology In-depth Knowledge Acquisition and Localization (OPTIKAL)
- STAMINA4SPACE Project 2. Building PHL-50: Localizing the Diwata-1 and Diwata-2 Bus System as the Country's Space Heritage 50kg Microsatellite Bus
- STAMINA4SPACE Project 4. Ground Receiving Archiving, Science Product Development and Distribution (GRASPED) for the STAMINA4Space Program
- S4CP NICER Program: Center for Astronomy Research and Development: Astronomical Near Earth Observation Light Pollution (ANEO-LiPo)
- S4CP NICER Program: Establishment of Niche Center on Environmental Informatics for Central Visayas

Given the country’s current capability and with the availability of satellite data from various subscriptions and from our own DIWATA and MAYA satellites, the plan seeks to address different issues through the use of data towards improvement of public service delivery.

Although much remains to be done in an inherently long-term endeavor such as space technology development, significant groundwork and momentum has been realized. These concrete advances and material progress on the ground have contributed fuel and substance to the creation and establishment of the Philippine Space Agency (PhilSA) which was passed into law on August 8, 2019 as Republic Act No. 11363 or the Philippine Space Act. It stipulates that the Philippine Space Development and Utilization Policy “will embody the country’s central goal of becoming a space-capable and space-faring nation within the next decade” through the establishment of “capacity building measure for human resources development”.

PRIORITIES FOR 2023

1. Downstream segment
    a. Development of Earth Observation (EO) solutions for Public Services
        - Land use/land cover change mapping and monitoring system of watershed and ecosystems
        - EO solutions for implementation of precision agriculture (e.g. site-crop suitability, suitability, crop monitoring and yield, pest detection and disease management, nutrient management, irrigation, soil management) (2023-2024)
        - Landscape generator and Land use/land cover scenario modeler for urban development and sustainable land use and transportation policies
        - Climate monitoring
        - Ocean and Climate Change
    b. Development of applications using other various available satellite data (e.g. Jason, Sentinel-4, Suomi, MODIS – Aqua and Terra, Hyperspectral EO, Landsat-9, etc.)
    c. Development of EO Data Cubes for Big Data Analytics and Management of EO data (2023-2027)
    d. Development of EO Application Products from the Open Data Cube addressing Sustainable Development Goals and contributing to Global Policy Frameworks (2023 - 2026)
    e. Establishment of Web-based or cloud computing services for big data EO analytics (2023 - 2025)
    f. Complementation of various remote sensing technologies to be used for indoor and underground applications (2023 - 2024)
2. Upstream segment
    a. Development of next generation of experimental 50-100kg satellite (e.g. DIWATA-3) (2023 - 2024)
    b. Development of Operational application-specific 100-300 kg satellite: - Infrared and Video Imaging satellite - Microwave satellite (Synthetic Aperture Radar) (2023 - 2025)
    c. Establishment of testing simulation facility (2023 - 2024)

PRIORITIES FOR 2024

1. Downstream segment
    a. Development of thematic applications for EO Data Cubes (2024 - 2026)
    b. 3D Mapping for Smart Cities
    c. EO-based Smart City Decision Support Services
    d. Development of application for single-photon Light Detection and Ranging (LiDAR) (the next generation of LiDAR technology for 3D mapping) (2024 - 2026)
    e. Development of Global Navigation Satellite System (GNSS)-based indoor location technologies (e.g. High-sensitivity Global Positioning System (GPS), Assisted GPS, Indoor GPS tracking) (2024-2026)
    f. Develop application from hyperspectral imaging
    g. Conduct of research on small satellite subsystem or components for various applications (e.g. M2M/IoT enabled satellite, AI for onboard systems) (2024-2025)
    h. Broaden the data access and processing, and small satellite development (including manufacture, assembly, integration, and testing) capabilities to regional universities, research institutions, and local industry through R&D

i. Development of laboratory-based and/or ground-based Synthetic Aperture Radar (SAR) to establish the system focusing on phase array antenna and signal processing of SAR.

2. Upstream segment
   a. Development of 3 Units/6 Units (3U/6U) nanosatellites
   b. Know-how of small geostationary communication satellite

PRIORITIES FOR 2025

1. Upstream segment
   a. Research on Small satellite for IoT applications
   b. Development of mission partnerships for
      - Telecommunication satellite
      - Satellite broadband internet

PRIORITIES FOR 2026 – 2027

1. Upstream segment
   a. Explore the development of launch systems (e.g. smallsat launch vehicles, propulsion systems, attitude and orbit control system (AOCS); and facilities (spaceport/launch sites) (2026-2027)
   b. Graphene for space application (e.g. light-powered propulsion system, thermal management for satellite) (2026-2027)

PRIORITIES FOR 2027

1. Downstream segment
   a. Develop application for space debris monitoring and mitigation (detecting, monitoring and imaging of space debris, systems for space surveillance to alert us to natural and man-made hazards)
2. Upstream segment
   a. Develop operational application-specific 100-300kg satellite: Microwave (SAR)
   b. Development of High-Altitude pseudosatellite (HAPS) as a new platform for telecommunications networks and remote sensing
   a. Research on self-healing materials for space application (e.g. space debris impact protection, spacecraft materials, aerospace application)

PRIORITIES FOR 2028

1. Downstream segment
   a. Development of application for space debris monitoring and mitigation (detecting, monitoring and imaging of space debris, systems for space surveillance to alert us to natural and man-made hazards)
   b. Development of applications for space-based quantum sensing and computing
2. Upstream segment
   a. Development of space-based secure quantum communication (e.g. Quantum computing and communications via nanosatellites)
   b. Research on the development of Solar sails for small satellites

PROPOSED BUDGET FOR SPACE TECHNOLOGY APPLICATIONS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
176.25 M	176.25 M	500 M	765 M	670 M	720 M	450 M

N. TRANSPORTATION

Through series of consultations with the stakeholders, the DOST identified strategies on R&D technologies that aim to alleviate traffic congestion, reduce accidents, reduce fuel consumption and vehicle emissions; and provide safer, efficient movement of people and goods and improve quality of life.

The transport R&D Roadmap has four (4) subsectors: Land, Maritime, Intelligent Transport Systems (ITS) and Logistics and Freight Management in order to address various specific problems per area of concern.

For the Land Transportation Subsector, it aims to provide modernized, energy efficient and safe public utility vehicles (PUVS) through the use of electric vehicles, alternative sources of energy and providing test facilities and standards that will improve the mass transportation systems.

The Maritime Transportation Subsector aims to provide safer, cleaner and efficient maritime transport systems through a collaborative effort with the industry and the national government. Localization of the current fleet in terms of looking for potential raw materials and boat assessment studies that will improve the designs through the use of established modernized facilities.

The ITS subsector acts as the integrating or unifying system for all the subsectors as these cuts across all subsectors by providing integrated and responsive transport systems with the use of ICT, Internet of Vehicles (IOV), camera/sensors, automatic fare collection system, on-board trackers. It applies the use of computer programming and simulation software as decision support tools. The first three (3) subsectors are focused mainly on the movement of the people and services, the newest subsector for transportation.

The Logistics and Freight transportation subsector aims to address the movement of goods through infrastructure support and use of ITS. It aims to provide smart, seamless supply chain network and logistics that contribute to the economic development of the nation by ensuring that accessibility to goods and services in times of natural and man-made crisis or health crisis, there are still means to ensure seamless transport.

PRIORITIES FOR 2023

1. Maritime
    a. Design and development of Marine Autonomous Surface Ship
    b. Pilot localized vessel tracking system for marine protected areas (MPAs)
    c. Maritime Transport Energy Demand Modelling Tools
    d. Prototype hull for municipal fishing vessels
    e. Draft policies on the use of AIS
    f. Draft standards for e-boat
    g. Web based tool for maritime transport
2. Land Public Utility Vehicles (PUVs) and Electric Vehicles (EVs)
    a. Deployment of Flexible Electric Van (FLEV) in Selected LGUS
    b. EVs with Lightweight body architecture
    c. Development of EV Parts and Components Standards (Fast Charging, Battery Cell Degradation, Optimized battery packs)
3. Intelligent Transport System (ITS)
    a. Deployment of on-board IoT devices for PUV drivers
    b. Design road incident detection software

c. Design integrated framework for transport database connectivity
d. Launch the System Optimization and Routing Tool (SORT) app in a pilot city

PRIORITIES FOR 2024

1. Maritime
   a. Efficient cargo monitoring system through an integrated network of terminals and ports
   b. Recycling Index for boats and vessels
   c. Customized Mobile handling logistics vehicle
2. Land (PUVs and EVs)
   a. Craft Business Model for Charging Program
   b. Roll-out optimized fast charging stations with battery management system (BMS) through integrated network
   c. Performance assessment of EVs and other Alternative vehicles
3. ITS
   a. Deployment of Road Incident Detection and Analysis and Reporting (RIDER) software to national agencies
   b. Deployment of ACCRADS: Integrated platform of road accidents to concerned agencies, e.g. Department of Health (DOH), Metro Manila Development Authority (MMDA) and Department of Transportation (DOTr)
4. Logistics
   a. Modelling Tools on assessing the logistics system performance

PRIORITIES FOR 2025

1. Maritime
   a. Design and develop prototype mobile handling mini trucks
   b. Autonomous and interconnected system of cargo trucks
2. Land (PUVs and EVs)
   a. Establishment of Advanced Hybrid Vehicles Research Center
   b. Alternative sources of energy for mass transport systems, i.e. rail
   c. Simulation tools for manufacturing vehicles
3. ITS
   a. Decision support tool for setting up smart intermodal networks
   b. Decision software tool for assessing Critical Transport Infrastructure (CTI)
4. Logistics
   a. Analysis of Transportation and Distribution Mode During Emergency Crisis

PRIORITIES FOR 2026

1. Maritime
   a. Decision support tool for recycling index of boats
   b. Fully Tested Prototype mobile handling mini trucks for cargo
2. Land (PUVs and EVs)
   a. Establishment of Rail Research center
   b. Testing Centers aligned to Philippine National Standards (PNS)
3. ITS
   a. Decision support tool for setting up smart intermodal networks in additional cities
   b. Decision software tool for assessing CTI continuation
4. Logistics
   a. Establishment of suitability index on the mode of transport for logistics support area

PRIORITIES FOR 2027

1. Maritime
   a. Enhanced prototype of mobile handling vehicles
   b. Deployment of prototype handling vehicles
2. Land (PUVs and EVs)
   a. Fully tested advanced transport systems and vehicles
3. ITS
   a. Establishment of Road Safety R&D Center
4. Logistics
   a. Development of specialized logistics products and transport handling vehicles

PRIORITIES FOR 2028

1. Maritime
   a. Near real time decision support tool for sea routing
   b. Algorithm for alternative voyage or sea route (based on boat design and weather conditions)
2. Land (PUVs and EVs)
   a. Hydrogen Fuel Cells Powered Vehicles
   b. Vibrant Public Transport Systems
3. ITS
   a. Establishment of ITS Center
4. Logistics
   a. Development of integrated data recording and archiving systems for logistics
   b. Decision support tool for determining logistics mode per geographical and economic requirements

PROPOSED BUDGET FOR TRANSPORTATION (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
81.1 M	150.1 M	160.1 M	225 M	330 M	195 M	125 M

O. ENERGY

The policy under the RA 9513 or the Renewable Energy Act is geared towards harnessing indigenous and renewable energy resource which can offer clean, abundant, and efficient supply of energy. The Philippines has pushed for rural electrification in the past years. Recently, it has achieved 100% electrification at the village level. At the household level, however, many areas are still unelectrified, including off grid, and unviable areas in parts of Regions 5 (Bicol), 4B (MiMaRoPa) and 8 (Eastern Visayas) and in Mindanao. Several agencies and organizations have developed programs to provide electricity to these areas using mostly renewable energy technologies for rural electrification due to its ability to produce 24-hr electricity, applicability to mountainous, off grid, and GIDA areas and ease of installation and operation. These, however, did not attain sustainability.

Renewable energy development in recent years needs to improve its uptake since developers who choose to invest in RE face many risks, even though the risks in every stage of the project's life cycle and their cost implication have been identified. It is believed that RE projects implemented by private groups would be successful once these risks are effectively managed. Some identified risks associated with RE technology are social, economic, sustainability, technical, supply chain and market problems. Through this

intervention, the program will contribute to the current uptake of the technology via the development and improvement of the local industries to support RE technology development, utilization and application for larger generation capacity, introduction of hybrid RE, microgrid system to off-grid and island community and technology design innovation. Addressing most of the challenges in developing RE systems, specifically in remote communities, is the availability of technology, including equipment and components. Several installed systems in the country rely on importing components from nearby Asian countries. Localization of these components would provide useful in reducing supply chain cost, greater control, and flexibility in dealing with the needs of the technology.

It is expected that the program will push for a more comprehensive policy to support RE in the country.

PRIORITIES FOR 2023

1. Renewable Energy (RE)
    a. Improvement of Local RE facility
    b. Localization of equipment including balance of systems (BOS)
    c. Improvement of energy generation for microgrid applications
    d. Micrositing tools and small wind applications
    e. Design and development of Ocean RE mechanical harvesting devices
2. Energy Efficiency and Conservation
    a. Energy profiling of Philippine MSMEs
    b. Development and demonstration of low carbon technology applications for Philippine MSMEs
3. Energy Storage
    a. Energy storage R&D Facility
    b. Energy Storage Testing Facility

PRIORITIES FOR 2024

1. Renewable Energy
    a. Novel and innovative RE technologies (hydrokinetic turbine, low head low flow application, wind harvesting)
    b. Solar PV facility for certification
    c. Wave energy harvesting system
    d. Development of next generation biofuels
2. Energy Efficiency and Conservation
    a. Next generation Energy efficient tech
3. Energy Storage
    a. Lead Acid Battery life span improvement
    b. Assessment of indigenous materials for energy storage

PRIORITIES FOR 2025

1. Renewable Energy
    a. Offshore platform development for Solar and Wind applications
    b. Hybrid RE system for off/on grid application
    c. Ocean Thermal energy assessment and development
    d. Development of efficient catalyst and conversion system for biofuel
2. Energy Efficiency and Conservation

a. Intelligent/Smart Energy Monitoring, Management and Control
3. Energy Storage
   a. Nickel Iron Battery Development
   b. Energy Storage Grid Integration

PRIORITIES FOR 2026

1. Renewable Energy
   a. Development/Improvement of technologies for hemicellulosic materials for biofuels
   b. Biogas Storage and transport
   c. Design and development of local MHP system for irrigation channel application
   d. Development of efficient catalyst and conversion system for biofuel
2. Microgrid System
   a. Microgrid modelling using suppressed load methods
   b. Novel/next generation microgrid applications
3. Energy Storage
   a. Hydrogen based storage system
   b. Indigenous materials for energy storage

PRIORITIES FOR 2027

1. Renewable Energy
   a. Validation of local resource assessed
   b. Sustainable Local RE Industry
2. Microgrid System
   a. Microgrid systems for urban application
3. Energy Storage
   a. Sustainable Energy Storage Industry

PROPOSED BUDGET FOR ENERGY (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
192.31 M	221.01 M	201.76 M	488 M	418 M	404 M	435 M

P. UTILITIES

CONSTRUCTION

The Philippine construction industry registered a growth of 15.1% in real terms in 2018. The government total spending on infrastructure grew by 49.7% in the first eleven months of 2018, compared to the same period in 2017. It increased from PHP486.5 billion in January-November 2017 to PHP728.1 billion in January-November 2018.

The industry's output value is expected to continue to expand in real terms over the forecast period (2019-2023), driven by the government's plans to upgrade the country's transport infrastructure. It is expected to rise at a compound annual growth rate (CAGR) of 8.60% over the forecast period. The industry is consequently expected to rise from a value of US$44.3 billion in 2018 to US$66.9 billion in 2023, measured at constant 2017 US dollar exchange rates.

The total value of all pipelined construction projects of the country including mega projects stands at PhP19.1 trillion.

The Smart Approach for the Construction Industry program is in support to the country's projects under the construction sector which are aligned with the NEDA Ambisyon 2040 - The Life of All Filipinos: Matatag, Maginhawa at Panatag na Buhay by 2040 and the Philippine Construction Industry Roadmap 2020-2030 with the themed "TATAG at TAPAT". It aims to provide the necessary technological support in the implementation of the Build-Build-Build Infrastructure Project.

WATER RESOURCES MANAGEMENT

The Philippines has an abundant freshwater resource obtained mainly from rainfall, surface water, and groundwater. The average annual rainfall amounts to 2,440 mm, the volume of water in rivers, lakes and reservoirs constitute to 125.4 billion cubic meters, and groundwater has a potential volume of 20.2 billion cubic meters. Theoretically, it is expected that the Philippines should have sufficient water supply. However, due to geography, changing environmental and climatic conditions, high-economic growth, high water demand and insufficient water infrastructure, various localities suffer from insufficient water supply.

Forecast suggests that in 2025, the Philippines will not be able to meet the demand for water supply. More so, the World Resources Institute (WRI) predicted a high degree of water shortage that will be experienced in 2040 with agriculture as the most stressed sector, and Mindanao as the most stressed region. In 2015-2016 alone, the country experienced the most severe El Niño event ever recorded, which affected 16 out of 18 regions – drying nine (9) dams, where six (6) were critical and ten (10) were below normal levels. On the other hand, the recent onslaught of typhoon Ulysses caused severe flooding in Cagayan Valley and demonstrated that the current water infrastructures and disaster management flood control systems cannot satisfactorily cope with extreme conditions. These climate extremes inflict impact on streamflow, dam operation and water allocation, domestic water supply, irrigation, hydro power generation, depth and recharge of aquifers, water quality, and watershed.

To address these issues, S&T solutions for water resource management is needed in accordance with the objectives of the Philippine Development Plan (PDP) 2017-2022, National Climate Change Action Plan (NCCAP) 2011-2028, and aligned with the goals of the proposed national framework for water resource management, department of water resources and water regulatory commission

PRIORITIES FOR 2023

1. Construction
    a. Earthquake Engineering R&D Center
    b. Modular and Cost-effective equipment for assessment, surveying, monitoring and testing
    c. 3D Printer and Application for the Construction Industry
2. Water Resources Management
    a. Comprehensive water resource management
    b. Localized water harvesting and recharge facility

c. Innovative flood defense
d. Water saving technologies
e. Dam/watershed/reservoir management strategy

PRIORITIES FOR 2023 – 2024

1. Water Resources Management
   a. Green infrastructure for water management (2023 - 2024)
   b. Sedimentation monitoring and mitigation system and technologies (2023 - 2024)
   c. Water auditing technologies (2023 - 2024)

PRIORITIES FOR 2024

1. Water Resource Management and Infrastructure Intervention
   a. Drought mitigation technologies and systems
   b. Innovative flood defense/control system/infrastructure
   c. Integrated community-based water and wastewater treatment
   d. Dams/watershed management and monitoring strategies
      - Monitoring system and decision support tool for high turbidity in water during extreme weather events
      - Water operations and treatment processes

PRIORITIES FOR 2024-2025

1. Construction
   a. S&T-based Preservation of Heritage Structures (2024 - 2025)
   b. Innovative Housing/Building Technologies (2024 - 2025)
   c. Rubber-based Products for Construction Application (2024 - 2025)
   d. Concrete Petrography S&T Application (2024 - 2025)

PRIORITIES FOR 2025

1. Water Resources Management
   a. Smart farming innovative water management systems
   b. Community-based water harvesting technologies
   c. Development of drought and flood mitigation systems and technologies

PRIORITIES FOR 2026

1. Construction
   a. Coastal Engineering Technologies/S&T Intervention
   b. Mountain Engineering Technologies/S&T Intervention
   c. Underground Engineering R&D Center
   d. Green Technologies
2. Water Resources Management
   a. Water supply and demand management and monitoring technologies/S&T intervention
   b. Water desalination system (non-membrane, non-solar powered)
   c. Hydrological groundwater site investigation w/emerging contaminants
   d. Modelling and monitoring tools for extraction of safe quality of water

PRIORITIES FOR 2027

1. Construction

a. Earthquake Engineering Technologies/S&T Intervention
b. Heritage Building/Site S&T Preservation Technologies
c. Innovative Construction Materials/Products

2. Water Resources Management
   a. Innovative Technologies for the advancement of operation and maintenance (O&M) for water supply facilities
   b. Integrated central-web based water monitoring and management system

PRIORITIES FOR 2028

1. Construction
   a. Underground Engineering Technologies/S&T Intervention
   b. Digitalization Technologies for the Construction Industry
   c. 3D Concrete Printing Products and application with demonstration
2. Water Resources Management
   a. Nationwide comprehensive water resource assessment
   b. Green infrastructure technologies/S&T intervention

PROPOSED BUDGET FOR CONSTRUCTION (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
110 M	120 M	130 M	140 M	150 M	160 M	170 M

PROPOSED BUDGET FOR UTILITIES (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
80 M	50 M	20 M	55 M	55 M	40 M	45 M

Q. DISASTER RISK REDUCTION-CLIMATE CHANGE ADAPTATION (DRR-CCA)

The Philippines, because of its location, is vulnerable to numerous natural hazards and climate change effects which result to catastrophic loss of lives and property each year. In fact, the Philippines ranks 3rd in the World Risk Index for Natural Disasters according to a study done by the United Nations University Institute for Environment and Human Security (UNU-EHS) in 2017 and 2nd in the Global Climate Risk Index as of 2018. Lessening the impact and/or reducing the vulnerable of different communities to the harmful effects of natural hazards and climate change has remained one of DOST's primary goals over the years.

Threats have ranged from natural hazards such as tsunami, earthquakes, volcanic activity, landslides, typhoons, thunderstorms, severe wind, heavy rains, and floods as well as climate-induced hazard such as extreme weather phenomena (heatwaves, droughts, frost, hail, intense storms, etc.), changes in precipitation and temperature patterns, and sea level rise.

Priorities for the DRR-CCA sector should generally focus on the following:

1. Multi-Hazard Assessment Tools and Systems

Various multi-natural hazard and exposure maps have been created such as Tsunami Susceptibility Maps, Earthquake Hazard Maps, Active Faults Map,

Volcano Hazard Maps, Rainfall-induced and Earthquake- induced Landslide Maps, Severe Wind, Flood Maps and Drought Maps. Because of these outputs, it is also now possible to generate near-real-time multi-hazard assessment reports for tsunami, earthquakes, volcanic activity, landslides, typhoons, severe wind, heavy rains and floods. These maps can be used for further research and other applications to DRR-CCA.

2. Vulnerability Assessment, Risk and Warning Communication Systems

With the generation of reference maps mentioned above, addressing, and assessing local vulnerabilities to help planners and managers mitigate the impacts of natural hazards are easier. Mandated agencies are also able to create warning communication systems thru integrated web-based and mobile phone-based warning and information systems. In this way, there is enhancement of the capabilities of high and moderately vulnerable communities to assess risks and quantify impacts so that appropriate risk reduction measures can be formulated.

3. Localization of Observation and Forecasting Tools and Monitoring Networks

Across several projects, locally developed/manufactured, cost-effective sensors and prototype instruments for effective monitoring of Disaster Risk Reduction-Climate Change Adaptation (DRR-CCA) related events have also been made.

PRIORITIES FOR 2023

1. Disaster Risk Reduction
    a. Tsunami
        - Other alternative Early Warning Systems (EWS) for tsunami (low-cost, locally fabricated and developed detection systems)
    b. Earthquake
        - Nationwide Earthquake hazard Mapping and Modeling thru Alternative Methods
    c. Volcanic Eruption
        - Low-cost instrumentation for geophysico-chemical monitoring and/or sampling/ data collection of volcanic gases
    d. Landslides
        - Updated landslide inventory of earthquake-induced and rain-induced landslide forecasting
        - Landslide thresholds and models for areas with mining activities
        - Landslide thresholds based on different Lithological Types
    e. Tropical Cyclones
        - Impact-based Risk Assessment
        - Cloud/Thunderstorm High-resolution Near real-time Detection/Mapping/Monitoring for Micro-weather Forecasting
        - Ship Route Gale Warning Visualization
        - Bow Echo Detection for Tornado Warning
    f. Floods and Heavy Rains
        - Community or Barangay Level Near-real time Flood Forecasting for Vulnerable Areas
            - Land subsidence
            - Urban/river flooding

2. Climate Change
    a. Coastal Hazards
        - Sea level rise impacts to coastal communities - localized analysis of sea-level rise vis a vis global projections
        - Coastal flooding, shoreline shift (erosion and accretion)
        - Reconstructing past storm surges using coastal sediment record: Input to storm surge models
    b. Thermal and environmental-related land-use scenarios
    c. Impact-based Forecasting for Flooding, Landslides, Severe Wind and Storm Surge Mapping, modeling/projections and instrumentation for extreme phenomena
        - Heatwaves
        - Droughts
        - Frost
        - Hail
        - Intense Storms

PRIORITIES FOR 2024

1. Disaster Risk Reduction
    a. Tsunami
        - Deployment of working, real-time accurate and optimized tsunami early detection, warning and information systems
        - Integrated operational real-time monitoring networks for tsunamis
    b. Earthquake
        - Updating of Exposure Data Maps all over the Philippines (also may be geographical/case studies at first)
        - Translation of earthquake- related vector data from the 1970s to digital files
        - Additional reference for earthquakes historical data
    c. Volcanic Hazard
        - Translation of active volcano vector data from the 1970s to digital files
    d. Landslide
        - Landslide in mining areas particularly slope failure in open pit
            - Effects of hydrothermal alteration to weathering and erosion
            - Applicability of open pit design for certain geological conditions and rainfall threshold data
    e. Tropical Cyclones
        - Storm surge forecasting using wind and wave current for the whole Philippines
        - Automation of storm surge models
    f. Floods and Heavy Rains
        - Flood Forecasting and Early Warning using Advance Technology (Radar, Satellite, High Resolution Modelling and others)
        - Convective Scale Modelling and Ensembled Forecasting
2. Climate Change
    a. Sectoral impacts and risk assessment of possible changes in rainfall, temperature, wind, humidity, and other meteorological elements associated with El Niño and the Southern Oscillation (ENSO), Madden–Julian Oscillation (MJO), boreal summer intraseasonal oscillation (BSISO), Indian Ocean Dipole (IOD), urbanization, land-use change, global warming, etc. (2021 – 2028)
        - Water resources impacts-translated climate information
        - Health impacts-translated climate information
        - Agricultural impacts-translated climate information
        - Energy impacts of higher temperature, drought, flood, etc.

b. Ocean Forecast System for Marine Activities
c. Groundwater Resource - Groundwater management subsector
    - Assessment of impacts of land use to karst water resources
    - Identification of inland water resources for coastal communities
    - Comparison of water resources availability and vulnerability of island and inland karst in the Philippines

PRIORITIES FOR 2025

1. Disaster Risk Reduction
    a. Tsunami
        - Capacity building/effective risk communication for coastal communities
        - Tsunami community- based early warning systems and warning plan
    b. Earthquake
        - Earthquake Vulnerability Maps for the Philippines
    c. Volcanic Hazard
        - Bathymetric Mapping of Sub-lacustrine Features in Volcanic Lakes
    d. Landslide
        - Radar-Based Flashfloods and Landslides Forecasting
        - Satellite Based Flashfloods and Landslides Forecasting
    e. Tropical Cyclones
        - Weather Forecast Visualization
        - Enhancement of the Objective Forecast Guidance and Operational Support Systems for Tropical Cyclones
    f. Floods and Heavy Rains
        - Advanced Space Technology for Real-Time Flood Monitoring; IoT Approach and Cloud Computing in Flood Forecasting
        - Sedimentological and geomorphological approach in flood hazard models: Identifying recurrence pattern using direct evidence
2. Climate Change
    a. Subsidence hazards - Engineering geology and geotechnical applications and monitoring system for karst subsidence
        - Monitoring system for karst subsidence/sinkhole
        - Engineering geological characteristics of various types of infrastructures in karst environment
        - “Breakability” of young (geologically) limestone in relation to subsidence
        - Vegetation Index in tropical karst areas: Tool for karst feature
    b. Green spaces in major urban centers
    c. Interventions to reduce 75% greenhouse gases emission (as part of the National Commitment)

PRIORITIES FOR 2026

1. Disaster Risk Reduction
    a. Tsunami
        - Optimized and Freely-accessible Early Warning and Alarm Systems for Coastal Communities Nationwide
        - Vulnerability Assessment Studies
    b. Earthquake
        - Risk Assessment Maps for Earthquake-prone Areas
    c. Volcanic Hazard
        - Volcanic Hazards Vulnerability Maps for the Philippines

d. Landslide
    - Lahar/Landslide Models based on Climate Maps and Models
    - Preliminary Vulnerability studies (sample sites)
e. Tropical Cyclones
    - Typhoon Structure/Wind Radii/Intensity Change Modelling and forecasting
f. Floods and Heavy Rains
    - Strengthening Nowcasting of Thunderstorm and Heavy Rainfall (Radar, QPE, QPF, MCS)
    - Application of Artificial Intelligence (AI) in Weather Forecasting

2. Climate Change
    a. Multi-scale monitoring and prediction of climate extremes
    b. Fine-scale modeling and provision of sub-seasonal to seasonal forecasts of rainfall, temperature, tropical cyclones, etc.
    c. Advance technologies for monitoring and prediction of ENSO, MJO, BSISO, forest and bush fire, etc.
    d. Early warning system for monitoring and prediction of extreme events associated with monsoons
    e. Climate modeling and cloud computing
    f. Emerging technologies for database management and near real-time climate monitoring, medium and long-term climate prediction, and climate projections

PRIORITIES FOR 2027

1. Disaster Risk Reduction
    a. Tsunami
        - Tsunami Vulnerability Maps for all coastline communities
    b. Earthquake
        - Post-earthquake fire assessment (fire as a secondary hazard resulting from earthquakes)
        - Old edifices/culturally important infrastructures damaged by earthquakes (vulnerability and propose immediate interventions)
    c. Volcanic Hazard
        - Risk Assessment Maps for Volcanic Hazards-prone Areas
    d. Landslide
        - Nationwide Operational Landslide Monitoring and Warning System
    e. Tropical Cyclones
        - Application of predictive analytics on magnitude tropical cyclone rapid intensification
        - Nationwide Intensity Forecast Guidance of Tropical Thunderstorms and Tropical
    f. Floods and Heavy Rains
        - Flood Vulnerability and Risk Assessments for critical Coastal Areas
            - Land subsidence
            - Urban/river flooding
2. Climate Change
    a. User Interface platforms (UIPs) for Communicating Weather, Flood, and Climate Risks
    b. Socio-Economic Valuation of Meteorological Products and Services
    c. Loss and Damage related to Climate Change events
    d. Climate Change Scenarios (based on major hazard/s affecting that area) for the top most vulnerable provinces in the Philippines: Eastern Samar, Southern Leyte, Zamboanga del Norte, Lanao del Sur, Bukidnon, Maguindanao, North Cotabato,

Sulu, Sultan Kudarat, Sorsogon, Masbate, Western Samar, Negros Oriental, Dinagat, Surigao del Norte, Surigao del Sur and Sarangani

PRIORITIES FOR 2028

1. Disaster Risk Reduction
   a. Tsunami
      - Risk Assessment Maps for Tsunami-prone Areas
      - Community-based Risk communication, capacity building and preparedness for Tsunami-prone Areas
   b. Earthquake
      - Community-based Risk communication, capacity building and preparedness for earthquake-prone areas
   c. Volcanic Hazard
      - Community-based Risk communication, capacity building and preparedness for volcano hazard-prone areas
   d. Landslide
      - Risk Assessment Maps for Landslide-prone Areas
      - Community-based Risk communication, capacity building and preparedness for Landslide-prone Areas
   e. Tropical Cyclones
      - Risk Assessment Maps for Tropical Cyclone-prone Areas
      - Community-based Risk communication, capacity building and preparedness for Tropical Cyclone-prone Areas
   f. Floods and Heavy Rains
      - Nationwide Vulnerability and Risk Assessment Studies for Urban and River Flooding-prone Areas
      - Community-based Risk communication, capacity building and preparedness for Urban and River Flooding-prone Areas
2. Climate Change
   a. Astronomical Researches
      - Influence of extreme solar activity on the intensity of landfalling Tropical Cyclones in the Philippines
      - Space Weather Monitoring System
      - Common Monitoring and Evaluation of Climate Actions in the Philippines
      - Nationwide Vulnerability and Risk Assessment Studies for Extreme Weather Phenomena, Temperature Extremes or Sea Level Rise/Flooding
      - Community-based Risk communication, capacity building and preparedness for Climate Change-related Hazards

PROPOSED BUDGET FOR DRR-CCA (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
170 M	280 M	255 M	270 M	240 M	180 M	630 M

R. UNMANNED VEHICLE SYSTEMS (UVS)

Unmanned Vehicle Systems (UVS), particularly unmanned aerial vehicles (UAV), are still among the latest technology trends sweeping across and disrupting a broad spectrum of industries. For more than a decade in the global market, UVS has been the face of intelligence, disaster response and assessment, warfare/military, humanitarian relief,

among others. With the inclusion of the land and sea applications, the benefits of unmanned systems will extend beyond these sectors.

Currently, the UAV industry in the Philippines is comprised of technology and service providers, users, hobbyists/enthusiasts, technology developers from research and academic institutions, UAV parts and component suppliers. The country will benefit a lot if the vast and fast-evolving UVS technology applications are explored and adopted.

PRIORITIES FOR 2023

1. Multi-mission UVS
2. Development of UVS communication architecture
3. UVS secured systems (resistance to hacking, interception, jamming of communications)
4. High payload capacity platforms

PRIORITIES FOR 2024

1. Development of UVS smart systems
2. Application of new/innovative material and energy sources for UVS
3. Swarm intelligence for industrial applications
4. UVS with computer vision and has airspace/environmental awareness

PRIORITIES FOR 2025

1. Application and integration of IoT and robotics
2. Development of Intelligent Autopilot Systems

PRIORITIES FOR 2026

1. Collaborative missions (air, land, water)
2. Hybrid UVS
3. Establishment of UVS Consortium and Commercial Provider Partnership

PRIORITIES FOR 2027

1. Establishment of UVS R&D Center and Facilities
2. Development of UVS database system

PRIORITIES FOR 2028

1. Local development of UVS software and hardware
2. Sustainable UVS Local Industry
3. Defense and Human Security

PROPOSED BUDGET FOR UNMANNED VEHICLE SYSTEMS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
10 M	50 M	90 M	50 M	50 M	50 M	30 M

S. FOOD

FOOD SAFETY PROGRAM

Under Food and Nutrition Security, the DOST Integrated Food Safety program is the Department's support for the implementation of Republic Act No. 10611 or the Food Safety Act of 2013, with the following objectives:

a. Provide food safety related services to meet customer satisfaction
b. Develop and implement effective systems, processes, and protocols on food safety
c. Develop and enhance human resources on food safety, and
d. Develop and institute strategies and mechanisms to sustain the food safety program

The Food Safety Program is aligned with the following priorities:

SUSTAINABLE DEVELOPMENT GOALS ADDRESSED	Goal 3: Good health and well-being Goal 9: Industry, innovation, and infrastructure Goal 12: Responsible consumption and production
KEY RESEARCH AREAS	● Rapid, Inclusive and Sustainable Economic Growth
11-POINT AGENDA	● Pursue R&D to address pressing national problems ● Develop STI human resources and build a strong STI culture ● Upgrade STI facilities and capacities to advance R&D activities and expand S&T services ● Strengthen industry-academe-government and international STI collaboration

As an action plan to the strategies, the developed DOST Food Safety Program has four (4) major program components with the overall vision towards safe food for everyone, by everyone, through science, technology, and innovation:

- Research and Development on Food Safety
- S&T Services on Food Safety
- Human Resource Development on Food Safety
- Knowledge/Technology Transfer and Policy Advocacy Program on Food Safety

DOST HALAL S&T PROGRAM

In support of Republic Act No. 10817 or the Philippine Halal Export Development and Promotion Act, and as a provider of scientific and technical knowledge in support to the development of the Halal industry, the DOST implemented the DOST Halal S&T Program which lays down the plans and programs for four (4) areas, namely: (1) Research and Development, (2) Human Resource Development, (3) Knowledge Transfer, and (4) Halal Verification Laboratory Testing.

The Philippines ranks 36th out of 130 countries in the 2021 Global Muslim Travel Index, up by 3 notches from 2019 and tied at the 8th spot for Non-OIC destinations together with France, Germany, and USA. With its strong tourism industry, the country is accelerating its plans to position itself as one of the world's preferred destinations for Muslim tourists. A Muslim Travel Guide was also developed which includes necessary information for top

destinations in the country in partnership with HalalTrip, a global online platform for Muslim travelers.

Recognizing the role of science and technology, and innovation, the initiatives hope to strengthen the Halal industry specifically in meeting world standards, promoting the competitiveness of entrepreneurs, increasing capability in Halal accreditation and formulating standards, and upgrading Halal research and development.

The program, aligned with the following priorities is working on the continual development of its local Halal industries:

SUSTAINABLE DEVELOPMENT GOALS	Goal 8: Decent work and economic growth
KEY RESEARCH AREAS	Rapid, Inclusive and Sustainable Economic Growth
11-POINT AGENDA	▪ Maximize utilization of R&D results through technology transfer and commercialization ▪ Expand STI assistance to communities and the production sector, particularly MSMEs

FOOD INNOVATION PROGRAM

Despite its continuous growth, the food processing sector is hindered by several challenges that need to be addressed. Investments in research and development, technology transfer, and upgrading — the widely accepted measures of innovation, have been historically low for food manufacturing industries in the Philippines (PIDS, 2017). These challenges were identified relative to the ASEAN integration in 2015 and remain as the main challenges affecting the local industries. These are the following:

a. Continued dependence on imported raw materials
b. Need for improvement or innovation in local technology
c. Ability to consistently deliver the required level of quality and food safety

These industry concerns and challenges were also validated in the recent S&T consultation with the food industry conducted by the Council in partnership with the Board of Investments of the Department of Trade and Industry (DTI-BOI). With these priorities at hand, the Food Innovation Program was developed with the vision to make local industries more sustainable and at the same time, geared towards innovative food products with better quality and improved safety that responds to the population's nutritional and health requirements.

PRIORITIES FOR 2023

1. Halal Program
    a. Human Resource Development/Knowledge Transfer
        - Strengthening Halal compliance of food service establishments

PRIORITIES FOR 2023 – 2024

1. Food Safety Program
    a. Integrated Food Safety Research and Development Program
        - Development of MSMEs' Traceability Systems (2023)
        - Hazard contamination assessment: microplastics (2023)

- Establishment of Safety Protocols in the Delivery of Freshly Cooked Foods and Fresh Salads and Cut Fruits (2023)

b. DOST Human Resource Development Program on Food Safety
   - Development of Competency-based Evaluation Criteria and Training Plan (2023)
   - Development of Massive Open-Online Course on Food Safety (2023-2024)

c. Knowledge/Technology Transfer and Policy Advocacy Program on Food Safety
   - Determination of Technology Readiness Level of Food Safety Technologies (2023)
   - Review of the Policy Making Environment (2023)

2. Halal Program
   a. Human Resource Development/Knowledge Transfer
      - Halal Knowledge Center (2023 - 2024)
   b. Research and Development
      - Development of Recommended Code of Practice for Halal-friendly Hospitality Industry (2023 - 2024)
        - Lodging/Accommodation
        - Recreation facilities (resort, spa, amusement parks, tourist sites)

PRIORITIES FOR 2023 – 2025

1. Food Safety Program
   a. Integrated Food Safety Research and Development Program
      - R&D to support food industry in the time of pandemic and beyond (2023-2025)
      - Validation of Test Methods for the Detection of Food Allergens (2023-2025)
      - NICER for Food Safety Risk Profiling
   b. S&T Services on Food Safety
      - Strengthening food safety and traceability through nuclear and isotope-based technology (2023-2025)
   c. Human Resource Development Program on Food Safety
      - Food Safety in Disaster Management (2023-2025)

PRIORITIES FOR 2023 – 2026

1. Food Safety Program
   a. Human resource Development Program on Food Safety
      - Development of Food Safety Training Modules (2023-2026)

PRIORITIES FOR 2023 – 2027

1. Food Safety Program
   a. Integrated Food Safety Research and Development Program
      - Standards Development to Ensure Safety of Priority Products (2023-2027)
      - Food packaging hazard migration studies (2023-2027)
   b. S&T Services on Food Safety
      - Adoption of globally-accepted methods for food safety parameters (2023-2027)
        - Standardization and Validation of Chemical Test Methods for Food Safety Parameters among DOST laboratories
        - Validation and Verification of Standard Microbiological Test Methods for Food Safety Parameters Towards DOST Harmonized Methods Among DOST Laboratories

- Integration of selected methods of analysis towards AOAC Southeast Asia Harmonization of Methods for Food Safety Parameters
- Provision of analytical testing services for quality assessment and shelf-life of selected local products to assist LGUs and MSMEs (2023-2027)
- Improvement of DOST RSTL Lab Efficiency thru Facility Expansion, Equipment Upgrading and Optimization (2023-2027)
- Establishment of the National Food Reference Laboratory (2023-2027)

PRIORITIES FOR 2023 – 2028

1. Food Safety Program
   a. DOST Human Resource Development Program on Food Safety
      - Competency-based Human Resource Development Project (2023 - 2028)
   b. Knowledge/Technology Transfer and Policy Advocacy Program on Food Safety
      - DOST Food Safety Fora and Summit (2023 - 2028)
      - Deployment and Dissemination of Food Safety Modules (2023 - 2028)
      - Support for Commercialization of Food Safety Technologies (2023 - 2028)
      - Food Safety Month Celebration (2023 - 2028)
      - Development of policies as a result of R&D (2023 - 2028)
      - Dissemination and adoption of science-based policy recommendations (2023 - 2028)
      - Monitoring and Evaluation of Policy Advocacy Campaign (2023 - 2028)
2. Halal Program
   a. Human Resource Development/Knowledge Transfer
      - Halal Summit (2023 - 2028)
3. Food Innovation Program
   a. Innovative Food Products
   b. Enabling Systems for Food Innovation
      - Enhancement of Competencies of Food Innovation Centers on Bringing Products to Market, Operations Management, and Mechanisms for Sustainability
      - New Innovative and Nutrient-sensitive Food Processing Technologies for Local Industries
   c. Specific Industry or Regional Concerns

PRIORITIES FOR 2024 – 2028

1. Food Safety Program
   a. Integrated Food Safety Research and Development Program
      - Philippine Total Diet Study Program: Exposure Assessment of Chemical and Microbiological Hazards in Food
   b. Policy Advocacy
      - Monitoring and evaluation of Policy Advocacy Campaign (2024 - 2028)

PRIORITIES FOR 2025-2026

1. Food Safety Program
   a. Integrated Food Safety Research and Development Program
      - Development of Guidance Manual: Hygienic and Safety Aspects of Food Processing Equipment (FPE) for Micro and Small Food Processors (2025-2026)
2. Halal Program
   a. Research and Development
      - Enhancing Digital Presence: Development of Halal Tourist Portal (2025 - 2026)

PRIORITIES FOR 2027

1. Food Safety Program
    a. Integrated Food Safety Research and Development Program
        - R&D studies on Predictive microbiology

PRIORITIES FOR 2028

1. Food Safety Program
    a. Integrated Food Safety Research and Development Program
    b. S&T Services on Food Safety
    c. DOST Human Resource Development Program on Food Safety
    d. Knowledge/Technology Transfer and Policy Advocacy Program on Food Safety
2. Halal Program
    a. Research and Development
    b. Human Resource Development/Knowledge Transfer
    c. Laboratory Testing

PROPOSED BUDGET FOR FOOD (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
170.30 M	843.52 M	601.36 M	512.61 M	439.86 M	388.75 M	368.75 M

T. METALS AND ENGINEERING

The Metals and Equipment Engineering Sector plays a significant role towards the competitiveness of Philippines manufacturing industries. It principally impacts across the other sectoral priorities of the PCIEERD such food, mining, textile, process agri-processing as well on the environment sector and advanced technology sectors.

The Metals and Equipment Engineering (M&E) industries plays a vital role in the country's economic growth and development. The Philippine economic sectors manufacturing, agricultural and service sectors-are heavily dependent on the M&E industry especially in terms of their requirements for tools, implements, machines and equipment, parts and assemblies, among others.

The Metals and Equipment Engineering will support infrastructure development of metals-related S&T services, the research programs directed towards the development of improved and advanced metal-related technologies. IT also prioritizes support for capacity building and institutional technology development directed to the Metals and Equipment Engineering sectoral priorities.

PRIORITIES FOR 2023 – 2025

a. Machining and Fabrication
b. Establishments of Regional Innovation Centers in Regions CAR, I, II, and X
c. Establishments of Regional Innovation Centers in Regions IVA, IVB, V, VI, VII, IX, X, XI, XII and CARAGA
d. Establishment of Upgraded Metal Testing Center Applicable to the Needs of the Metal Industry
e. R&D Application on Robotics and Mechatronics for shop automation

f. Design and Development of Technology-Based Products for Aerospace Applications
g. Design and Development of innovative, cost effective and appropriate Machinery, Parts and Engineered Products (MPEPs) (e.g. food processing industry, Agri-industry, essential oils and fragrances, aerospace, etc.)
h. Capability Building for Certification for Aerospace Standards
i. Establishment of Micro Machining Facility

PRIORITIES FOR 2026 – 2028

1. Machining and Fabrication
    a. Program A: S&T Program for the Competitiveness of Agro-industry Processing Sector
    b. Program B: S&T Service Facility for the Industry
    c. Program C. Support Program for the Productivity and Competitiveness of the Metals and Engineering Industries

PRIORITIES FOR 2023 – 2028

1. Machining and Fabrication
    a. R&D on Physical Metrology (realization of S.I. Units)

PRIORITIES FOR 2023 – 2025

1. Metal Casting
    a. Establishment of Facilities that will contribute the improvement of Metal Casting Industry
    b. Establishment of Upgraded Heat Treatment Facility
    c. R&D on Advanced Metal Casting and Metal Injection Technologies for Various Applications
    d. R&D on Materials and Metallurgy Technologies for Various Applications
    e. Development of Machine Tool for Manufacturing Industry
    f. Development of Induction Furnace
    g. Standardization of Cupola Furnace

PRIORITIES FOR 2026-2028

1. Metal Casting
    a. Program A: S&T Program for the Competitiveness of Agro-industry Processing Sector
    b. Program B: S&T Service Facility for the Industry
    c. Program C. Support Program for the Productivity and Competitiveness of the Metals and Engineering Industries

PRIORITIES FOR 2023 – 2028

1. Tool and Die
    a. Design and development molds and die for processors and fabricators applications (e.g. food industries, aerospace, medical, marine industries, etc.)
    b. Design and Development of Tool and Die for Handicraft Industries
    c. Design and Development of Tool and Die Automotive industry

PRIORITIES FOR 2023 – 2025

1. Surface Engineering
    a. Development and Creation of Materials Applicable for Metal Coating, Polishing and Finishing Technologies for Various Applications

PRIORITIES FOR 2026 – 2028

1. Surface Engineering
    a. Development and Creation of Materials Applicable for Metal Coating, Polishing and Finishing Technologies for Various Applications

PRIORITIES FOR 2023 – 2028

1. Surface Engineering
    a. Establishment of Advanced Surface Engineering Facility
    b. R&D for Metal and Composite Etching or Photo Etching

PROPOSED BUDGET FOR METALS AND ENGINEERING (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
316 M	481.9 M	384.3 M	356.3 M	528.5 M	385 M	390 M

U. ENVIRONMENT

The Environment Sector focused on the three sub-sectors, namely: (1) water quality/wastewater treatment and management, (2) air quality, and (3) solid waste management. These topics would like to address pressing national problems by providing solutions through S&T programs for the prevention and control of water pollution, air pollution, and innovative solutions to plastic wastes, respectively. Other important priority R&D areas include but not limited to toxic and hazardous wastes, particularly on waste electronics, alternatives to Persistent Organic Pollutants (POPs), and water resource management.

PRIORITIES FOR 2023

1. S&T Water Environment
    a. Application of technologies for treatment of Industry Environmental Concerns (IoT-based treatment, application of nanosilicate adsorbents, etc.)
    b. Establishment of a Center for Lakes Sustainable Development and Center for Environmental Technologies and Compliance
    c. Deployment of compact technologies (Quick Service Restaurant (QSR), Modular Eco-Friendly Domestic Wastewater (MEDOWW) Management, Post-treatment trickling filter, etc.)
    d. Baseline data gathering/Policy Review/Policy recommendation to include microplastics, veterinary products, and pharmaceutical and personal care products (PPCPs) in regulatory monitoring; Information, Education and Communication (IEC)/Education campaign
2. S&T Clean Air
    a. Use of high-resolution Mass Spectrometers and satellite data for improvement of air quality (Baseline Data Gathering/Technology Database
    b. Development of localized technology for Indoor air quality

c. Geographic Information System (GIS) and AI for image analysis and information extraction (2023-2024)
d. System based measurement devises
e. Real time monitoring and sensor networks

3. Sustainable S&T Solid Waste Management
   a. Development of alternative materials to plastic-based packaging and products
   b. Resource recovery plan for the plastic generated (infectious wastes/healthcare materials)
   c. Baseline data gathering and assessment of plastic Wastes
   d. Development of Application and Database (Integrated Waste Analysis, Survey and Technological Options (IWASTO))
   e. Policy recommendation for volcanic ash

PRIORITIES FOR 2024

1. S&T Water Environment
   a. Resource recovery of nutrients, heavy metal (HM), and Endocrine disruptors in wastewater (Biological, Capacitive deionization, radiation modified polymer, etc.)
   b. Development of technology for smart water management (PPCPs, nanotechnology purifiers, IoT, nanosensors) (2024 - 2025)
   c. Development of rapid test kits for detection of toxins and pathogens in water
   d. Water Re-use, Water recycling (from industrial wastewater)
   e. Development of water purification devices using membranes/filters
   f. Application of additive manufacturing for water purification, wastewater treatment, creation of biocarrier, and production of selective solvent for removal of HM and other micropollutants (2024 - 2025)
2. S&T Clean Air
   a. Development of portable analyzer, localized data loggers, pollution exposure monitors, and upgrading of equipment for real-time monitoring (high-performance liquid chromatography (HPLC), atomic absorption spectrometry (AAS), Gas Chromatograph)
   b. Containment technologies to prevent diffusion of pollutants and industrial gas leaks
   c. Use of predictive/smart technology for air quality monitoring (Localized data logger)
   d. Policy development on Local reference method for air quality monitoring
3. Innovative Solutions to Solid Waste Management
   a. Development of Technologies for Upcycling/Recycling of plastics/Co-processing
   b. Development for alternatives for POPs
   c. Development of Microplastic capturing and treatment Technology
   d. Establishment of Biodegradability Testing Facility
   e. Social and economic studies for the development and upgrading of recycling industry
4. Sustainable S&T Solid Waste Management Roadmap
   a. Development of Technologies for Upcycling/Recycling of plastics/Co-processing
   b. Development for alternatives for POP's
   c. Development of Microplastic capturing and treatment Technology
   d. Establishment of Biodegradability Testing Facility
   e. Social and economic studies for the development and upgrading of recycling industry

PRIORITIES FOR 2025

1. S&T Water
    a. Desalination, Deionization Technology (for Technology Innovation for Commercialization (TECHNICOM) Program)
    b. Installation/Application of microplastic capturing technology/facility in strategic area
    c. R&D for groundwater quality (water quality index and remediation)
    d. Baselining and technology determination to treat microplastics, veterinary products, and pharmaceutical and personal care products (PPCPs)
2. S&T for Clean Air
    a. Installation of air pollution treatment facilities in key areas
    b. Establishment of Calibration centre for aerosol devices
    c. Modelling techniques and approaches, big data, databasing, etc.
3. Sustainable S&T Solid Waste Management
    a. Value-adding of Wastes from Electrical and Electronic products (WEE)
    b. Deployment of Clean Technologies for solid waste prevention and control for ship recycling
    c. Establishment of Recyclability Testing Facility
    d. Development of standards for microplastic
    e. Development of reusable/environment-friendly personal protective equipment (PPE)
    f. Development and adoption of circular economy technologies and solutions

PRIORITIES FOR 2026

1. S&T Water
    a. Application of additive manufacturing, biocarrier for removal of HM and other micropollutants
    b. Diffuse Pollution - Characterization, Evaluation and Monitoring Guidelines
    c. Centralized Center for Wastewater Management and Treatment (Industry-Academe-Government linkage)
    d. Development of Smart Wastewater Treatment Technologies (with advanced instrumentation and control)
2. S&T for Clean Air
    a. GIS and AI for image analysis and information extraction
    b. Adoption of ambient air monitors
    c. Policy recommendations (local reference methods for developed sensors)
    d. Incentives for industries that apply pollution prevention/containment technology
3. Sustainable S&T Solid Waste Management
    a. Development of clean technologies for industrial waste management
    b. Development of green alternatives to plastic products
    c. Development of tech, expertise for the recovery of high-value materials
    d. Development of treatment technologies for POPs
    e. Formulation of Guidelines/policies/standards from results of R&D

PRIORITIES FOR 2027 – 2028

1. S&T Water Environment
    a. Loading analysis, Pilot-Projects and Technologies for treatment of diffuse pollution
    b. Desalination (membrane fabrication); Deionization for brackish and surface water
    c. Radiation-modified polymer technology for nutrient treatment
    d. Capacitive deionization for water purification or recovery of nutrients and HM

e. Non-point source pollution characterization and treatment (Diffuse pollution)

2. S&T for Clean Air
   a. GIS and AI for image analysis and information extraction
   b. Adoption of ambient air monitors
   c. Policy recommendations (local reference methods for developed sensors)
   d. Incentives for industries that apply pollution prevention/containment technology
3. Sustainable S&T Solid Waste Management
   a. Development of Clean Technologies for solid waste management
   b. Development of standards for nanoplastics
   c. Development of green alternatives to plastic products
   d. Development of tech, expertise for the recovery of high-value materials
   e. Grow pool of 3rd party Hazardous/Special Waste Treater
   f. Commercialization/tech transfer of developed technology
   g. Identification/Development Environment friendly alternatives
   h. Designing of packaging material

PROPOSED BUDGET FOR ENVIRONMENT (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
118 M	136 M	220 M	119 M	242 M	182 M	152 M

V. PROCESS

The Process Sector covers the process industries where the primary production processes are either continuous or occur on a batch of materials that is indistinguishable such as chemicals, pharmaceuticals, petroleum, plastics, rubber, textiles, tobacco, food, beverages, etc. (definition as cited by IISE -Institute of Industrial and Systems Engineers, US). There are four subsectors under Process:

1. Agro-industrial processing
2. Natural products
3. Textiles and
4. Chemical and Biological Manufacturing and Allied Industries

The *Agro-Industrial Processing* subsector is the program addressing commodity-based R&D needs on the downstream processing side. The *Natural Products* subsector is the program focused on products from extraction and downstream processing from agricultural and marine sources that would serve the needs of the community for industries, such as personal care, cosmetics, food, household products, and non-active components of pharmaceuticals. The *Textiles* subsector is the program focused on products that develops and makes use of fibers, yarn intermediates, yarns, fabrics, and end-user products that retain all the strength, flexibility, and other typical properties of the original fiber or filaments. The *Chemical and Biological Manufacturing and Allied Industries* subsector covers chemicals (basic, specialty), chemical preparations, predominantly chemical processes, sensors, chemical and biological reference materials and standards, and related technologies.

AGRO-INDUSTRIAL PROCESSING

PRIORITIES FOR 2023

1. Development of high-value products for cacao for various industries

PRIORITIES FOR 2024 – 2026

1. Development of specialty/currency base paper and reinforced packaging paper
2. Valorization of agricultural wastes from coffee

PRIORITIES FOR 2027 – 2028

1. Value-adding technologies development for in-demand agricultural commodities (coconut, rubber, etc.)

NATURAL PRODUCTS

PRIORITIES FOR 2023

1. Extraction and application of antioxidants for industries such as cosmetics and personal care
2. Development and application of Natural Dyes and Colorants
3. Improvement of Extraction, Processing, Application, Standardization Technologies and Performance Assessment of Selected Gums, Resins and Oils

PRIORITIES FOR 2024 – 2028

1. Valorization of Various Wastes for extraction of natural compounds for various industry applications
2. Extraction, Characterization of Natural hydrocolloids for various applications
3. Extraction, Characterization of Natural polymers for modified drug release in vivo for personal care applications and pharmaceutical applications
4. Establishment of Testing Services for Active components in Personal Care and Pharmaceutical products

TEXTILES

PRIORITIES FOR 2023 – 2028

1. Development of local capability in textile and colorant production and processing
2. Expansion of alternative sustainable fibers for textile application
3. Development of smart textile finishing technologies for natural fiber-blended textiles
4. Development of smart textile materials for industrial applications
5. Establishment and enhancement of textile quality assurance of functionalized textile materials and products
6. Integration of Smart Textile Innovation Center framework and Institute development to support smart textiles R&D and activities
7. Integration of the elements of Industry 4.0 towards material and product design and development
8. Textile material design and innovation R&D towards improved self-reliance posture for protection, combat, and other technical applications.
9. Valorization of different by-products and discarded material from textile processes
10. Innovation of textile processing towards cost reduction and quality improvement

CHEMICAL AND BIOLOGICAL MANUFACTURING AND ALLIED INDUSTRIES

PRIORITIES FOR 2023

1. Sustainable Polymers Development and Applications
2. Chemical Metrology for Organic and Inorganic Contaminants in Food and Environment
3. Chemical Metrology for Inorganic Contaminants in Drinking and Environmental Waters, and Food Products
4. Biological Metrology for Microorganisms in Food and Water
5. Improvement of materials and processing methods in the manufacture of packaging for industrial applications.
6. Innovation of bioplastic manufacturing processes towards cost reduction and commercialization

PRIORITIES FOR 2024 – 2028

1. Green Materials Development and Processing
2. Bioplastic Development and Applications
3. Chemical and Biological Metrology for High Value Industries
4. Development of High Value Chemicals
5. Development of High Value Products for Chemical and Biological Manufacturing and Allied Industries

PROPOSED BUDGET FOR PROCESS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
216 M	594 M	922 M	598 M	452 M	426 M	325 M

W. MINING AND MINERALS

The Philippines is one of the world's most well-endowed country in terms of mineral resources – with rich and vast amounts of metallic and non-metallic mineral deposits including gold, copper, nickel, iron, chromite, coal, cobalt, gypsum, silver, and sulfur. This immense untapped potential makes the mining and mineral industry an important contributing factor in the catalyzation of the country's economic recovery and development.

Mining provides the essential components for virtually everything we use daily – from building roads and infrastructures to generating electricity and producing goods that improve the consumers' standard of living. As well as supplying the world with the mineral commodities it needs, the mining industry also provides employment opportunities and livelihood programs, and is a direct contributor to the country's economic success. Even so, concerns have been raised about the mining industry's long-term viability and sustainability as the minerals are extracted from nonrenewable resources and the industry generates complex environmental and socio-economic issues.

To address these challenges, ongoing research and innovative solutions are being developed in the mining and minerals sector to help the country in its pursuit towards a more economically, environmentally, and socially responsible and sustainable way of providing for the modern society's growing need for minerals and metals.

PRIORITIES FOR 2023

Program on Metallic Minerals

a. Copper
   - Process development/improvement for sulfide and oxide copper ores and purification of copper to high grade copper (99.9999% purity)

PRIORITIES FOR 2024 – 2025

Program on Metallic Minerals

a. Copper
   - Production of copper wires, rods, strips, rolled sheets and other special products

b. Chromite
   - Process improvement on the recovery of chromite (large/small scale)

PRIORITIES FOR 2026 – 2028

Program on Metallic Minerals

a. Iron and Iron Rich Minerals
   - Establishment of a ferrous metallurgical R&D facility for iron and iron-rich minerals ores for iron and steelmaking

b. Nickel
   - Production and refining of pig iron from Saprolite ores to produce to high value stainless steel products

PRIORITIES FOR 2023

Program on Non-Metallic Minerals

a. Clay Silicate
   - Development of clay silicate products for industrial application (e.g. armor plates for armed personnel)

PRIORITIES FOR 2024 – 2025

Program on Non-Metallic Minerals

a. Bauxite
   - Development of bauxite products for industrial application

PRIORITIES FOR 2026 – 2027

Program on Non-Metallic Minerals

a. Silica
   - Development of silica products for industrial application

PRIORITIES FOR 2028

Program on Non-Metallic Minerals

a. Clay
   - Development of clay products for industrial application

PRIORITIES FOR 2023

Program on Critical Elements/Metals

a. Metallic Minerals (Nickel)

- Advanced/innovative/novel extraction processing technology for critical elements/metals (e.g. Nickel from laterite ores for battery)
- Refining of critical elements/metals for specific emerging technology application

PRIORITIES FOR 2024

Program on Critical Elements/Metals

a. Metallic Minerals (Copper, Gold (large/small scale), Chromite (large/small scale))
   - Advanced/innovative/novel extraction technology for critical elements/metals from iron and chromite
   - Refining of critical minerals/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)
b. Non-metallic Minerals (Bauxite)
   - Advanced/innovative/novel extraction technology for critical elements (e.g. Critical minerals from bauxite)
   - Refining of critical elements/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)
c. Mine Tailings/Wastes (large scale Copper and small scale Gold)
   - Advanced/innovative/novel extraction technology for critical elements from copper mine tailings (e.g. REE from CFA; Heavy metals/precious metals from tailings)
   - Refining of critical elements/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)

PRIORITIES FOR 2025 – 2028

Program on Critical Elements/Minerals

a. Metallic Minerals (Nickel, Iron, Gold and Chromite)
   - Inventory of critical elements in metallic minerals
   - Advanced/innovative/novel extraction technology for critical minerals from metallic minerals
   - Refining of critical minerals/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)
b. Non-metallic Minerals (Limestone, Silica, Clay)
   - Inventory of critical elements in metallic minerals
   - Advanced/innovative/novel extraction technology for critical elements (e.g. Critical minerals from limestone)
   - Refining of critical minerals/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)
c. Mine Tailings/Wastes (Gold (large and small scale), Copper, Nickel waste/silt, Phosphogypsum)
   - Inventory of critical elements in mine tailings
   - Advanced/innovative/novel extraction technology for critical minerals from metallic minerals

- Refining of critical minerals/metals for specific emerging technology applications (e.g. for solar cells, fuel cells, wind turbine components, light weight alloys for automotive industries, etc.)

PRIORITIES FOR 2023

Program on Technologies in Support to Rehabilitation of Mined-out Area

a. Treatment and utilization of mine tailings
   - Copper Tailings
   - Nickel Wastes

PRIORITIES FOR 2024

Program on Technologies in Support to Rehabilitation of Mined-out Area

a. Treatment and utilization of mine tailings
   - Copper Tailings

PRIORITIES FOR 2025-2028

Program on Technologies in Support to Rehabilitation of Mined-out Area

a. Development on environment-friendly technologies and utilization of mine tailings
   - Gold Tailings (large and small scale)
   - Nickel Wastes/Silt
   - Phosphogypsum
   - Other mining wastes/tailings (large and small scale)
b. Assessment on the Impact of Offshore magnetite mining
   - Assessment of the impact of magnetite offshore mining in the ecosystem and community with predictive modelling

PROPOSED BUDGET FOR MINING AND MINERALS (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
92 M	112.777 M	228.704 M	151.704 M	214.429 M	270.337 M	254.837 M

OTHER PRIORITY PROGRAMS

X. TECHNOLOGY TRANSFER PROGRAM

The Program provides support for accelerating transfer and commercialization of technologies generated from DOST and PCIEERD supported projects and/or developed network institutions, partners and/or stakeholders. It covers support for translation and spinning-off of technologies, capacity building and strengthening the technology transfer processes in universities, training programs for researchers venturing into commercialization, as well as for collaborations within the innovation ecosystem in the country.

As its main effort to stimulate further commercialization of government-funded R&D, the Council has facilitated technology transfer on two fronts: a) assisting the research team directly, and b) capacitating the university on commercialization processes.

The commercialization program aims to bridge the gap between R&D and commercialization of PCIEERD-funded technologies including translation of research results into marketable technologies or spinning off as a startup as mode for commercialization. It helps ease and coach university research teams in addressing the gaps for their technologies, fitting their prototypes to market needs, designing their business models for possible spin offs and simulating the operations of a startup to increase market reach. The Proposals are co-developed by the research team, PCIEERD, the university technology transfer office and the TBI where the output shall be a registered company and the number of clients for the startup to break even. The output of the individual projects under this program are marketable technologies and/or registered spin off companies

On the other hand, assistance to universities aims to increase utilization and commercialization of university-based research by providing fund support for the establishment of its technology protection and transfer policies/ processes, capability building of university tech transfer officers, conduct of audit/assessment of the results of researches, disclosure and protection of intellectual properties, promotion, and licensing of technologies. The program shall prepare universities in seeking more licensees, company adopters and startup/ spin offs from the pool of university research. Creation of a spin-off policy for the university is also included as one of the strategies for universities to commercialize and transfer the output of research.

In addition, capacity building programs are also in place to i) provide researchers with basic business and entrepreneurial skills, ii) enable them to determine the commercial readiness of their research, decide on whether the innovation warrants further efforts to bring the technology to market, and develop a transition plan from research, validation to commercialization, and iii) provide research teams and universities a conducive environment for licensing technologies, which includes tailored mentorship sessions on crafting appropriate licensing strategies.

PRIORITIES FOR 2023 – 2028

1. Funding Assistance to Spin-off and Translation of Research in Advancing Commercialization (FASTRAC) Program
2. Knowledge and Technology Transfer Office Development Program (KTTO) - IP Management Program for Academic Institutions Commercializing Technologies (IMPACT) Program
3. SciTech Super Highway
4. Preparing Researchers as Entrepreneurs Program (PREP)
5. Leveraging Innovation Partners to Nurture Collaboration (LINC), Filipinnovation Entrepreneurship Corps (FEC), Strategy to Accelerate and Revitalize Technology Transfer (StARTT), Licensing Clinics

PROPOSED BUDGET FOR TECHNOLOGY TRANSFER PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
47.5 M	124 M	140 M	150 M	160 M	170 M	170 M

Y. STARTUP DEVELOPMENT PROGRAM

To support the Philippine startup ecosystem, the DOST-PCIEERD has established programs such as the Startup Research Grant Program and the Technology Business Incubation (TBI) Program.

In 2020, a year after the signing of the Innovative Startup Act (Republic Act No. 11337), the DOST PCIEERD relaunched its Startup Research Grant Program and rebranded it as the Startup Grant Fund (SGF) Program. The SGF intends to provide a fund mechanism that would support startups, help them focus on providing solutions that are relevant to the needs of the people, and reinvigorate the economy during the post-COVID situation. Various sub-programs will also be supported under the Startup Development Program, all with the goal of nurturing at least 1,000 technology-based startups for the next 5 years.

PRIORITIES FOR 2023 – 2028

1. Startup Grant Fund Program
2. Women Helping Women: Innovating Social Enterprises (WHWISE)
3. Startups Creating Innovations for the Government (SCI4Gov) Program
4. Innovation to Incubation for New and Emerging Technologies (iNEST) Program
5. DOST-DTI-DICT Partnership

PRIORITIES FOR 2024 – 2028

1. Electronic-Learning Initiatives for the Next Generation to Advance Education in the Philippines (e-LINGAP) Program

PROPOSED BUDGET FOR STARTUP DEVELOPMENT PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
116 M	181 M	184 M	207 M	190 M	200 M	220 M

Z. TECHNOLOGY BUSINESS INCUBATION PROGRAM

A Technology Business Incubator or TBI offers assistance to aspiring technopreneurs and existing startups by providing them with office and co-working spaces, mentoring and training programs, marketing assistance and networking, IP Strategy and IP Protection, and access to their host university's network of alumni, innovation facilities, and business linkages, among others.

Since 2009, the Council has supported the establishment of thirty-two (32) industry based TBIs which are strategically located in different regions of the country. Through this TBI Network, the DOST-PCIEERD aims to help capacitate the innovation and entrepreneurial ecosystem within the Regions wherein these TBIs are located. Assistance for the TBIs shall continue through various capacity building programs, partnership support for internationalization, support for the improvement of incubation modules and network support through the establishment of startup enablers ecosystem consortia.

Moving forward, the Council will be focusing on supporting the transformation and application of the PCIEERD TBIs into full-blown S&T Parks. The World Bank and the United Nations Conference on Trade and Development (UNCTAD) places S&T Parks (or STPs) under the umbrella term of Special Economic Zone (SEZ), which are geographic areas

where the rules of business are different and where varied incentives are in place to attract investors and businesses from a wide range of manufacturing, technology, and service industries. S&T Parks are unique as they provide the necessary environment and ecosystem (e.g. proximity to research institutes and universities) that makes it conducive to innovation, knowledge-based work, and R&D activities.

Through the SPARK Program, which will be implemented in partnership with the PEZA, strategies shall include compliance to guidelines, branding, increasing client reach, provision of incentives and additional programs and building new programs meeting the international practices for S&T Parks and Services.

PRIORITIES FOR 2023 – 2028

1. Higher Education Readiness for Innovation and Technopreneurship Program for Starting TBIs (HEIRIT)
2. Higher Education Readiness for Innovation and Technopreneurship Regional Startup Enablers for Ecosystem Development (HEIRIT ReSEED)
3. Science & Technology Parks for Accelerating Research and Knowledge (SPARK)

PROPOSED BUDGET FOR TECHNOLOGY BUSINESS INCUBATION PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
73.9 M	115 M	23 M	115 M	96 M	42 M	96 M

AA. CAPABILITY BUILDING Programs

The program provides support and developed regional network institutions, researchers, scientists and engineers (RSEs), partners and/or stakeholders in the country. To support the human resource development and research institutions in the country under the industry, energy and emerging technology (IEET), DOST-PCIEERD has established programs such as the Human Resource Development Programs (HRDP) that includes research attachment, visiting expert, presentation of research results in conferences/fora/seminars, support to workshop and conferences, publication of research papers in S&T journals, facilities and laboratory access grant (FLAG), Providing Resources and Opportunities to Project-based Personnel (PROSPPER), Researchers on Industry, Energy and Emerging Technologies – Opening Opportunities for Learning (RIEETOOL) and Balik Saliksik, Institution Development Program (IDP), Young Innovators Program (YIP), Good Governance through Data Science and Decision Support System (GODDESS) Program, Balik Scientist Program (BSP) and Regional Research Institutions (RRI).

The Council provides different funding opportunities to enable our researchers and innovative thinkers to pursue world-class research. The ***Human Resource Development Program or HRDP*** was established with the aim of – developing and enhancing Filipino research and development (R&D) and support capabilities to meet the present and future human resource requirements in the industry, energy, and emerging technology sectors or Industry, Energy and Emerging Technology.

Recently, PCIEERD is exerting efforts to update and revitalize the existing PCIEERD's Human Resource and Institutional Development (HRIDD) Programs. In 2021, four (4) new

programs under the HRDP were launched: 1) Providing Resources and Opportunities to Project-based Personnel (PROSPPER); 2) Researchers on Industry, Energy and Emerging Technologies – Opening Opportunities for Learning (RIEETOOL); 3) Expert Intervention for Scientific Engagement (ExperTISE) Program for PCIEERD Regional Consortia; 4) Regional Research Institutions (RR). The roadmaps help us and those we serve see eye to eye in terms of R&D direction or where things could be headed.

1. HUMAN RESOURCES DEVELOPMENT PROGRAM (HRDP)

The HRDP was established to develop and enhance Filipino R&D and support capabilities to meet the present and future human resource requirements in the IEET sectors. The program provides support to the following components: research attachment, visiting expert, presentation of research results in conferences/fora/seminars, support to workshop and conferences, publication of research papers in S&T journals, facilities and laboratory access grant (FLAG). New programs were also implemented in 2021 to increase the RSEs in the sector, namely: Providing Resources and Opportunities to Project-based Personnel (PROSPPER), Researchers on Industry, Energy and Emerging Technologies – Opening Opportunities for Learning (RIEETOOL) and Balik Saliksik.

PRIORITIES FOR 2023

1. Implementation of the HRDP with provision of support for 30 HRDP grantees / activities in the IEET sectors, as follows but not limited to the following: Quantum mechanics, Quantum Technology, Satellite Comm, Satellite Dev, Earth Observation, Optics and photonics, AI and other areas identified in the HNRDA

PRIORITIES FOR 2024

1. Implementation of the HRDP with provision of support for 30 HRDP grantees / capability development activities in the IEET sectors, as follows but not limited to the following: Optics and photonics, Nanofabrication, Materials for energy, Advanced materials, AI and other areas identified in the HNRDA

PRIORITIES FOR 2025

1. Implementation of the HRDP with provision of support for 35 HRDP grantees / capability development activities in the IEET sectors, as follows but not limited to the following: Optics and photonics, Nanofabrication, Materials for energy, Advanced materials, AI and other areas identified in the HNRDA

PRIORITIES FOR 2026

1. Implementation of the HRDP with provision support for 35 HRDP grantees / capability development activities in the IEET sectors, as follows but not limited to the following: Optics and photonics, Materials for energy, 4D/3D printing with AI, AI and other areas identified in the HNRDA

PRIORITIES FOR 2027

1. Implementation of the HRDP with provision of support for 40 HRDP grantees / capability development activities in the IEET sectors as identified in the HNRDA

PRIORITIES FOR 2028

1. Implementation of the HRDP with provision of support for 45 HRDP grantees / capability development activities in the IEET sectors as identified in the HNRDA

PROPOSED BUDGET FOR HRDP (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
15 M	18 M	20 M	25 M	25 M	25 M	25 M

2. YOUNG INNOVATORS PROGRAM (YIP)

The program is an initiative of PCIEERD to provide funding to students who want to pursue an innovative work leading to quality research paper, publication or product/invention. The program will also aid in ushering young innovators, to independent research to accelerate the production of scientific workforce and encourage new and innovative research areas.

The YIP roadmap is envisioned to support the generation of new young researchers in the country. The objective of the roadmap is to increase the number of young researchers engaged and trained in R&D.

PRIORITIES FOR 2023

1. YIP 2023 Call for Proposals
2. YIP impact assessment
3. 20 New YIP Projects
4. Implementation of the YIP Roadmap
5. 1 New support program for selected completed YIP projects
6. Result of impact assessment

PRIORITIES FOR 2023 – 2027

1. YIP Pre-engagement and Promotional activities
2. New YIP Institutions and Researchers Engaged
3. Improved efficiency of evaluation process

PRIORITIES FOR 2024

1. 2024 YIP Call for Proposals
2. Revision of YIP guidelines/policies
3. 25 New YIP Projects
4. Enhancement of the YIP guidelines/policies, strategies and/or implementation mechanism
5. 1 Outstanding YIP award
6. 1 Support program for selected completed YIP projects

PRIORITIES FOR 2025

1. 2025 YIP Call for Proposal
2. 30 New YIP Projects
3. Implementation of new support program for selected completed YIP projects (2025 - 2027)

PRIORITIES FOR 2026

1. 2026 YIP Call for Proposal
2. 33 New YIP Projects

PRIORITIES FOR 2027

1. 2027 YIP Call for Proposal
2. 33 New YIP Projects

PRIORITIES FOR 2028

1. 2028 YIP Call for Proposal
2. YIP Pre-engagement and promotional activities
3. 35 New YIP Projects
4. New YIP Institutions and Researchers Engaged
5. Improved efficiency of evaluation process
6. Implementation of new support program for selected completed YIP projects

PROPOSED BUDGET FOR YOUNG INNOVATORS PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
5 M	7 M	9 M	11 M	13 M	15 M	17 M

3. REGIONAL CONSORTIA PROGRAM

The program aims to establish, develop and maintain local and international technical cooperation linkages. This cooperation includes building partnerships in the regions through various schemes, also serve in harnessing the effective use of resources in the regions through the pursuit of research and development (R&D) and other scientific activities responsive to regional industry needs and anchored on the PCIEERD's priority areas which is also essential and pivotal in the country's envisioned inclusive growth.

These efforts are envisioned to sustain the holistic development of the regions' resources through networking and collaborations among its member institutions from the academe, government and the private sectors. This is also in line with the Council's commitment for continuous improvement to streamline and improve the efficiency of its regional consortia processes.

The following are the three (3) components of the program:

a. **Regional Consortia Operations:** This is in line with the Council's commitment for continuous improvement to streamline and improve the efficiency of its regional consortia processes and building partnerships in the regions through various schemes by providing funding support for the operations of the consortia.

b. **Regional Research Institution (RRI):** The Regional Research Institution (RRI) provides R&D funding assistance for new researchers and/or new institutions members of the PCIEERD Regional Consortia for the development of research projects to address the needs that are aligned with priority areas of the regions and the PCIEERD.

c. **Experts Intervention For Scientific Engagement (Expertise):** The Expert Intervention for Scientific Engagement (ExperTISE) program serves to: 1) Provide industry

intervention program for the PCIEERD regional consortia researchers and institution members; 2) Strengthen R&D partnerships of existing consortia researchers with industries and industry professionals in the region, 3) Offer scientific skills and services of all our consortia researchers to the industry in the region, and 4) Support the budding and emerging industries and/or companies in the region and identify their potential niche, industry gaps, challenges and R&D needs as well as engage the industry leaders in each region.

PRIORITIES FOR 2023 – 2028

1. Approval of projects per year for RRI/ ExperTISE (at least 1 per region)
2. Implementation of industry-academe actual immersion program
3. Engagement of new Institution members of the consortia
4. Evaluation and submission of S&T agenda

PROPOSED BUDGET FOR REGIONAL CONSORTIA PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
40 M	40 M	40 M	50 M	50 M	50 M	50 M

4. INSTITUTION DEVELOPMENT PROGRAM (IDP)

The IDP aims to provide support for the development of infrastructure/upgrading of research laboratories and facilities of academic and research institutions in areas within the PCIEERD sectoral priority areas or the Harmonized National R&D Agenda (HRDA) where there is inadequacy of research expertise and/or facilities. The program is open to DOST-attached Agencies, DOST Regional Offices, State Universities and Colleges (SUCs), CHED-recognized Center of Development and government research institutions who has a five-year research agenda (or an equivalent strategic plan) in the laboratory being proposed and has demonstrated potential capability in research.

The grant covers purchase of laboratory equipment/facilities, including highly specialized software and other relevant operational expenses.

From 2015-2020, the project has helped set up and upgrade 23 laboratories all over the country, amounting to a total investment of Php 125.1 million. In 2021, 11 new laboratories will be established specializing in artificial intelligence, microbiology, natural language processing, pavement research, microgrid for sustainable energy, IoT research, drilling fluids, food integrated research, amateur satellite ground station and smart warehouse inventory management.

The IDP roadmap is to establish new facilities and services in the regions where the researchers will have sustained access.

PRIORITIES FOR 2023

1. At least 4 IDP laboratories on creatives footwear facility, furniture facility, and textile, UVS lab and nitration, legal technologies
2. Updating of IDP Guidelines
3. Increased budget allocation per Laboratory
4. Launching of newly approved facilities
5. Nationwide coverage for IDP

PRIORITIES FOR 2023 – 2028

1. Outstanding IDP Lab and PL
2. Equipment/facilities database (equipment.pcieerd.dost.gov.ph, oneDerful, oneTreat)
3. Engagement of New Institutions
4. Profiling of institutions

PRIORITIES FOR 2024

1. At least 5 IDP laboratories
2. Establishment of metal casting facility, Air Quality Lab, Block Chain Facility

PRIORITIES FOR 2025

1. At least 6 IDP laboratories
2. Establishment of Quantum Computing Lab, photonics lab and nanofabrication manufacturing/electronics facility

PRIORITIES FOR 2025 – 2028

1. Completed IDP upgraded into NICER

PRIORITIES FOR 2026

1. At least 7 IDP laboratories

PRIORITIES FOR 2026 – 2028

1. Establishment of new and emerging facilities in the regions

PRIORITIES FOR 2027

1. At least 8 IDP laboratories

PRIORITIES FOR 2028

1. At least 10 IDP laboratories

PROPOSED BUDGET FOR INSTITUTION DEVELOPMENT PROGRAM (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
20 M	25 M	30 M	35 M	40 M	45 M	50 M

5. BALIK SCIENTIST PROGRAM

This program is a DOST's flagship program for reversing brain drain in the country. It aims to encourage Filipino scientists, technologists, and experts to return to the country and share their expertise to promote scientific, agro-industrial, and economic development, including the development of the country's human capital in science, technology and innovation. It is envisioned to sustain supply of science and technology experts from abroad who are Filipino or foreigners of Filipino descent with appropriate expertise to serve our country and accelerate economic development through research and development.

PROPOSED BUDGET FOR THE BALIK SCIENTIST PROGRAM (PCIEERD COMPONENT) (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
62 M	65 M	65 M	65 M	65 M	65 M	70 M

6. GODDESS PROGRAM

The Good Governance through Data Science and Decision Support System (GODDESS) program provides funding for projects to aid the local and national government agencies to have a data-driven decision-making. In addition, different institutions also send their personnel, researchers and faculty to undergo training or degree programs in the data science fields since these institutions recognize the importance of data science and analytics in support of decision-making. Thus, GODDESS is expanded to include graduate students, researchers, faculty, personnel and practitioners in data science and analytics field for the development of systems and technologies to aid in decision making of their respective institution/s and/or identified partner/s from an LGU, NGA or MSME.

Overall, the GODDESS aims to provide assistance for the development of appropriate systems and technologies to address the specific needs of the LGU, NGA, academic or research institutions and MSMEs and enable them to adapt data driven governance and evidence-based management.

PRIORITIES FOR 2023 – 2025

1. Support for up to 25 projects on Data Science and Analytics per year focusing on the following agencies: DOJ, DAR, COA, DAP, Procurement
2. Expansion to LGU, NGA, and MSMEs

PRIORITIES FOR 2026 – 2028

1. Support for up to 30 projects on Data Science and Analytics per year focusing on the following agencies: DOJ, DAR, COA, DAP, Procurement
2. Expansion to LGU, NGA, and MSMEs

PROPOSED BUDGET FOR THE GODDESS PROGRAM (PCIEERD COMPONENT) (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
25 M	25 M	25 M	25.5 M	25.5 M	30 M	30 M

BB. SCIENCE COMMUNICATION

Science Communication (SciComm) is a growing area of practice and research (Burns, 2003) that plays a vital role in today's development challenges. The Philippines, although having a rich documented history of science and its development (e.g. Anderson, 2007 Velasco and Baens-Arcega, 1984), still needs to delve into the "identity" or "face" of SciComm in the country.

Efforts in mainstreaming Science Communication in the country was initiated through roundtable discussions led by the University of the Philippines – Los Baños, College of Development Communication (UPLB-CDC). Conducted last 1999, 2002, and 2016 respectively, these in-house workshops established science communication's distinct features, scope, areas of application, and role in the fields of development issues such as disaster risk reduction and management, food security, and health, among others. After five (5) years, the 4th Roundtable Discussion on Science Communication was organized by DOST-PCIEERD in collaboration with UPLB-CDC to identify the needs, priorities and capabilities of the key players of Science Communication from the industries and research institutions.

With a growing demand for basic research, evaluation metrics, and technology in SciComm, it is regarded as vital to maintain R&D support efforts in the country toward an integrated, inclusive, and innovative approach to Science Communication (SCICOM). The general objective of this call is to establish the foundation of science communication in the country through R&D support. The following are the specific objectives of the call:

- Provide R&D support for research on science communication
- Provide R&D support for the establishment and/or development of science communication infrastructure, technologies, human resource development plans, and among others.

PRIORITIES FOR 2023

1. Collaboration with stakeholders on science communication by fostering research and frameworks
    a. In partnership with science communicators, creation of a draft guidebook that can be used as a common guide across the country
    b. Creation of a database and knowledge management on SciComm
2. Development of SciComm Training Programs and HRD Plan
3. Development of SciComm in R&D Projects Policy
4. Development of SciComm Center
5. Development of SciComm Bill

PRIORITIES FOR 2024

1. Collaborative efforts should be intensified, and a holistic study of PH scientific communication should be promoted
    a. Finalization of the draft guidebook through a series of changes and include a Filipino edition. This can be partnered with the *Komisyon sa Wikang* Filipino.
    b. As a result of peer reviews, intensify database and knowledge management system revisions
2. Training programs and HRD methods, partnerships with a number of government organizations and even commercial businesses should have been established
3. Intensification of partnerships with agencies and stakeholders that can come up with studies and designs that can be included into various policies is necessary
4. Alliance with key people to create a SciComm Center
5. Partnership with policy makers in the country that can author the bill and lobby it for support

PRIORITIES FOR 2025

1. The foundation for a holistic study of PH scientific communication has been laid.
   a. SciComm Framework and Handbook Tool Kit are being disseminated in both English and Filipino
   b. Establishment of Science Communication Database/KMS
2. Implementation of science communicator training programs in the community, schools, organizations, government agencies, and other important stakeholders
3. Implementation of Science and Communication in research and design
4. Actual establishment of physical centers in strategic areas throughout the country
5. The Bill is signed and implemented throughout the country, from municipal to national levels

PROPOSED BUDGET FOR SCIENCE COMMUNICATION (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
70 M	70 M	70 M	70 M	50 M	50 M	50 M

III. ROADMAPS

(Please click the link below to open the IEET Roadmaps)

https://drive.google.com/file/d/1vwGa_zHu7T6hvCHD6Ew2xo-ZhMLVoLPY/view?usp=sharing

SECTION 5

DISASTER RISK REDUCTION AND CLIMATE CHANGE

I. INTRODUCTION

This chapter on Disaster Risk Reduction and Climate Change of the Harmonized National Research and Development Agenda (HNRDA) covers the initiatives that address the Filipino aspirations of safe, inclusive, resilient, and sustainable communities.

As a societal concern, disaster risk reduction and climate change (DRRCC) is multi-sectoral. When a disaster strikes, the impacts affect all sectors - public and private; all communities - rich and poor; all governments - national and local; all individuals - women and men, adults and children. The DRRCC agenda stakeholders are All People, rather than those traditional sectors.

Disasters are a complex societal problem, and dimensions of disaster studies span across the Key Result Areas of the other sectoral R&D agenda covered by the previous chapters. Disaster and climate change R&D is a cross-cutting theme.

Moreover, in contrast to the other agenda of the HNRDA, which are managed by Sectoral Councils and advisory bodies under the DOST system, the DRRCC agenda is managed by the DOST Central Office, under a designated Undersecretary.

As a national policy, this agenda derives its relevance from its interface with societal realities and experiences. It is fed by evidence; it responds to, and is triggered by societal concerns; it reflects the values of DOST and research institutions; and it recognizes political realities and governance structures. For DRRCC Agenda, the desired outcome is Science, Technology and Innovation for Safer Communities.

The Goals and Objectives of this agenda are primarily derived from the national policies and plans of the Philippine disaster risk reduction and management system, the agreements and decision made by the National Disaster Risk Reduction and Management Council at its Full Council and Thematic Pillar meetings, the climate change strategy and action plan consultations led by the Climate Change Commission, and the agreements and decision arrived at by the Cabinet Cluster on Climate Change Adaptation and Mitigation, and Disaster Risk Reduction. From DOST, the attached agencies with DRRCC mandates help define the Goals and Objectives and at the same time operationalize them through their agency initiatives.

Internationally, this agenda also draws from regional and global disaster and climate risk reduction platform agreements, in particular the Sendai Framework for Disaster Risk Reduction (SFDRR), the Paris Agreement, and the Sustainable Development Goals, giving it a global and strategic perspective.

The convergence of disaster and climate risk reduction and the integration of their action plans is an aspiration of DOST, who has always considered the two as parts of a continuum. As a guiding principle, the DOST subscribes to the concept that disaster risk reduction and management address those risks that arise from what is now already known – such as natural hazards and even health hazards. On the other hand, climate change adaptation and mitigation address those risks that are anticipated and have not been manifested, or are just incipiently manifested in the current time – such as rising sea level and global temperatures.

Conceptually, it means that what disaster risks we are able to reduce now will affect (reduce) climate change risks in the future. This is theoretically supported by Systems Thinking, a holistic approach to analysis that states that constituent parts interact and interrelate with each other over time, and within the context of larger systems.

This continuum of disaster and climate change risks is central to the development of the chapter's framework.

The HNRDA 2017-2021 Framework

In the previous document, HNRDA 2017-2021, the influence of the SFDRR in the chapter on DRRCC was very prominent. The DRRCC agenda identified eight Key Result Areas (KRAs) grouped under three strategic concerns, namely 1) understanding the disaster risks, 2) Communicating the disaster risks, and 3) Investing in developing STI solutions to address preventable disasters (Table 1).

Strategic Concern 1 was primarily about developing systems to monitor known and most frequently encountered natural hazards, as well as developing technologies and models to improve the forecasting capabilities, especially timeliness and accuracy of warning messages.

Strategic Concern 2 dealt with communicating the hazards and risks – where they are expected, how big is the area and magnitude of impact, and what are the losses associated with these hazards when they occur. It also aimed to develop different communication materials, including those intended for decision-makers to contribute to conversations in the policy arena.

Strategic Concern 3 focused on developing technologies and applications for disaster and climate risk management, to address preventable disasters.

Table 1. The DRRCC Framework 2017-2021 consisted of Strategic Concerns and Key Result Areas

STRATEGIC CONCERNS	KEY RESULT AREAS
Understanding the disaster risks	1 Observation and monitoring networks 2 Technology Development and Application for Monitoring 3 Modeling and Simulation for Improvement of Monitoring and Forecasting 4 Hazards, vulnerability, and risk assessment
Communicating the disaster risks	5 Warning and Risk Communication 8 Policy Research
Investing in developing STI solutions to address preventable disasters	6 Technology Development and Application for Climate Change Adaptation and Mitigation 7 Technology Development and Application for Disaster Risk Management

The Sectoral Councils and advisory body under the DOST system evaluated DRRCC R&D proposals using the framework. It should also be noted that of the eight KRAs, DOST directly supported KRAs 1 to 5 through its attached agencies and their Programs, Projects and Activities (PPAs), primarily under the annual General Appropriations Acts.

The HNRDA 2022-2028 Framework

The years 2020 and 2021 taught us notable lessons on risk reduction during long-drawn disasters. Our generation has never felt a long-drawn disaster more strongly than during the COVID-19 pandemic. The health risks from the COVID-19 added to, and exacerbated the risks from typhoons, earthquakes and volcanic eruption, from hunger, from economic deprivation and other stressors in our daily lives.

In the practice of disaster risk reduction, what the pandemic demonstrated and what we continuously re-learn, among others, is the pluralistic nature of risk. Risks do not operate in isolation, but multiple risks from multiple causes, in multiple forms, and in multiple scales occur together at the same time. A year earlier in 2019, the UN Secretary General Antonio Guterres (24 January 2019) * said,

> *"...we are in a world in which global challenges are more and more integrated, and the responses are more and more fragmented, and if this is not reversed, it's a recipe for disaster."*

*UN Secretary General Antonio Guterres speech at the World Economic Forum Annual Meeting, accessed on January 2022 at https://www.weforum.org/agenda/2019/01/these-are-the-global-priorities-and-risks-for-the-future-according-to-antonio-guterres/

In addressing multiple risks, we are thus challenged to have a mindset and approach that are integrative and holistic, as well as bold and edge-pushing.

In the new framework, we give more flesh to the complexity of compounding disaster risks from natural hazards and climate change, by considering dimensions of resilience that we find across the sectoral concerns in Chapters 1 to 4 of the HNRDA.

We noted, for example, how pursuing the Systems Thinking principle, we see that climate is affected by demographics, settlements and communities, waste, lifeline networks, and other artifacts of human activities. We therefore aimed to surface these dimensions of resilience clearly to better guide the stakeholders of the HNRDA in appreciating the wide horizon and landscape of DRRCC R&D.

In regard to the dimensions of resilience, we want to directly address two matters:

1. in recognizing that DRR and CC operate in a System, we demonstrate that the interaction of parts can better capture the needs of society, and the gaps in the R&D, and
2. we demonstrate the logical flow from one KRA to other KRAs.

Operational Framework

By intersecting these dimensions of resilience with the KRAs and applying the lens of disaster-and-climate-risk-reduction, we can guide the type of research questions we want to be answered, and the type of results they provide.

The first dimension, NATURAL HAZARDS, covers what is traditionally considered in disaster and climate risk reduction, and mainstreamed at the operations level of two DOST attached agencies (see Section below DOST R&D Programs).

DOST drew the other dimensions from the current urgent calls of major DRRCC stakeholders, one of which is to continue to study the COVID pandemic and to prioritize water-related concerns. Therefore, we have HEALTH and WATER. We considered major themes in the Sustainable Development discourses and selected NATURAL RESOURCES and ENERGY. We also included a theme that would capture the effects of human activities as they interact with the natural environment. Thus, we have SOCIETY.

Using this operational framework (Table 2), DOST translated them to the menu of R&D initiatives to be pursued through its R&D Councils and attached agencies, and their research partners. In the table, we identified R&D Themes that we find most relevant for supporting the risk reduction, sustainable and climate change goals of the Philippines.

In the next sections we present a typology of research themes, the type of research questions under each KRA and their expected outputs. Because DRRCC concerns cut across the sectoral concerns, we also indicate the related Programs under Sections 1 to 5.

Table 2. Key result areas, dimensions of resilience, and the broad R&D themes

DRRCC KRAs	**A NATURAL HAZARDS**	**B HEALTH**	**C WATER**	**D NATURAL RESOURCES**	**E ENERGY**	**F SOCIETY**
Strategic Concern 1 Understanding the disaster risks						
1 Observation and monitoring networks	Natural hazards observation	Communicable diseases observation, Public health	Freshwater supply and quality, Dam discharge Sea level rise and fall	Biodiversity, Crops, Livestock and Fish stock, Diseases observation	Greenhouse gasses **Hazardous waste products*	Urban growth, Lifeline networks, Waste products **environmental radioactivity*
2 Technology Development and Application for Monitoring	monitoring systems	monitoring systems	monitoring systems	monitoring systems	monitoring systems	monitoring systems
3 Modeling and Simulation for Improvement of Monitoring and Forecasting	Frequency, magnitude, intensity	Frequency, magnitude, intensity	Discharge models, Rate of loss, Rate of rise and fall	Rate of loss, frequency, magnitude, intensity	Dispersion, Reduction, Carbon Footprint	Growth models, Carrying capacity, Contamination and dispersion
4 Hazards, vulnerability, and risk assessment	Statistical estimates, Methodologies	Statistical estimates, Methodologies, Health security	Dam break, Statistical estimates, Methodologies, Water security	Statistical estimates, Methodologies, Food and natural ecosystem security	Statistical estimates, Methodologies, GHG Inventory and supply chain Energy Security	Exposure *(elements-at-risk)* GIS-based methodologies for assessment
Strategic Concern 2 Communicating the disaster risks						
5 Warning and Risk Communication	Warning messages, Warning protocols, Access to information	Warning messages, Warning protocols, Access to information	Warning messages, Warning protocols, Access to information	Warning messages, Warning protocols, Access to information	Access to information **warning messages*	Access to information
*8 Policy Research	Analysis, evaluation and recommendation	Analysis, evaluation and recommendation	Analysis, evaluation and recommendation	Analysis, evaluation and recommendation	Analysis, evaluation and recommendation	Analysis, evaluation and recommendation
Strategic Concern 3 Investing in developing STI solutions to address preventable disasters						
6 Technology Development and Application for Climate Change Adaptation and Mitigation	Tools for adaptation, mitigation, managing future or projected natural-hazard risks	Tools for managing future or projected health risks	Preservation and conservation, Efficient use of water	Resistant varieties to climate change, improving ecosystem services	Alternative fuels and energy sources, Energy-efficient technologies	Product life cycle, alternative products
7 Technology Development and Application for Disaster Risk Management	Tools for managing currently known natural-hazard risks	Tools for managing currently known health risks	Resilient water supply system and infrastructure, tools for managing water environment risks	Resistant varieties to diseases; Preserving stock, tools for managing food supply-chain and natural ecosystem risks	Resilient and green energy infrastructure, tools for managing energy supply-chain risks	Resilient and green lifeline infrastructure, buildings and homes, Tools for managing disaster impacts

II. R&D Themes, Questions and Results and Related Programs under Sections 1 to 5

1. KRA 1 Observation and Monitoring Networks and the Dimensions of Resilience

KRA 1 covers the establishment and operations of various observation and monitoring networks. The R&D themes are subject matters under the various dimensions that are known to have a role in, been affected by, or may lead to future disasters under certain conditions.

1.A. Natural Hazards

a. Earthquake and tsunami, volcanic activity, landslide
   - Section 4: Development of Earth Observation (EO) solutions for Public Services; Multi-Hazard Assessment Tools and Systems
   - Section 5: Volcano, Earthquake, and Tsunami Monitoring and Warning Program; Volcano, Earthquake and Tsunami Hazards Mapping and Research and Development Program

b. Cyclone, severe wind, riverine and coastal flooding
   - Section 4: Development of Earth Observation (EO) solutions for Public Services; Multi-Hazard Assessment Tools and Systems
   - Section 5: Modernizing Weather Analysis and Forecast Operations; LIGTAS-BAHA

c. Environmental radioactivity

1.B. Health

a. communicable diseases
   - Section 2: Re-emerging and emerging Diseases; Communicable Diseases)

b. other public health concerns
   - Section 1: National security and sovereignty
   - Section 2: Food Safety; Genomic Bio-surveillance
   - Section 4: Chemical Metrology for Organic and Inorganic Contaminants in Food and Environment; Chemical Metrology for Inorganic Contaminants in Drinking and Environmental Waters, and Food Products; Biological Metrology for Microorganisms in Food and Water

1.C. Water

a. freshwater supply and quality
   - Section 1: Watershed Studies; Water quality, accessibility and availability
   - Section 4: Water supply and demand management and monitoring technologies

b. dam discharge
   - Section 4: Dam/watershed/reservoir management strategy

c. sea level rise or fall

1.D. Natural Resources

a. natural foliage such as forest and grassland cover, and environmental conditions
   - Section 1: Watershed Studies; Water quality, accessibility and availability; Vulnerable Ecosystems; Biodiversity and Ecosystem Studies
   - Section 3: Forestry Physiological and ecological studies; Varietal improvement of priority agroforestry/non-timber and forestry species; Conservation, sustainable utilization, and management of biodiversity in

terrestrial, freshwater and marine ecosystems; Resource and ecosystems assessment and monitoring

b. crops, livestock and fish stock for food production
    - Section 1: Taxonomic studies of flora and fauna as food sources
    - Section 3: Germplasm evaluation, conservation, utilization and management; Varietal improvement and selection
c. communicable diseases in plants and animals, especially those threatening food security
    - Section 1: Taxonomic studies of flora and fauna as food sources; Basic Veterinary Studies
    - Section 3: Cultural management practices (pest, water, soil and nutrient management); Fish health, disease diagnostics and disease management

1.E. Energy

a. Greenhouse gas emission inventory
    - Section 4: Interventions to reduce 75% greenhouse gases emission (as part of the National Commitment)
b. hazardous waste products of energy production

1.F Society

a. urban growth and demand for land
    - Section 4: Development of Earth Observation (EO) solutions for Public Services
b. lifeline networks, such as water, electricity, communications, road system, and infrastructure
c. waste products from agricultural, industrial, and household activities
    - Section 4: S&T Water Environment; S&T Clean Air; Sustainable S&T Solid Waste Management

Under KRA 1, the type of Research Question asked is:

> What monitoring network needs to be established to gather or generate baseline information on [research theme], the provision of which may lead to better understanding of [the theme's] characteristics and preventing disasters?

The KRA 1 Research Outputs are:

> The operating monitoring network and the datasets generated from the monitoring network, which may be enhanced or established for the first time under the project.

A possible Strategic Direction under KRA 1 is to be able to turn the project into a Frontline Service, such as warning information.

The research can lead to the other KRAs that will utilize the output of the monitoring network:

a. model certain [research theme] under KRA 3
b. assess hazards, vulnerability and risks under KRA 4
c. package into an information product to communicate hazards, vulnerability and risks under KRA 5
d. inform policy under KRA 8

2. KRA 2 Technology Development and Application for Monitoring and the Dimensions of Resilience

KRA 2 directly supports KRA 1 by creating the space for R&D to develop monitoring technologies where there are none, or to improve them where they exist, for the Research Themes identified under KRA 1. Hence the R&D themes are the same, but there is a nuanced difference in the research questions and outputs.

- Section 4: Development of Earth Observation (EO) solutions for Public Services; Sedimentation monitoring and mitigation system and technologies; Dams/watershed management and monitoring strategies; Water supply and demand management and monitoring technologies; Modelling and monitoring tools for extraction of safe quality of water; Localization of Observation and Forecasting Tools and Monitoring Networks for DRRCC; Multi-scale monitoring and prediction of climate extremes; S&T Clean Air - Real time monitoring and sensor networks;
- Section 5: Seismic and Tsunami Network Development; Volcano Network Development; Enhancement of Space Technology Applications for Tropical Cyclone monitoring; Operationalization of MCS Tracking Algorithm using HIMAWARI Satellite Data; Advanced Space Technology for Real-Time Flood Monitoring

Under KRA 2, the type of Research Question asked is:

> What technologies can be developed and applied to meet the local needs of monitoring [KRA 1 research theme], the provision of which may lead to better understanding of [the theme's] characteristics and how the operation of certain conditions on [the theme] may lead to disasters?

The KRA 2 Research Outputs are:

> the monitoring technology and the test and calibration data generated from it.

A possible Strategic Direction under KRA 2 is to develop our own local capabilities to commercially manufacture monitoring systems suited to our own needs and circumstances.

The research can lead to the other KRAs that will utilize the output of the technology:

a. establish a [research theme] monitoring network under KRA 1 when fully tested
b. assess hazards, vulnerability and risks under KRA 4
c. inform policy under KRA 8

3. KRA 3 Modeling and Simulation for Improvement of Monitoring and Forecasting and the Dimensions of Resilience

KRA 3 models the characteristics of the research themes under KRA 1, but also aims to generate the datasets that would enable forecasting and predicting their behavior and their possible future states. Special focus is on developing methodologies to provide robust forecasts and predictions.

3.A. Natural Hazards

a. intensity, magnitude, frequency of natural hazards
    - Section 4: Coastal hazards; thermal and environmental-related land-use scenarios; Impact-based forecasting
    - Section 5: Measurement of Velocities of Earthquake Faults; 3D Philippines; Multi-Hazard Impact-Based Forecasting and Early Warning System for the Philippines; Improvement of Data Assimilation and Numerical Prediction System; Radar Quantitative Precipitation Estimate; Observation and Modeling Studies of Typhoon Formation Structure; Radar and Satellite-Based Flashfloods and Landslides Forecasting; High-Resolution Flood Modeling of Major Urban Areas with Advanced Hydrological Models; Internet of Things (IoT) Approach and Cloud Computing in Flood Forecasting; CLIM'UP; Atmospheric Aerosols Dispersion Modeling
b. probabilities and uncertainties of natural hazards
    - Section 5: Improvement of Data Assimilation and Numerical Prediction System; Radar Quantitative Precipitation Estimate

3.B. Health

a. intensity, magnitude, and frequency of communicable diseases and other public health concerns
    - Section 2: Re-emerging and emerging Diseases; Communicable Diseases; Disease Modelling
b. probabilities and uncertainties of health hazards

3.C. Water

a. discharge models from rivers, groundwater source models, rate of loss of freshwater sources
    - Section 4: Groundwater management subsector - Karst
b. discharge models from dams
c. rate of rise and fall of sea-level
    - Section 4: Ocean Forecast System for Marine Activities

3.D. Natural Resources

a. rate of loss of foliage cover and biodiversity
    - Section 1: Vulnerable Ecosystems; Biodiversity and Ecosystem Studies
    - Section 3: Resource and ecosystems assessment and monitoring
b. intensity, frequency and magnitude of crop, livestock, fish stock losses from natural and human-induced triggers
    - Section 1: Vulnerable Ecosystems
    - Section 3: Fish health, disease diagnostics and disease management; Fish kill warning and mitigation system

3.E. Energy

a. Dispersion, reduction of greenhouse gases, carbon footprints

3.F. Society

a. growth models of urban areas, carrying capacity of lands
    - Section 1: Vulnerable Ecosystems
b. contamination and dispersion of hazardous waste products

Under KRA 3, the type of Research Questions asked are:

How will the [research theme] behave under the condition of [x, y, z parameters]?
How sensitive is [the research theme] to the influence of [x, y, z parameters]?

The KRA 3 Research Outputs are:

the model, simulation, forecast or prediction of a [research theme], as well as the methodology and dataset used to derive the model

A possible Strategic Direction under KRA 3 is to make a library or a collection of ready models for all possible scenarios. By having many scenarios, one can generate probabilistic models (preferred by Insurance and other Risk financing organizations), but also making possible issuing of warning information close to real-time in case of hazards.

The research can lead to the other KRAs that will utilize the output:

a. assess hazards, vulnerability and risks under KRA 4
b. package into an information product to communicate hazards, vulnerability and risks under KRA 5
c. inform policy under KRA 8

4. KRA 4 Hazards, Vulnerability and Risk Assessment and the Dimensions of Resilience

KRA 4 aims to describe the vulnerability of natural and human-built systems, and to quantify hazards and risks society faces, under current situations or in some future time. Similar to KRA 3, an important aspect of the R&D is to develop the methodologies to quantify hazard, vulnerability, and risk. Under this KRA, we want to address the concerns on security of health, water, food, ecosystems, and economic systems.

4.A. Natural Hazards

a. natural hazard and risk information
    - Section 4: Multi-Hazard Assessment Tools and Systems
    - Section 5: Volcano, Earthquake and Tsunami Hazards Mapping and Research and Development Program; Volcano, Earthquake and Tsunami Hazards Mapping and Research and Development Program; 3D Philippines; Philippines Storm Surge Atlas for Coastal Flood Early Warning
b. vulnerability and capacity, risks to natural hazards
    - Section 4: Sectoral impacts and risk assessment of possible changes in meteorological elements
    - Section 5: Stakeholders' Engagement and Analysis (SEA)

4.B. Health

a. health hazard and risk information
    - Section 2: Re-emerging and emerging Diseases; Communicable Diseases; Researches to ensure health consequences during disasters are reduced; Climate Change Adaptation in Health
    - Section 4: Sectoral impacts and risk assessment of possible changes in meteorological elements
b. vulnerability and capacity, risks to health hazards

- Section 2: Re-emerging and emerging Diseases; Communicable Diseases; Climate Change Adaptation in Health

4.C. Water

a. vulnerability of fresh groundwater sources
    - Section 4: Sectoral impacts and risk assessment of possible changes in meteorological elements
    - Section 5: Basin-wide Water Resources Assessment with Climate Predictions
b. dam break hazard and risk

4.D. Natural Resources

a. vulnerability of biodiversity, risks from natural or human-induced threats
    - Section 1: Vulnerable Ecosystems
    - Section 4: Development of Earth Observation (EO) solutions for Public Services; S&T Clean Air
b. vulnerability of crops, livestock, and fish stock, risks from natural or human-induced threats
    - Section 3: Fishkill warning and mitigation systems
    - Section 4: Development of Earth Observation (EO) solutions for Public Services; Sectoral impacts and risk assessment of possible changes in meteorological elements

4.E. Energy

a. GHG emission hazard and risk information, GHG inventory and supply chain
b. vulnerability of energy supply, risks from natural or human-induced threats
    - Section 4: Sectoral impacts and risk assessment of possible changes in meteorological elements

4.F. Society

a. exposure databases, GIS-based methodologies and applications for estimating risks to communities
    - Section 4: Development of Earth Observation (EO) solutions for Public Services; Exposure Data
    - Section 5: National Exposure Database, GeoRisk Philippines; Enhanced Knowledge Management Systems for Reducing Vulnerability of Coastal Communities to Climate-Induced Coastal Hazards
b. vulnerability of human-built elements in communities, such as lifeline infrastructures, buildings and settlements
    - Section 5: Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC; GeoRisk Philippines
c. vulnerability of economic and social systems
    - Section 1: Vulnerable Ecosystems; Greening the mined-out areas in the Philippines; Risk Communication Studies for Disaster Risk Management
    - Section 3: Agriculture and resource economics studies; Applied rural sociology studies
    - Section 4: Development of Earth Observation (EO) solutions for Public Services
    - Section 5: GeoRisk Philippines; Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events; Socio-economic benefit

of meteorological products and services (Cost-Benefit Analysis); Strengthening Institutions and Empowering Localities Against Disasters and Climate Change in the Philippines

Under KRA 4, the type of Research Questions asked are:

To what extent will a [hazard, condition] affect society?

What set of conditions makes [element of community or society] vulnerable to hazards and risks?

The KRA 4 Research Outputs are:

a. Representation of hazard and risk. The output differs from KRA 3 because KRA 4 is from datasets collected from the ground, whereas KRA 3 is from possible scenarios
b. Assessment and evaluation of vulnerability of [research theme], hazard and risk impacts to society, loss-and-damage expressed in economic value, social well-being
c. Climate scenarios, possible future of natural and human-built ecosystems under projected climate scenarios

A possible Strategic Direction under KRA 4 is developing alternative policies to secure health, water, food, natural ecosystems, energy, infrastructure, buildings and settlements and other societal needs.

The research can lead to the other KRAs that will utilize the hazard, vulnerability or risk information output:

a. model certain research themes under KRA 3
b. package into an information product to communicate hazards, vulnerability and risks under KRA 5
c. technologies and applications under KRAs 6 and 7
d. inform policy under KRA 8

5. KRA 5 Warning and Risk Communication and the Dimensions of Resilience

KRA 5 is concerned with developing contents of public warning messages, warning protocols from the source of warning to the recipients of warning information, access to information, and packaging information for planning and decision-making for the Research Themes identified under KRA 1.

- Section 1: Vulnerable Ecosystems; Risk Communication Studies for Disaster Risk Management)
- Section 4: Capacity building / effective risk communication for coastal communities; Early Warning Systems and Warning Plans
- Section 5: Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events; DANAS: Earthquake, Tsunami and Volcano Disaster Narratives for an Experiential Knowledge-based Science Communication; Weather and Climate Data Science for Service Partnership for SEA; FOREWARN -Risk Communication

Under KRA 5, the type of Research Question asked is:

In what manner can information on [research theme] be packaged to optimally serve and support its stakeholders' decisions, policies, plans and actions?

The KRA 5 Research Outputs are:

Information products and platforms

A possible Strategic Direction under KRA 5 is that information products can be made available at-the-tip-of-the-fingers through online and mobile applications.

The research can lead to the other KRAs that will utilize the information product and system:

a. technologies for disaster risk reduction and management, or climate change adaptation and mitigation under KRA 6 and 7
b. inform policy under KRA 8

6. KRA 6 Technology Development and Application for Climate Change Adaptation and Mitigation and the Dimensions of Resilience

KRA 6 and 7 are both about technologies and applications other than monitoring. KRA 6 focuses on addressing future anticipated effects of climate change through adaptation and mitigation technologies.

6.A. Natural Hazards

a. addressing future anticipated risks to natural and human-built systems from natural hazards
    - Section 4: Drought mitigation technologies and systems; Community-based water harvesting technologies; Water supply and demand management and monitoring technologies; S&T Water

6.B. Health

a. addressing future anticipated risks to natural and human-built systems from health hazards

6.C. Water

a. preserving and conserving resources
    - Section 4: Comprehensive water resource management; Localized water harvesting and recharge facility; Water saving technologies; Water auditing technologies; Drought mitigation technologies and systems; Community-based water harvesting technologies; Water supply and demand management and monitoring technologies; Water desalination system; S&T Water

6.D. Natural Resources

a. developing resistant varieties of plants and animals to climate change
    - Section 3: Varietal improvement and selection, Crop production systems; Breed development and genetic improvement; Application of genomics in the study of diseases of aquatic species and fish resistance to climate

change; molecular phylogenetics; population genetics; New species for culture
- Section 4: Smart farming innovative water management systems

b. improving ecosystem performance under changing conditions
- Section 1: Greening Mined-out Areas in the Philippines
- Section 3: Cultural management practices (pest, water, soil and nutrient management); Production and management decision support systems; Sustainable inland and coastal watershed management and utilization; Strategies / decision management tools for climate change resilient environment; Habitat management for fishery and ecosystem sustainability

6.E. Energy

a. developing alternative fuels and energy sources, green technologies
- Section 1: Alternative energy
- Section 4: Advanced materials (energy generation and storage); Materials for Energy (Electrical Energy Storage); Nanotechnology-enabled technologies; Renewable Energy (RE); Development and demonstration of low carbon technology applications for Philippine MSMEs

b. promoting efficient use of energy
- Section 4: Materials for Energy; Renewable Energy (RE); Development and demonstration of low carbon technology applications for Philippine MSMEs; Next generation Energy efficient technologies

c. calculating carbon footprint
- Section 4: Interventions to reduce 75% greenhouse gases emission (as part of the National Commitment)

6.F. Society

a. product life cycle to aggressively address waste, developing alternative products
- Section 3: High-value product development from agricultural and forests wastes; Supply/value chain development of selected AANR industries and other agribusiness-related initiatives
- Section 4: Conduct of impact study of the success in adoption of Additive Manufacturing in construction; Advanced Materials (smart materials for biodegradable packaging and anti-corrosion coatings; Infinitely Recyclable Plastics); Innovative Housing/Building Technologies; Rubber-based Products for Construction Application; S&T Water Environment – compact technologies; S&T Solid Waste Management

b. calculating and reducing carbon footprint
- Section 4: Additive manufacturing (Actual application of 3DCP in construction projects)

Under KRA 6, the type of Research Question asked is:

For adaptation: what technology can trigger a [behavior change] to prevent the anticipated risk of [negative consequence] due to climate change?

For mitigation: what alternative technology can replace [an existing GHG technology] to reduce greenhouse gas emission?

The KRA 6 Research Outputs are:

Technologies, decision tools, information systems for adaptation and mitigation

A possible Strategic Direction under KRA 6 is to develop our local capabilities to address

our adaptation and mitigation needs in the way that is most suited to our local circumstances.

The research can lead to the other KRAs that will utilize the adaptation or mitigation technology:

a. establish a [research theme] monitoring network under KRA 1 when fully tested
b. model certain [research theme] under KRA 3
c. assess hazards, vulnerability and risks under KRA 4
d. package into an information product to communicate climate change hazards, vulnerability and risks under KRA 5
e. inform policy under KRA 8

7. KRA 7 Technology Development and Application for Disaster Risk Reduction and Management and the Dimensions of Resilience

KRA 7 focuses on addressing the current and known concerns in Disaster Risk Reduction and Management.

7.A. Natural Hazards

a. addressing current and known risks to natural and human-built systems from natural hazards
    - Section 5: Cloud Seeding Experiments and Application

7.B. Health

a. addressing current and known risks to natural and human-built systems from health hazards
    - Section 1: Fundamental Studies on Potential Sources of Natural Products from rare environments and endemic species
    - Section 2: Genomic Biosurveillance
b. application of new digital tools to manage disease spread and health crises
    - Section 2: S&T based innovations in building resilient health systems during disasters
c. compact, long-lasting health care essentials needed during pandemic and other crises
    - Section 2: S&T based innovations in building resilient health systems during disasters; Food Innovations to address the nutritional and health effects of disasters

7.C. Water

a. promoting efficient use of water
    - Section 4: Additive Manufacturing (Solar water evaporation for clean water production); Integrated community-based water and wastewater treatment; S&T Water Environment – compact technologies; S&T Water
b. resilient water-supply system infrastructure
    - Section 4: Localized water harvesting and recharge facility; Water saving technologies; Community-based water harvesting technologies; Water desalination system; Dam/watershed/reservoir management strategy; Green infrastructure for water management

7.D. Natural Resources

a. promoting the efficient use of water and other natural resources in food production; developing freshwater sources
    - Section 3: Sustainable inland and coastal watershed management and utilization
    - Section 4: S&T Water Environment
b. protecting and conserving biodiversity and habitats
    - Section 3: Germplasm evaluation, conservation, utilization and management; Varietal improvement and selection; Forestry Decision support systems; Habitat management for fishery and ecosystem sustainability; Marine environmental management; Fishkill warning and mitigation systems; Innovative management systems for unique landscapes and ecosystems; Ecotourism management
c. developing resistant varieties of plants and animals to diseases; improving agricultural yield
    - Section 3: Cultural management practices (pest, water, soil and nutrient management)
    - Section 4: Advanced Materials (Rapid disease diagnostics and enhancement of plant's capacity to absorb nutrients for agriculture and food industry)

7.E. Energy

a. developing resilient energy infrastructure
    - Section 4: Nanotechnology-enabled technologies; Smart Cities; Land Public Utility Vehicles (PUVs) and Electric Vehicles (EVs)
b. managing energy supply-chain risk
    - Section 4: Smart Cities; Land Public Utility Vehicles (PUVs) and Electric Vehicles (EVs); Alternative sources of energy for mass transport systems; Interventions to reduce 75% greenhouse gases emission (as part of the National Commitment)

7.F. Society

a. developing resilient lifeline infrastructure and networks, buildings and settlements, including resilient construction materials and design standards
    - Section 4: Water supply and demand management and monitoring technologies
b. managing disaster impacts
    - Section 1: Greening Mined-out Areas in the Philippines
    - Section 2: Researches to ensure health consequences during disasters are reduced
    - Section 3: Management and rehabilitation of degraded and polluted agricultural soils; Ecotourism management
    - Section 4: Advanced materials (Chemical and biosensors for occupational health and environmental monitoring; Infinitely Recyclable Plastics); Space Technology Applications; Development of Earth Observation (EO) solutions for Public Services; Innovative flood defense; Mine Tailings/Wastes
    - Section 5: Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC; GeoRisk Philippines

Under KRA 7, the type of Research Question asked is:

What technologies can be developed to address [DRRM concern] to ensure the

security of health, water, natural resources, energy and society?

The KRA 7 Research Outputs are:

Technologies, decision tools, information systems for disaster risk reduction and management

A possible Strategic Direction under KRA 7 is to develop our local capabilities to address our disaster risk reduction and management needs in the way that is most suited to our local circumstances.

The research can lead to the other KRAs that will utilize the disaster risk reduction and management technology:

a. establish a [research theme] monitoring network under KRA 1 when fully tested
b. model certain [research theme] under KRA 3
c. assess hazards, vulnerability and risks under KRA 4
d. package into an information product to communicate climate change hazards, vulnerability and risks under KRA 5
e. inform policy under KRA 8

8. KRA 8 Policy Research

We have long recognized that R&D results could and should inform policies. Thus, R&D projects supported by DOST are encouraged to state how their results may inform and be relevant in policy-making or policy reforms.

The policy research themes draw directly from the themes identified under KRAs 1 to 7.

- Section 1: Waste to energy; Future Earth; Hunger
- Section 3: Policy research and advocacy on natural resources/environment-related issues, supply chain/value chain related issues and others
- Section 5: Stakeholders' Engagement and Analysis, Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities, Analysis of DOST-PHIVOLCS Social Media data and Science Communication

Under KRA 8, the type of Research Question asked are:

How does [the R&D result] impact the [national, regional or policy] on [research theme or policy area]?

What alternatives are appropriate?

The KRA 8 Research Outputs is:

Policy analysis, evaluation and recommendation

A possible Strategic Direction under KRA 8 is active participation in defining science-based policies.

The research can lead to the other research themes under KRAs 1 to 7.

III. DOST R&D PROGRAMS

Among the agencies attached to DOST, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST-PAGASA), and the Philippine Institute of Volcanology and Seismology (DOST-PHIVOLCS) are the ones that have regular Programs, Projects and Activities (PPAs) that directly contribute to the KRAs, especially to KRAs 1 to 5, of the DRRCC agenda. Regular PPAs are funded under the annual GAA, but also, these agencies access the financing support of the Sectoral Councils, especially for their big-ticket investments in DRRCC projects.

PROGRAMS ON WEATHER FORECASTING, FLOOD AND CLIMATE

A. Program "FOREWARN"
B. Program "LIGTAS BAHA"
C. Program "CLIM'UP"
D. R&D for DRR/CCA

A. FORECAST AND WARNING (FOREWARN)

FOREWARN advances the meteorological services in the country, particularly those that deal with the improvement of weather forecasting and warning capabilities, through the application of emerging technologies and state-of-the-science tools to boost the Philippines' socio-economic advantage.

PRIORITIES FOR 2023 – 2026

1. Weather and Climate Data Science for Service Partnership for SEA (WCSSP)
2. Socio-economic benefit of meteorological products and services (Cost-Benefit Analysis, Nationwide)
3. Multi-Hazard Impact-Based Forecasting and Early Warning System for the Philippines (Tuguegarao; Legaspi, Albay; Palo, Leyte; New Bataan in Mindanao)
4. Modernizing Weather Analysis and Forecast Operations (Nationwide)
5. Enhancement of Space Technology Applications for Tropical Cyclone monitoring (Nationwide)
6. Improvement of Data Assimilation and Numerical Prediction System Radar Quantitative Precipitation Estimate (QPE) (Mactan, Guiuan, Iloilo, Subic, Tagaytay Radar Stations)
7. Improvement of wave prediction system (West Philippine Sea)
8. Operationalization of MCS Tracking Algorithm using HIMAWARI Satellite Data (Nationwide)
9. Philippines Storm Surge Atlas for Coastal Flood Early Warning (Leyte and Bohol)
10. Risk Communication (GCF-Counterpart) (Metro Manila, Cebu City, Tuguegarao, Legaspi, Palo Leyte, New Bataan in Mindanao)
11. Observation and Modeling Studies of Typhoon Formation Structure
12. Wave Modelling

PROPOSED BUDGET FOR FOREWARN (2022 – 2026)

2022	2023	2024	2025	2026
676.71 M	387.12 M	240.226 M	226.43 M	60.562 M

B. LIGTAS-BAHA

LIGTAS-BAHA encapsulates PAGASA's priority research and applications projects to address national concern on floods and landslides, aggravated by new external threats from climate change that has induced more intense events.

PRIORITIES FOR 2023 – 2025

1. Community-level Flood Monitoring and Forecasting (Nationwide)
2. Radar and Satellite-Based Flashfloods and Landslides Forecasting (Nationwide)
3. Land Subsidence-flooding Relationship in Critical Areas (San Andres, Catanduanes)

PRIORITIES FOR 2026 – 2028

1. Basin-wide Water Resources Assessment with Climate Predictions (Pampanga, Agno, Bicol, Cagayan River Basins)
2. High-Resolution Flood Modeling of Major Urban Areas with Advanced Hydrological Models
3. Advanced Space Technology for Real-Time Flood Monitoring (Nationwide)
4. Internet of Things (IoT) Approach and Cloud Computing in Flood Forecasting (Nationwide)

PROPOSED BUDGET FOR LIGTAS BAHA (2022 – 2028)

2022	2023	2024	2025	2026	2027	2028
68.047 M	15.4 M	194.423 M	193.216 M	50 M	34 M	23 M

C. CLIM'UP

The program improves the existing climate information services (CIS) by including the provision of historical and near-real time observations, as well as model-derived sub-seasonal to seasonal (S2S) forecasts of climate information in a seamless spatial and temporal coverage across the country. It will translate the climate information into an end-user and/or sector-relevant CIS to make climate-related risk information more accessible and user-oriented.

PRIORITIES FOR 2023 – 2025

1. High Resolution observation-based gridded data for the Philippines
2. Warning System of Extreme Events Associated with Monsoon
3. Sectoral Climate Impact Assessment and Modeling (Nationwide)
4. Dynamically Downscaled Seasonal Forecast System (Nationwide)
5. Impact-based forecasting of El Nino-induced Drought (6 provinces highly impacted)
6. Climatological Data Management System Life Cycle Sustainability

PRIORITIES FOR 2026 – 2028

1. Sectoral Climate Impact Assessment and Modeling (Nationwide)
2. Impact-based forecasting of El Nino-induced Drought (6 provinces highly impacted, 2006)
3. Improved Sub-seasonal to Seasonal (S2S) Forecasting of Extreme Climate Event (Nationwide)

4. Development of Fire Weather-based Index for Monitoring and Predicting Forest and Bush Fire due to Drought (General Santos, Isabela, Agusan Marsh, Leyte)
5. Development of Next Generation Technologies for Drought Monitoring (4 Regions)

PROPOSED BUDGET FOR CLIM'UP (2023 – 2028)

2023	2024	2025	2026	2027	2028
14.6 M	8.5 M	8.4 M	9.1 M	11.2 M	2.7 M

D. DISASTER RISK REDUCTION/CLIMATE CHANGE ADAPTATION (DRR/CCA)

The program addresses the urgent need for more proactive and inclusive disaster risk reduction and climate risk management for the pilot areas, focusing on a people-centered early warning system for atmospheric aerosols dispersion modeling, risk assessment for severe wind and storm surge, new technologies for the realization of new strategy in DRR/CCA, as well as the application of next generation technologies for Disaster Mitigation.

PRIORITIES FOR 2023 – 2025

1. Cloud Seeding Experiments and Application
2. Atmospheric Aerosols Dispersion Modeling
3. Science to Action Project: Severe Wind and Storm Surge Hazard Mapping and Risk Assessment (Albay, Pampanga, Pangasinan, Quezon, Cebu, Eastern Samar, Northern Samar, Agusan del Norte, Agusan del Sur and Davao Oriental) (UNDP/AusAid)
4. Coastal Resilience Project: Enhanced Knowledge Management Systems for Reducing Vulnerability of Coastal Communities to Climate-Induced Coastal Hazards

PROPOSED BUDGET FOR DRR-CCA (2023 – 2025)

2023	2024	2025
3 M	3 M	3 M

PROGRAMS ON VOLCANO, EARTHQUAKE AND TSUNAMI

A. Volcano, Earthquake and Tsunami Monitoring and Warning Program
B. Volcano, Earthquake and Tsunami Hazards Mapping and Research and Development Program
C. Volcano, Earthquake and Tsunami Disaster Preparedness and Risk Reduction Program

A. VOLCANO, EARTHQUAKE AND TSUNAMI MONITORING AND WARNING PROGRAM

PRIORITIES FOR 2023

1. Seismic and Tsunami Network Development (Davao del Sur, Cotabato, La Union, Pangasinan, Laguna, Zamboanga, Iloilo City)
2. Volcano Network Development (Cagua and Cabalian Volcanoes)

PRIORITIES FOR 2024

1. Seismic and Tsunami Network Development (Iloilo, Misamis Oriental, Misamis Occidental, Iloilo City, Roxas City, Aklan, Bacolod City, Dumaguete City, Region IV)
2. Volcano Network Development (Parker and Mayon Volcanoes)

PRIORITIES FOR 2025 – 2028

1. Seismic and Tsunami Network Development
2. Volcano Network Development

PROPOSED BUDGET FOR VOLCANO, EARTHQUAKE AND TSUNAMI MONITORING AND WARNING PROGRAM (2023 – 2028)

2023	2024	2025	2026	2027	2028
25.5 M	25.5 M	21.5 M	21.5 M	21.5 M	21.5 M

B. VOLCANO, EARTHQUAKE AND TSUNAMI HAZARDS MAPPING AND RESEARCH AND DEVELOPMENT PROGRAM

PRIORITIES FOR 2023

1. Earthquake Hazards Assessment and R&D (Quezon, Nueva Ecija, Mindanao, Visayas)
2. Volcano Hazards Assessment and R&D (Makaturing, Bud Dajo, Musuan, Pinatubo and Mayon Volcanoes)
3. Volcano Eruption Potential R&D (Hibok-Hibok, Bulusan, Iriga, Biliran, Natib, San Cristobal and Cuernos de Negros Volcanoes)
4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PRIORITIES FOR 2024

1. Earthquake Hazards Assessment R&D (Camarines Norte, Camarines Sur, Sorsogon, Catanduanes, Mindanao, Cebu Strait, Tanon Strait, Bohol Sea)
2. Volcano Hazards Assessment R&D (Mariveles, Kalatungan, Pinatubo and Mayon Volcanoes)
3. Volcano Eruption Potential R&D (Negron, Mahagnao, Cancajanag, Matutum, Parker, Banahaw and Iriga Volcanoes)
4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PRIORITIES FOR 2025

1. Earthquake Hazards Assessment and R&D (Oriental Mindoro, Occidental Mindoro, Mindanao, eastern seaboard of Luzon)
2. Volcano Hazards Assessment and R&D (Natib, San Cristobal, Cuernos de Negros, Pinatubo and Mayon Volcanoes)
3. Volcano Eruption Potential R&D (Malinao, Parang, Parangan, Pitogo, Biliran, Isarog and Cabalian Volcanoes)
4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PRIORITIES FOR 2026

1. Earthquake Hazards Assessment and R&D
2. Volcano Hazards Assessment and R&D
3. Volcano Eruption Potential R&D
4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PRIORITIES FOR 2027

1. Earthquake Hazards Assessment and R&D (Antique, Aklan, Capiz, Iloilo, Mindanao, Luzon)
2. Volcano Hazards Assessment and R&D (Malinao, Parang, Parangan, Pitgo, Pinatubo and Mayon Volcanoes)
3. Volcano Eruption Potential R&D (Dakt, Gorra, Lapac, Sinumaan, Pinatubo, Mayon and Hibok-hibok Volcanoes)
4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PRIORITIES FOR 2028

1. Earthquake Hazards Assessment and R&D (Northern Luzon, Mindanao, Visayas, Batanes)
2. Volcano Hazards Assessment and R&D (Malinding, Mandalagan, Silay, Vulcanm Pinatubo and Mayon Volcanoes)
3. Volcano Eruption Potential R&D (Maripipi, Tukay, Corregidor, Tumatangas, Bud Dajo, Didicas, Musuan and Matutum Volcanoes)

4. Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)
5. GeoRisk Philippines
6. National Exposure Database (NED)
7. Measurement of Velocities of Earthquake Faults (MOVE Faults)
8. Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)
9. 3D Philippines (DOST-PCIEERD)

PROPOSED BUDGET FOR VOLCANO, EARTHQUAKE AND TSUNAMI HAZARDS MAPPING AND RESEARCH AND DEVELOPMENT PROGRAM (2023 – 2028)

2023	2024	2025	2026	2027	2028
71.5 M	71.5 M	71.5 M	71.5 M	71.5 M	71.5 M

C. VOLCANO, EARTHQUAKE AND TSUNAMI DISASTER PREPAREDNESS AND RISK REDUCTION PROGRAM

PRIORITIES FOR 2023

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication
4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events
5. DANAS: Earthquake, Tsunami and Volcano Disaster Narratives for an Experiential Knowledge-based Science Communication (DOST-PCIEERD Proposal for 2023-2024)

PRIORITIES FOR 2024

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication
4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events
5. DANAS: Earthquake, Tsunami and Volcano Disaster Narratives for an Experiential Knowledge-based Science Communication (DOST-PCIEERD Proposal for 2023-2024)

PRIORITIES FOR 2025

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication
4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events

PRIORITIES FOR 2026

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication

4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events

PRIORITIES FOR 2027

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication
4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events

PRIORITIES FOR 2028

1. Stakeholders' Engagement and Analysis (SEA)
2. Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities
3. Analysis of DOST-PHIVOLCS Social Media data and Science Communication
4. Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events

PROPOSED BUDGET FOR VOLCANO, EARTHQUAKE AND TSUNAMI DISASTER PREPAREDNESS AND RISK REDUCTION PROGRAM (2023 – 2028)

2023	2024	2025	2026	2027	2028
0.7 M	0.7 M	0.7 M	0.7 M	0.7 M	0.7 M

ANNEX - HNRDA 2022-2028_Proposed Budget (in million Pesos)

AGENDA/ PROGRAM/PROJECT	2022	2023	2024	2025	2026	2027	2028	2022-2028
SECTION 1 - NATIONAL INTEGRATED BASIC RESEARCH AGENDA (NIBRA)								
I.BLUE SKIES OR PURE BASIC RESEARCH	2.91	5.00	7.00	9.00	11.00	13.00	15.00	62.91
II. ORIENTED BASIC RESEARCH								
A. WATER SECURITY (TUBIG – Tubig ay Buhayin at Ingatan)								
Program on Sustainable Drinking Water	12.92	27.00	36.25	40.00	45.00	52.00	60.00	273.17
Program Total	12.92	27.00	36.25	40.00	45.00	52.00	60.00	273.17
B. FOOD SECURITY AND NUTRITION (SAPAT – Saganang Pagkain para sa Lahat)								
Program on Food and Feed Contaminants along the Supply Chain	6.20	22.00	29.25	30.00	32.00	33.00	35.00	187.45
Program on Taxonomic Studies of Flora and Fauna		5.00	10.00	11.00	12.00	13.00	15.00	66.00
Program on Halal Studies			2.00	4.00	6.00	10.00	12.00	34.00
Program Total	6.20	27.00	41.25	45.00	50.00	56.00	62.00	287.45
C. HEALTH SUFFICIENCY (LIKAS – Likas Yaman sa Kalusugan)								
Program on Natural Products Discovery from Rare Environment	6.06	30.00	35.50	50.00	52.00	54.00	56.00	283.56
Program on Basic Veterinary Studies	2.71	7.00	15.00	21.00	25.50	30.00	36.00	137.21
Program Total	8.76	37.00	50.50	71.00	77.50	84.00	92.00	420.76
D. CLEAN ENERGY (ALERT – Alternative Energy Research Trends)								
Resource Assessment of Alternative Energy Sources for Geograhically-Isolated and Disadvantaged Areas	5.50	12.00	16.25	20.00	25.00	32.00	40.00	150.75
Program Total	5.50	12.00	16.25	20.00	25.00	32.00	40.00	150.75
E. SUSTAINABLE COMMUNITIES (SAKLAW – Saklolo sa Lawa)								
Comprehensive Program on Philippine Lakes, Rivers, Seas and Oceans	20.17	51.97	63.00	79.00	82.00	92.00	102.00	490.14
Program for Empowering Highly Vulnerable Communities through Disaster Risk Management	5.22	11.82	12.00	15.00	17.00	20.00	25.00	106.04
Program on Greening Mined-out Areas in the Philippines (GMAP)	1.81	8.22	11.25	23.00	25.50	28.00	32.00	129.77
Program Total	27.20	72.00	86.25	117.00	124.50	140.00	159.00	725.95

F. INCLUSIVE NATION-BUILDING (ATIN – Ang Tinig Natin)								
Heritage and Arts for Tourism and Creative Industries (HATCI)	0.83	35.00	65.96	68.00	74.00	85.50	97.00	426.29
Defense and National Security (DaS-KTOP)	4.00	41.00	47.00	52.00	56.00	60.50	64.00	324.50
Program Total	4.83	76.00	112.96	120.00	130.00	146.00	161.00	750.79
III. POLICY RESEARCH	3.80	5.00	7.00	9.00	11.00	13.00	15.00	63.80
TOTAL	**72.11**	**261.00**	**357.46**	**431.00**	**474.00**	**536.00**	**604.00**	**2,735.57**

SECTION 2 - HEALTH RESEARCH AND DEVELOPMENT AGENDA

A. TUKLAS LUNAS (DRUG DISCOVERY AND DEVELOPMENT)								
Development of standardized herbal drugs	175	190	190	230	240	210	210	1,445.00
Discovery of new drug candidates from local sources for development up to the pre-clinical stage	145	165	165	155	155	155	165	1,105.00
Improving health products formulation and delivery		20	40	40	40	40	40	220.00
Program Total	**320**	**375**	**395**	**425**	**435**	**405**	**415**	**2,770**

B. FUNCTIONAL FOOD								
Development of guidelines for the use and promotion of the term "Functional Food" in commercial products	0.5							0.5
Conduct of safety assessment studies and biological assays to characterize priority commidities	40	40	40	40	40	40	40	280
Agenda-setting for new priority commodities for research							2	2
Development of functional food products/technologies ready for commercialization and adoption	40	50	50	60	60	70	70	400
Conduct of human intervention studies to establish health benefits	50	50	50	50	50	50	50	350
Technical Writing Training for Functional Food Research	2		2		2		2	8
Establishment of facilities and services for capacity building	10	10	10	10	10	10	10	70
Establishment of R&D Centers in the regions	70	70	70	70	70	70	70	490
Program Total	**212.5**	**220**	**222**	**230**	**232**	**240**	**244**	**1,600.5**

C. NUTRITION AND FOOD SAFETY								
Nutrition								
Malnutrition and infectious diseases	20	20	20	20	20	20	20	140
Maternal and child nutrition	15	15	15	15	15	15	15	105
Nutrition Assessment in selected populations	15	15	15	15	15	15	15	105
	15	15	15	15	15	15	15	105

Upgrading dietary assessments and plans	20	20	20	20	20	20	20	140
	30	30	30	30	30	30	30	210
Sports Nutrition	30	30	30	40	40	40	50	260
Agenda-setting for new priority areas for research							2	2
Establishment of facilities and services for capacity building	25	25	25	30	30	35	40	210
Establishment of R&D Center for Sports Medicine and Nutrition	25	25	25	30	30	35	40	210
Food Safety								
Dietary Exposure Assessment of Selected Chemical Hazards in Food	50	50	50	50	50	50	50	350
Exposure Assessment of Selected Microbiological Hazards / Pathogens in Food	50	50	50	50	50	50	50	350
Technologies and approaches for prevention, traceability, and outbreak response	30	30	30	30	30	30	30	210
	20	20	20	20	20	20	20	140
Research on the mechanism of emergence and spread of foodborne pathogens	15	15	15	15	15	15	15	105
Establishment of facilities and services for capacity building	50	50	59	50	60	60	60	389
Program Total	**410**	**410**	**419**	**430**	**440**	**450**	**472**	**3,031**

D. RE-EMERGING AND EMERGING DISEASES								
Novel therapeutics and drug delivery systems against Emerging and re-emerging diseases (NCDs and infectious)	56	50	71	85	87	85	103	537
Epidemiological Research on infectious and non-communicable diseases and strengthening of data gathering, databases, and surveillance systems among urban and rural areas	109	213	106	85	92	99	108	812
Preventive interventions (Vaccine, and other modalities) Against Emerging and Re-emerging Diseases	452	317	370	428	324	333	436	2,660
Early Warning, Patient Support and Biosecurity, Biopreparedness Systems/Platforms Against Emerging and re-emerging diseases	45	50	54	60	66	72	80	427
Program Total	**662**	**630**	**601**	**658**	**569**	**589**	**727**	**4,436**

E. DIAGNOSTICS								
Communicable Diseases (Respiratory Diseases, including COVID-19) -Advancements for viral and bacterial respiratory diseases such as Acute Respiratory Tract Infection (upper and lower), pneumonia, bronchitis, tuberculosis, and influenza -Advancements for COVID-19	55	80	85	240	260	195	130	1,045
Other Communicable Diseases (HIV, Liver Diseases, etc.) -Advancements for Other Communicable Diseases such as HIV and Hepatitis	10	15	15	25	25	25	10	125
Neglected Tropical Diseases (Leptospirosis, Rabies, etc.) -Rapid, cost-effective, and minimally invasive diagnostic kits/ tools/ tests for early detection and/or monitoring of neglected tropical diseases such as leptospirosis, rabies, and soil-transmitted helminthiasis.	43	41	43	30	88	110	90	445

Non-Communicable Diseases (Cancer, Diabetes, Cardiovascular Diseases) -Development of rapid, cost-effective, and minimally invasive diagnostic kits/ tools/ tests for early detection and/or monitoring of non-communicable diseases such as cancer, cardiovascular diseases, and diabetes	19	19	27	35	62	82	62	306
Program Total	**127**	**155**	**170**	**330**	**435**	**412**	**292**	**1,921**

F. OMIC TECHNOLOGIES FOR HEALTH								
Multi omics approach on Health and Diseases- NCDs, Cancers, Maternal and Child Health, Nutrition, Neurosciences, etc.	0	100	110	120	120	100	100	650
Genomic Epidemiology and Biosurveillance -Infectious / Communicable Diseases; Rare Diseases	37.744	40	50	80	60	50	50	367.74
Translational Omics Research for Precision Medicine - Disease Models from OMICS data - Novel Therapeutics using OMICS	0	70	80	100	110	50	50	460
OMICS for Forensics, Ethnicity, Population Studies -R&D Program on S&T Applications in Criminal Justice -Program on Filipino Population OMICs Studies (ethnicity, ancestry, genetic history and evolution using OMICS) -R&D Program on Forensic DNA Profiling Technologies	0	40	50	50	70	100	100	410
Genomic BioBanking, and Data Management	0	60	50	50	50	100	100	410
Program Total	**37.744**	**310**	**340**	**400**	**410**	**400**	**400**	**2,297.74**

G. BIOMEDICAL DEVICES ENGINEERING FOR HEALTH								
Technology-assisted Surgical Innovations for Patient Safety		25	35	45	35	40	45	225
Innovations in Local Implants Development		20	30	35	40	50	55	230
Devices for Postoperative/ Rehabilitative / Assistive Care	21	25	45	50	50	50	55	296
Devices for Health Emergency Preparedness and Response		20	20	25	30	30	30	155
Biomedical Engineering Devices in support of Universal Health Care (Distributed Healthcare, facility-based health care Medical Devices)		30	40	45	70	70	80	335
Simulation Platforms and Devices for Health and Medical Research (Bioengineered tissues; Devices and equipment for medical training)		30	30	30	25	30	35	180
Program Total	**21**	**150**	**200**	**230**	**250**	**270**	**300**	**1,421**

H. DIGITAL AND FRONTIER HEALTH TECHNOLOGIES								
Artificial Intelligence in Healthcare Empowered by Data Analytics	35	45	45	125	125	125	125	625
Artificial Intelligence in Healthcare Applications	38	25	25	80	170	170	170	678
Assessment and Development of ICT-enabled health delivery services	15	15	15	15	15	15	15	105

Capacity building for facilities and human resource on Digital Health	2	5	5	5	5	5	5	32
Program Total	**90**	**90**	**90**	**225**	**315**	**315**	**315**	**1,440**

I. DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION IN HEALTH								
S&T Based Innovations in building resilient health systems during disasters	12	33	33	33	33	35	37	216
Food Innovations to address the nutritional and health effects of disasters	4	4	4	4	5	7	7	35
Researches to ensure health consequences during disasters are reduced	3	3	3	4	5	5	6	29
Climate Change Adaptation in Health	2	2	3	4	5	5	6	27
Capacity building for human resource and facilities on DRR-CCAH	5	5	5	5	5	5	5	35
Program Total	**26**	**47**	**48**	**50**	**53**	**57**	**61**	**342**

J. MENTAL HEALTH								
Improved mental health information system	27	25	27	32	25	23	30	189
Strengthened leadership and governance	17	10	10	10	8	8	19	82
Accessible, available, affordable, and responsive mental health services	5	5	46	40	38	38	40	212
Cross-cutting issues	30	40	37	37	15	15	15	189
Program Total	**79**	**80**	**120**	**119**	**86**	**84**	**104**	**672**

RESEARCH INFORMATION, COMMUNICATION, AND UTILIZATION								
Information Products and Services	6.5	7	14	14	16	16	16	89.50
Communicating Research Results	12.2	25	25	30	30	30	31	183.20
Support to Research Dissemination	5	5	5	5	5	5	5	35.00
Research to Policy Translation	1	1	1.5	1.5	1.5	1.5	2	10.00
Technology Transfer	107	295	300	448	494	614	714	2,972.00
Program Total	**131.7**	**333**	**345.5**	**498.5**	**546.5**	**666.5**	**768**	**3,289.70**

HUMAN RESOURCE DEVELOPMENT	88.7	178.7	242.1	338	486.1	679.5	920.5	2,933.60
NETWORK INSTITUTION DEVELOPMENT	108.5	239.4	229.8	244.7	307.3	289.7	301.9	1,721.30
Program Total	**197.2**	**418.1**	**471.9**	**582.7**	**793.4**	**969.2**	**1222.4**	**4,654.90**

SECTION 3 - AGRICULTURE, AQUATIC AND NATURAL RESOURCES (AANR) Research and Development Agenda

A. CROPS R&D AGENDA								
Abaca	125.7	119.2	100	164.5	142.7	112.9	173.2	938.20
Banana	33.3	34.9	73.55	83.75	102.25	82	85.5	495.25
Citrus	5.5	52.5	75	61.5	77.5	63.5	50.5	386.00
Coconut	44	67	80.5	92.5	55	40	37	416.00
Coffee	56	84	89	84	83	74	74	544.00
Durian	5	13	13	24	29	26	14	124.00
Legumes	25	20	40	65	70	60	75	355.00

Mango	36	73	50	36	34	22	27	278.00
Ornamental	30	40	40	40	30	30	40	250.00
Papaya			23	26	28	26	19	122.00
Queen Pineapple	14	33	79	40	68	43	36	313.00
Rice	36.1	36.4	40.75	57.51	43.55	39.83	40.37	294.51
Sweet Potato	10	43.5	59.5	69	51	53	39.5	325.50
Sugarcane	58.9	75.4	74	78	78.5	88.5	93.5	546.80
Vegetables	28.9	41.36	59.19	70.5	85	85	130	499.95
Smart Farming	64	73	74	68	74	81	79	513.00
Nanotechnology	30	36	43	52	62	75	90	388.00
Mechanization and Automation	38	42	55	58	60	60	60	373.00
Program Total	**640.4**	**884.26**	**1068.49**	**1170.26**	**1173.5**	**1061.73**	**1163.57**	**7,162.21**

B. LIVESTOCK R&D AGENDA								
Chicken	21.7	20.1	20.3	21	26.5	27.5	30	167.10
Dairy	52.5	48	55.5	31	87	75	57	406.00
Duck	19.27	111.38	75.38	105.17	58.5	45	35	449.70
Goat	6.83	16	35	33	52	49	52	243.83
Commercial Swine	107.52	119.24	112.5	67	90	100	85	681.26
Native Swine	31.11	59.16	66.16	65	60	80	85	446.43
Program Total	**238.93**	**373.88**	**364.84**	**322.17**	**374**	**376.5**	**344**	**2,394.32**

C. AQUATIC R&D AGENDA								
Inland								
Milkfish	51.89	83.7	121.93	86.3	82.3	26.3	40.3	492.72
Shrimp	83.71	142.19	148.91	93.5	52.5	19	17.5	557.31
Mangrove Crab	96	145	68	61.8	28.3	11.3	7	417.40
Tilapia	46.95	112.45	83.05	57.07	39.8	34.3	32.8	406.42
Shellfish - Mussel	2	44.15	20.1	22.3	24	16.5	12.5	141.55
Aquafeed	16.66	23.3	20.3	22.8	23.8	51.3	39.3	197.46
Marine								
Crustaceans - Blue Swimming Crab	10	45	46	37	51	54	55	298
Sardines	11.92	16.28	21.47	56	62	56	56	279.67
Sea Cucumber	40	45	35	50	60	55	81	366.00
Seaweeds	45.3	56.5	62	71.2	85.2	87	88	495.20
Shellfish - Oyster	5	18	38	31.5	57	60.7	74.7	284.90
Tuna	35	40	32	20	37	27	20	211.00
Program Total	**444.43**	**771.57**	**696.76**	**609.47**	**602.9**	**498.4**	**524.1**	**4,147.63**

D. FORESTRY R&D AGENDA								
Cacao	115	105	105	95	85	95	70	670
Bamboo	50	115	164	187	222	253	161	1,152
Rubber	109	89	71	61	91	85	70	576
Industrial Tree Plantation	65	70	81	81	85	85	90	557
Program Total	**339**	**379**	**421**	**424**	**483**	**518**	**391**	**2,955**
E. NATURAL RESOURCES AND ENVIRONMENT R&D AGENDA								
Biodiversity - Inland Aquatic	73.7	81	83	91.75	134.75	85	116.25	665.45
Biodiversity - Marine	79.81	131.7	187.44	189.61	179.16	151.81	133.34	1,052.87
Biodiversity - Forestry	31	56	56	78	55	68	95	439.00
Watershed	35	70	75	105	60	55	35	435.00
Coral	61.56	124.07	143.28	121.01	100.78	75.63	75.87	702.20
Harmful Algal Bloom	31.91	24.88	20	53.83	37.68	55.8	26	250.10
Program Total	**312.98**	**487.65**	**564.72**	**639.2**	**567.37**	**491.24**	**481.46**	**3,544.62**
F. CLIMATE CHANGE	**13**	**34**	**59.5**	**64.5**	**67.5**	**72.5**	**67.5**	**378.50**
G. TECHNOLOGY TRANSFER	**335.53**	**407.28**	**447.67**	**458.12**	**459.12**	**472.6**	**486.47**	**3,066.79**
H. SOCIO-ECONOMICS, POLICY RESEARCH AND GOVERNANCE								
Policy Analysis and Advocacy	118.73	130.41	95.72	73	58	73	63	611.86
Agri-Aqua Business	81.05	67.35	51.75	54.75	60.75	66.75	60.75	443.15
Impact Assessment	60.35	75.85	86.35	126.85	127.35	133.35	135.35	745.45
Gender Mainstreaming in Socio-Economic Researches	10.8	15.8	15.8	20.8	18.8	20.8	20.8	123.60
Applied Rural Sociology	14.5	17.5	16	21	23	23	24	139.00
Program Total	**285.43**	**306.91**	**265.62**	**296.4**	**287.9**	**316.9**	**303.9**	**2,063.06**
I. HUMAN DEVELOPMENT, SCIENCE COMMUNICATION AND KNOWLEDGE MANAGEMENT	**268**	**440**	**629**	**900**	**1287**	**2080**	**2631**	**8,235**
INSTITUTIONAL DEVELOPMENT PROGRAM	**150**	**154**	**160**	**164**	**165**	**166**	**170**	**1,129**
HUMAN RESOURCE DEVELOPMENT PROGRAMS	**66.3**	**74.3**	**77.9**	**79**	**82.9**	**86**	**90.6**	**557**

SECTION 4 - INDUSTRY, ENERGY AND EMERGING TECHNOLOGY Research and Development Agenda

A. ADDITIVE MANUFACTURING

-Accessible 3D Printers (low-cost for small-scale manufacturers -Materials for ESD (Semiconductor) -Policy/paper on AM in Ph -Localized metal powder for AM -Multiple materials platform for AM -Temperature sensors and other basic healthcare devices -Patient specific knee implant, spine implant -Metal materials for medical ultrasound impedance matching -Development of sharing platform for 3DCP -Local fibers for bicycle parts and helmet liners -Database of developed raw materials for AM -Prototype products of multiple material AM -Raw materials for AM -Minimally-invasive surgical devices -Database of developed raw materials for 3DCP -Solar water evaporation for clean water production from sea and wastewater for inland and remote communities (porous membranes – polymer, support layer for biomass materials, system) -3D printing with AI/ML and Robotics	171.25	171.25	171.25	171.25				685
-Inkjet printing for membrane modification (nanofiltration membrane) -Actual application of 3DCP in construction projects -Conduct of impact study of the success in adoption of AM in construction -Comparative assessment of 3DCP to traditional and modular construction methods used locally -3D-printed membranes for electrochemical energy systems (fuel cells, electrolyzers, batteries) -3D printing of health food for personalized nutrition -Locally-established biomedical industry – biomedical instruments and implants					40	40	40	120
Program Total	**171.25**	**171.25**	**171.25**	**171.25**	**40**	**40**	**40**	**805**

B. ADVANCED MATERIALS

Advanced Materials Program	2022	2023	2024	2025	2026	2027	2028	2022-2028
-IC design center / Wafer fab facility -Smart inverters -Development of smart materials for biodegradable packaging and anti-corrosion coatings; -Deployment for energy generation and storage; -Development of composite supercapacitors from conductive polymer and nano metal-oxide composites -Adoption of advanced materials such as intermetallics, nanoclays and smart fibers -Flexible solid-state and composite supercapacitors for electronics manufacturing -Graphene based sensors for smart phone; -Ultrasound/ Piezoelectric Micromachined Ultrasonic Transducers (PMUT) for automobile industry (for hand gesture recognition, vehicle); -Sensors for harsh environment: Gallium oxides, nitrides, silicon carbides; Chemical and biosensors for occupational health and environmental monitoring -Rapid disease diagnostics and enhancement of plant's capacity to absorb nutrients for agriculture and food industry	100	100	100	100				400
R&D on next generation technologies on advanced materials for manufacturing and sustainable energy and blue economy, among other applications supported - Improved performance of existing materials - Development of selfhealing polymers and ceramics - Mechanistic insight for functional polymers, nanocomposites, metals, high tech materials - Development of new corrosion protection technologies for automotive, construction and HiTech Coatings with antimicrobial properties - Development of sensoring response coatings - Development of Self-healing technologies for thin films and membranes					100	100	100	300
Materials Informatics								
Creation of a consortium of researchers for the benchmark datasets incorporating diverse tasks, sample sizes, materials systems, and data heterogeneity for materials informatics	100	100	100	100				400

-Establishment of an Artificial Intelligence-Aided Data-Driven infrastructure for Computational Materials Informatics -Link process model results to structure design -Develop accelerated dynamic modelling method across length scales from atomistic to macro scale to enable modelling of experimental time scales at appropriate length scales -Create fast process models that develop/enhance predictive models at different length scales that simulate rare events and nucleation -Develop physics-based models that address key sources of uncertainty and physical understanding -Develop methods to automatically generate interatomic potentials to enable molecular dynamic simulations on arbitrary reactive and non-reactive systems					100	100	100	300
Program Total	200	200	200	200				1,400

C. MATERIALS FOR ENERGY

Materials for Energy Program								
-Establishment of an Artificial Intelligence-Aided Data-Driven infrastructure for Computational Materials Informatics -Link process model results to structure design -Develop accelerated dynamic modelling method across length scales from atomistic to macro scale to enable modelling of experimental time scales at appropriate length scales -Create fast process models that develop/enhance predictive models at different length scales that simulate rare events and nucleation -Develop physics-based models that address key sources of uncertainty and physical understanding -Develop methods to automatically generate interatomic potentials to enable molecular dynamic simulations on arbitrary reactive and non-reactive systems					100	100	100	300
-Establishment of a robust research and testing infrastructure -Development of electrode materials for EDLC and pseudocapacitor; separators and electrolytes -Conductive Polymers and Metal Oxides -Development of energy conversion materials -Development of Post Lithium Ion batteries -Pt-free and metal-free catalysts -Reduction of Frictional Losses/ Cost Reduction of Flywheel -New catalyst -Air electrodes with high electrochemical activity and lower polarization/ resistance -Low-cost organometallic catalysis for air electrodes -Development of energy storage devices for power grid application; batteries for printed and flexible electronics, 3D printed batteries -Hybrid capacitors (composite hybrids and battery type) -Use of advanced technologies on lead-acid and Li-ion -Mobile energy source -Fabrication and testing of single cell, fuel cell, electrolyser, metal-air battery; Upscale production of components; Design and integration of fuel stack -Develop non-aqueous flow battery systems with wider cell operating voltages to improve efficiency	100	100	100	100				400

D. NANOTECHNOLOGY

Nanotechnology Program								
'-Carbon nanomaterials R&D (Development of graphene, carbon nanotubes and other carbon-based materials) -Aerogel R&D (Development of nanostructured aerogels) -Nanomaterials for energy R&D: Battery, fuel cell, and electrolyzer research(cathodes, anodes, separator, electrolyte), nanogenerators, nano-superconductors -Biomedical nanomaterials development -Nanomaterials for agriculture and environment (nanofertilizers, sensors, etc.) -Nano-Informatics: Nanomaterials design and development (applications in energy and quantum computing)	187.5	187.5	187.5	187.5				750
-Nanomaterials for energy R&D: Highly efficient power generation, Ultra-low power devices, smart energy systems -Nanomaterials for agriculture and environment (nanofertilizers, sensors, etc.)					150	150	150	450
Program Total	**187.5**	**187.5**	**187.5**	**187.5**	**150**	**150**	**150**	**1,200**

E. OPTICS AND PHOTONICS

Optics and Photonics Program								
-THz spectroscopy devices and applications -Delivery of Information -Fiber-optic sensors & wiring, -Optical communication networks, -Imaging -Hyperspectral imaging, -Infrared night vision systems, sensitive imaging, laser scanning	110	110	110	110				440
-Delivery of Information -LiFi, optical beamforming and steering, analog radio over fiber; -Imaging Terahertz imaging, Nuclear Imaging -Manufacturing Photovoltaics, Perovskite solar cells, -Conductive nanocomposites					40.33	40.33	40.33	121
Program Total	**110**	**110**	**110**	**110**	**40.33**	**40.33**	**40.33**	**561**

F. ELECTRONICS INDUSTRY

Electronics R&D Program								
A. Integrated Circuit Design								
Project 1 - Establishment of Center for Integrated Circuits and Devices Research		150						150
Project 2 - Development of new classes of electronics		80				200		280
Project 3 - Advancement in memory technologies		50				150		200
Project 4 - Advancement in logic technologies		70				200		270
Project 5 - Establishment of Wafer Fabrication Laboratory		200						200
B. Consumer / Medical / Industrial / Automotive Electronics								
Project 7 - Prototyping of robots and implementation of robot-as-a-service		50				100		150
Project 8 - Prototyping of medical devices		70						70
Project 9 - Development of smart wearables, local smart phones, smart batteries, and EV chargers		50				150		200
Project 10 - Development of advanced driver assistance systems		100						100
Project 11 - Prototyping of electronic components for autonomous vehicles						150		150
C. Sensors								
Project 12 - Prototyping of integrated and intelligent sensors and actuators		100						100
Project 13 - Development of advanced sensors		100				100		200
Program Total	20	300	500	200	400	350	300	2,070

G. ICT INNOVATIONS

ICT Innovations Program								
-Content Development for remote learning -Upgrading of infrastructure for remote learning platforms -Cloud Computing Data Centers -Hybrid cloud infrastructure -Data fabric -Graph databases -Internet of Things -Wireless networks -Sensors and actuators -Smart electronics -Smart meters and grids -Cyber Resilience/ Cyber Security -5G/6G Technology Orthogonal frequency-division multiplexing (OFDM) -5G new radio (NR) air interface -Bandwidth technologies (Program 6 GHzandmmWave) Fiber Optic Technology	9.75	9.75	9.75	9.75				39
-Establishment of a 5G/6G ecosystem innovation center -Development of new technologies for use of higher bandwidths (Ku-, K-, Ka-bands) -Development of a single core (nanocore) wireless mobile communication service					75	75	75	225
Program Total	**9.75**	**9.75**	**9.75**	**9.75**	**75**	**75**	**75**	**264**

H. INDUSTRY 4.0	**50**	**50**	**200**	**50**	**300**	**300**	**350**	**1,300**
I. QUANTUM TECHNOLOGY	**20**	**30**	**50**	**100**	**150**	**300**	**200**	**850**
J. SMART CITIES	**20**	**50**	**100**	**150**	**150**			**470**

K. ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) Pinas Program								
-Robotics AI for Autonomous Missions -AI for DRR Applications -Generative Adversarial Networks Applications -RNN and CNN -Speech Recognition -Recommender systems -Intelligent Applications -Image and Video Recognition -Situation interpretation through heterogeneous sensors -Reinforcement learning -Supervised Learning -Unsupervised Learning -Cognitive Computing – advanced intelligent applications such as virtual assistants and smart robots -Artificial General Intelligence	110	110	110	110				440.00
-Artificial Narrow Intelligence -Creative Machines -Diffractive Neural Networks -Technologies on data privacy and security -Cyber Defense Build-up -Artificial Super Intelligence -Simulation Engines -Swarm Artificial Intelligence -Quantum Deep Learning -Smart Data -Semantic Analysis -Intelligent autonomy					403.33	403.33	403.33	1,210
Program Total	**110**	**110**	**110**	**110**	**403.33**	**403.33**	**403.33**	**1,650**

L. CREATIVE INDUSTRIES

Material Footwear Innovation for Footwear								
1. Sustainable Textiles for Footwear Applications	15	85	15	5				120
2. Sustainable Local Materials for footwear applications					5	10	3	18
3. Local Materials for Adaptive clothing/footwear technologies					5		2	7
Footwear Innovations								
1. Development of Filipino Fit and Sizing Standards	28	30	10	5				73
2. Prosthetics for Asian Fit					5	5	3	13
3. Smart Shoe Design `						5	2	7
4. Specialized Footwear Design and Technologies			5	5	5	10	5	30
Facilities and Laboratories for Footwear Applications								
1. Development of 3D application technologies for footwear		17	5				5	27
2. AI-based solutions for footwear - IOT-enabled technologies - Local Software for Design			5				5	10
3. Creative Design for Industry 5.0					5		5	10
Program Total	**43**	**132**	**40**	**15**	**25**	**30**	**30**	**315**
Priority Program: Material Innovation for Furniture Applications								
1. Sustainable Local Materials from Wood/Non-Wood	4	5	25	5				39
2.Sustainable local natural materials and design for furniture applications					3	2	5	10
3. R&D on Sustainable and Biodegradable Packaging Materials					3	2	3	8
Priority Program: Furniture Design and Product Innovations								
1. Asian-based ergonomic design furniture	3	10	10	5	3	2	4	37
2. Woodcarving technologies for furniture applications and unique design furniture				3	3		5	11
3. Specialized Furniture for the New Normal			10	2	3			15
4. Green and Smart Furniture			11	5	3	2	3	24
Priority Program: Facilities and Laboratories for Furniture Applications								
1. 3D application technologies for furniture products and parts	3	5	30	5	2	1	5	51
2. AI-based solutions for Furniture Design -IOT-enabled technologies - Software and Tools for Desig and Makers				5		1	5	11
Program Total	**10**	**20**	**86**	**30**	**20**	**10**	**30**	**206**
Game, Animation and Film								
Project 1 - Development of serious games and gamification apps for education, tourism, and corporate sector			50					50
Project 2 - Development of proprietary software and software / platform-as-a-service			70					70
Project 3 - Establishment of Creative Innovation Hub			100					100
Project 4 - Establishment of Extended Reality Laboratory			100					100

Project 5 - Establishment of Interactive Moviemaking Facility			150					150
Project 6 - Prototyping of advanced gaming devices					150			150
Project 7 - Prototyping of advanced hardware for animation and film development					150			150
Project 8 - AI and machine learning integration in software and hardware for game, animation, and film development			50		150			200
Program Total	**70**	**150**	**150**	**150**	**150**	**150**	**150**	**970**

M. SPACE TECHNOLOGY APPLICATIONS (STA)	**176.25**	**176.25**	**500**	**765**	**670**	**720**	**450**	**3,457.50**

N. TRANSPORTATION

Maritime Transport (Subsector 1)	11.7	95.4	134.4	95	200	55	25	616.5
ITS / Land (PUVs and EVs) (Subsector 2)	69.4	54.7	20.7	120	120	120	85	589.8
Logistics and Freight Management Systems (Subsector 3)			5	10	10	20	15	60.0
Program Total	**81.1**	**150.1**	**160.1**	**225**	**330**	**195**	**125**	**1,266.30**

O. ENERGY

1. Solar Energy								
• Localization of efficient solar thermal system, i.e. concentrators, for drying, portable water production • Demonstration of Micro Grid RE system • Development of forecasting model for solar installation and resources assessment • Solar Home System Energy Use Optimization • Modular Stand Alone and Mobile desalination unit for brackish and seawater)	20	20	20					60
•Solar PV Marine Floating Platform Design Optimization •Development of hybrid RE system to support microgrid facility •Establishment of Solar PV Laboratory (For Certification			10	20	15	15		60
•Demonstration for New thin film solar pv farms and concentrator applications •Integration of Solar PV energy to building component/structure •Improving reliability and durability of BOS component							10	10
2. Microhydro Power Technology S&T								
•Microgrid RE system •Local turbine inventory assessment and fabrication capability •MHP performance and efficiency improvement •Improvement of MHP research facility •Development of local MHP equipment •Design and development of cascading MHP systems	30	30	20					80

•Design and development of hydrokinetic turbines •Design and development of low-head/low-flow micro-hydro turbines •Demonstration of hybrid microgrid RE facility (wind, solar, hydro •Design and development of novel micro-hydro turbines, housing, and load controllers •Utilization of irrigation channels for MHP technology applications				20	40	30	10	100
•Design and development of novel micro-hydro turbines, housing, and load controllers •Utilization of irrigation channels for MHP technology applications •Design and development of novel micro-hydro turbines, housing, and load controllers •Utilization of irrigation channels for MHP technology applications							20	20
3. Wind Energy								
•Establishment of small-wind turbine research facility •Development of micro-siting tools for specific remote island communities' small wind applications •Design and development of small wind turbine hybrid system for microgrid system	8	8	4					20
•Novel harvesting device design and assessment: modeling laboratory •Development of local manufacturing technologies				3	3	4		10
•Hybrid offshore system (ocean and wind) assessment and design •Advance blade design and manufacturing methods •Improving reliability and durability of BOS component							10	10
4. Waste to Energy								
•Design and development of waste-to-energy from Municipal Solid Waste (MSW) •Development of cost-effective process to produce biofuels from agri-based resources	20	20	8					48
•Development of Innovative and novel conversion technology from feedstock to finished fuel (algae, energy crops, forest resources •Advanced algal system to lower the cost of producing algal biofuels and bioproducts				10	5	5		20
•Development of superior feedstock crop plants with improved yield and quality •Improve pyrolysis systems to produce bio-oils from cellulosic feedstock at high efficiency rates •Locally developed biogas gas engines							10	10
5. Ocean Energy								
•Ocean energy detailed resource assessment in remote island/ isolated communities and other strategic areas (wave, tidal, marine current)	10	20	10					40
•Design and development of mechanical harvesting device modeling tools •Design and development of wave energy harvesting system •Tidal Instream Energy Conversion (TISEC)				10	10	10		30

•Supply-chain analysis for ocean technology from generation to utilization •Capacity building on ocean thermal energy conversion resource assessment •Ocean Thermal energy conversion (OTEC)							5	70
6. Hydrogen Technology S&T								
•Design and development of new methodology for hydrogen extraction using renewable energy •Hydrogen production from biomass conversion •Design and development of hydrogen production system	10	10	20	20	10	10		80
•Development of membrane technologies for separating and purifying hydrogen •Development of water gas shift reactors and hydrogen compression technology							10	10
7. Energy Efficiency & Conservation S&T								
Deployment of Energy Monitoring Application and Network at DOST (DEMAND) as Demonstration Sites	0.67							0.67
Design of a Modular Stator, Segmented Rotor Switched Reluctance Motor	3.74							3.74
Transitioning MSMEs through Low-Carbon and Energy Efficient Technologies		30	30	30				90
Establishment of Innovative and Smart Energy Systems R&D Center		50	50	50				150
Supply-Chain Analysis of Energy-Efficient, Low-Carbon, and Energy Management System Technologies					10	5	5	20
Design and Development of AI-Based Energy Optimization and Automation System for Distribution Utilities, Government / Commercial Buildings and Industrial Facilities							50	50
8. Energy Storage								
Novel Material as Anode and Cathode Electrode for Power Generator Al-Air Reactor	2.83							2.83
R&D Center for Advanced Batteries: Advanced Cathode Materials based on Earth-Abundant Elements (Ni, Fe) for High Energy Density Next Generation Batteries	34.17	7.06	7.93					49.16
R&D Center for Advanced Batteries: REBCell: Rechargeable Edison Battery for Long-lasting High Energy Density Application	18.18	6.71	6.83					31.72
R&D Center for Advanced Batteries: Advanced Lead Acid Batteries with Embedded Ultrasonics (ALAB-EU)	3.72	4.24						7.96
System hybridization of battery chemistries i.e. imported and locally developed batteries				25	25	25		75
Technology Demonstration of an Integrated Locally Developed Battery Energy Storage System for RE Off-grid and On-grid Microgrid Applications							50	50
9. Nuclear Energy								
Supply and Value Chain Analysis of Nuclear Technonologies and Assessment of Small Modular Reactors (SMR) Applications	15	10	10					35
Development of an SMR Design Concept and Optimization				50	50	50		150
Infrastructure Development for Research Reactors and Spent Fuel Storage Facility							250	250
10. Microgrid Energy								
Establishment of concentrating solar and tidal/wave research facility	5							5

Establishment of small-wind turbine research facility	5							5
Conduct of on-grid microgrid feasibility study	1							1
Establishment of Solar PV research facility				250	250	250		750
Design and development of cost-effective BOS, control systems, and demand-side management system	5	5	5					15
Supply-chain analysis (generation – utilization)							5	5
Program Total	192.31	221.01	201.76	488	418	404	435	2,425.08

P. UTILITIES

Construction	110	120	130	140	150	160	170	980
Locally developed Bio-cement material Locally developed FRSCC for marine app Natural Fiber-based construction products for indoor & outdoor apps Green Polymer and Fiber Material as retrofitting matl of heritage and government bldgs Cost-effective Rubber based construction products Locally developed superplasticizer Commercialized green cement Localized geosynthetic materials Lightweight foamed concrete panel Deployed green building technologies Implementation and adoption of RCA value-adding construction applications Database on the Concrete/Raw material Performance on the effect of climate change and saltwater or rainwater intrusion Implementation of construction technologies that contributed to at least 15% GHG contribution reduction								
S&T Guidebook for the Design, Analysis and Intervention of Slope Protection w/ Pilot Demonstration in Rice Terraces Cable-supported prototypes BIM-based Facility Management of Selected DOST Buildings Seismic ATLAS for Baguio City Comprehensive Structural Assessment Report of Selected Regional Structures with at least 20 trained DPWH and COA Technical Personnel on Concrete Petrography Techniques Localized underground surveying & assessment tools Road Pavement monitoring and assessment equipment Established Digitalization Center for the Construction Industry BIM-based applications Concrete crack assessment eqpt Nationally digitized construction data Established Underground Research Center Accredited and deployed housing and building tech Localized NDT eqpt Localized 3d Printer and agro-industrial based concrete resin Established & operational Digitalization and Heritage S&T services and facilities Application of Different 3D Construction Product and Application Demonstration of locally developed underground engineering, heritage preservation & digitalization developed solution/technologies Localized Surveying/monitoring/assessing equipment								

Operational PHIVOLCS Visualization Facility and enhanced Georisk website with 3D Risk and Site Suitability Feature S&T Guidebook for the Design, analysis and specific intervention of flood and coastal protection w/ actual pilot demo Operational Wave flume testing lab Digitized borehole data in Metro Manila Established Earthquake Research, Wind Tunnel Engineering Operational earthquake simulation lab and testing facilities with prototype demonstration Adopted mountain engineering & coastal technologies S&T Guidebook for the Design, analysis and specific intervention of 1) earthquake & wind resistant infrastructures, 2) heritage sites/buildings, 3) 3D Infrastructures 4) underground engineering w/ actual pilot demo Locally developed and deployed earthquake and wind engineering related technologies At least four policy recommendation related to the established centers								
Water Resource								
Establishment of Smart water infrastructure and management R&D Center (SWIM)	20	10						30
Comprehensive water resource management	15							15
Dam/watershed/reservoir S&T management strategy	10	10	10					30
Development of Green Infrastructures System for water management	15	10	10					35
Development of sedimentation monitoring and mitigation system and technologies (upstream and downstream)	10	15						25
Water balance management study	10	5						15
Community-based water harvesting technologies				10	10	5		25
Smart farming innovative water management systems				10	10			20
Development of drought and flood mitigation systems and technologies				35	35	35		105
Groundwater investigation for emerging contaminant							10	10
Advancement O&M for water supply facilities							10	10
Smart and innovative flood protection technologies							15	15
Internet of things-based technologies for water management (supply and demand)							10	10
Program Total	**190**	**170**	**150**	**195**	**205**	**200**	**215**	**1,325**

Q. DISASTER RISK REDUCTION

Disaster Risk Reduction: Tsunami Hazards	15	30	50	30	30	20	100	275
Disaster Risk Reduction: Earthquake Hazards	15	20	20	30	30	20	100	235
Disaster Risk Reduction: Volcanic Hazards	20	20	40	50	30	20	100	280
Disaster Risk Reduction: Landslide Hazards	30	60	50	60	30	20	100	350
Disaster Risk Reduction: Tropical Cyclones Hazards	40	50	20	20	40	20	100	290
Disaster Risk Reduction: Floods and Heavy Rains Hazards	40	20	60	60	50	20	100	350
Climate Change Adaptation: Climate-related Hazards	10	80	15	20	30	60	30	245
Program Total	**170**	**280**	**255**	**270**	**240**	**180**	**630**	**2,025**

R. UNMANNED VEHICLE SYSTEMS

Program 1 -UAS with passively rotating spherical shell for close-proximity inspection of infrastructure -UAV-Assisted Deployment System for Water Quality Monitoring -Establishment of UVS consortium and commercial provider partnership -Multimission UAS development -Collaborative aerial-ground missions -Flying ad hoc network of UAVs for delay-tolerant applications -Secured and resilient UVS communication infrastructure	10	50	90					150
Program 2 -Underwater systems for mine countermeasure with in-stride capabilities -Intelligent autopilot systems Underwater autonomous adaptive control systems -R&D on advanced UVS sensors technology -UVS real time traffic management (data transfer/ communication) -Application and integration of IoT and ROS				50	50	50		150
Program 3 -Computer vision-equipped UVS -Specialized underwater mapping -Underwater object detection and monitoring -Heavy payload, high endurance capacity platforms -Underwater system for persistent and tactical intelligence collection -Helium UVS -Establishment UVS Database Center							30	30
Program Total	**10**	**50**	**90**	**50**	**50**	**50**	**30**	**330**

S. FOOD

FOOD SAFETY								
Integrated Food Safety Research and Development Program	49.5	142.2	114	95	47.5	75	75	598.20
S&T Services on Food Safety	19.567	493.813	335.863	258.107	228.857	159.75	0.5	1,496.46
DOST Human Resource Development Program on Food Safety	1.2	17.5	14.5	10.5	4.5	4.5	4	56.70
Knowledge/Technology Transfer and Policy Advocacy Program on Food Safety	10	101	70	74	79	81	80	495.00
FOOD INNOVATION								
Innovative Food Products	15	15	15	15	21	21	21	123.00
Enabling Systems for Food Innovation	40	40	30	30	40	40	40	260.00
Specific Industry or Regional Concerns	20	20	20	20	30	30	30	170.00
HALAL	59.13	57.995	18	10	10	5	5	165.13
SMART FOOD VALUE CHAIN								
Food Security and Sustainability	1	1	1	1	1	1	1	7.00
Smart / Innovative Technologies in the Value Chain	9	2	1	5	5	5	7	34.00

Development of Integrated Food Value Chain Resource Management System	10	3	2					15.00
Program Total	**234.397**	**893.508**	**621.363**	**518.607**	**466.857**	**422.25**	**263.5**	**3,420.48**

T. METALS AND ENGINEERING

Program A: S&T Program for the Competitiveness of Agro-Industry					90	90	100	280
Design and Development of innovative, cost effective and appropriate Machinery, Parts and Engineered Products (MPEPs) for Agri-industry	15	15	15	15				60
Program B: S&T Service Facility for Industry					100	100	100	300
Establishment of Regional Innovation Centers in Regions CAR, I, II, III, X, IVA, IVB, V, VI, VII, IX, X, XI, XII and CARAGA	66	60	30	30				186
Establishment of Upgraded Metal Testing Center Applicable to the Needs of the Metal Industry	40	30						70
Establishment of Upgraded Heat Treatment Facility	20	20						40
Establishment of Facilities that will contribute the improvement of Metal Casting Industry	20	20						40
Establishment of Advanced Surface Engineering Facility	40	10						50
Expanding the Capabilities of Physical Metrology		166.9	79.3	121.3	178.5	25		571
Establishment of Micro Machining Facility			50	50				100
Program C: Support program for the Productivity and Competitiveness of the Metals and Engineering Industries					90	120	140	350
Design and Development of innovative, cost effective and appropriate Machinery, Parts and Engineered Products (MPEPs) (e.g. food processing industry,essential oils and fragrances, aerospace, etc.)	15	15	15	15				60
R&D Application on Robotics and Mechatronics for shop automation	20	15	15					50
Capability Building for Certification for Aerospace Standards	10	10	10	10				40
R&D on Advanced Metal casting and Metal Injection Technologies for Various Applications	15	15	15	15				60
R&D on Materials and Metallurgy Technologies for Various Applications	15	15	15	15				60
Design and development molds and die for processors and fabricators applications (e.g. food industries, aerospace, medical, marine industries, etc.)	10	10	10	10	10	10	10	70
Design and Development of Tool and Die for Handicraft Industries	10	10	10	10	10	10	10	70
Development and Creation of Materials Applicable for Metal Coating, Polishing and Finishing Technologies for Various Applications	10	10	10	10	10	10	10	70
R&D for Metal and Composite Etching or Photo Etching	10	10			10	10	10	50
Design and Development of Technology-Based Products for Aerospace Applications		20	15					35
Development of Machine Tool for Manufacturing Industry		10	10	10				30
Development of Induction Furnace		10	10					20
Design and Development of Tool and Die for Automotive industry		10	10		10	10	10	50
R&D on Mass Metrology			50	30	20			100
Standardization of Cupola Furnace			15	15				30
Program Total	**316**	**481.9**	**384.3**	**356.3**	**528.5**	**385**	**390**	**2,842**

U. ENVIRONMENT

R&D for Innovative Solutions to Solid Waste Management (SWM) -Managing pollution and waste levels including recycling and circular economy pathways -Treatment technology for Persistent Organic Pollutants -Development of alternative materials to plastic-based packaging and products under Non-Environmentally Accepted Products (NEAP) & Packaging (e.g., plastic stirrers/coffee cups) -Review of RA 9003 IRR (SUPs) -Third Party Treater Training	10	55	35	10				110
R&D for Innovative Solutions to SWM -Innovative Solution to SWM (Agricultural Wastes/plastics) -Alternatives to Persistent Organic Pollutant -Treatment of Microplastics and other marine litter. -Rehabilitation Program using the Developed Technologies -Recyclability Testing -Biodegradability Testing -ETV on Developed Technologies, Standards for Microplastics -Assisting low classes LGUs for establishment of SLF					47	47	46	140
R&D for Air Pollution Monitoring & Control -Baseline Data Gathering/ Technology Database Use of high-resolution Mass Spectrometers and satellite data for improvement of air quality monitoring -Development of localized technology for Indoor air quality -GIS and AI for image analysis and information extraction -Real-time monitoring & sensor networks -Validation of Philippine-made sensors and measuring devices for PM and CO -Use of predictive/System-based measurement devises -Application of bio-filters/ air scrubbers -GHG inventory & reduction technologies	64	37	85	64				250
R&D for Air Pollution Control and Management -Development of portable analyzers, localized data loggers, pollution exposure monitors, and upgrading of equipment for real-time monitoring -Containment technologies to prevent diffusion of pollutants/industrial gas leak, etc. (e.g. bio-filters & air scrubbers) -Installation/ Application/Deployment of air quality monitoring technologies -Development of a centralized calibration centre for aerosol devices -Forecasting of movement of toxic compounds in the atmosphere at high spatial and temporal resolution					70	70	70	210

R&D for Environmental Concerns of Industries -IOT-based treatment -Application of nanosilicate adsorbents -Biological treatment -Capacitive deionization -Radiation modified polymer -Mechano-chemical treatment to immobilize HM" Technology Database and Technology Transfer of Compact Technologies for Wastewater Treatment Installation/ Application of hybrid technologies for nutrients removal/ recovery. Formulation of guidelines/policies/ standards from results of R&D	44	44						88
R&D for Water Reuse, Recycling, and Resource Recovery -Capacitive deionization for water purification or recovery of nutrients and HM -Membrane Fabrication -Environmental Isotope technologies -Application of additive manufacturing for water purification -Creation of biocarrier -Production of selective sorbent for removal of HM and other micropollutants. -Mechano-chemical treatment to immobilize HM Technology Database and Technology Transfer of Desalination and Deionization technologies. Installation/ Application of treatment technologies for emerging contaminants (EDCs, antibiotic residues, etc.) Policy recommendation for ground water quality index and remediation.			100		35	35	36	206
R&D of Smart Water and Wastewater Treatment Technologies -Nanotechnology purifiers -IOT, nanosensors -Advanced instrumentation and control -Rapid test kits for detection of toxins and pathogens in water Technology Database and Technology Transfer of cost-effective membranes for wastewater treatment. Installation/ Application of additive manufacturing, biocarrier for removal of HM and other micropollutants. Policy recommendation for inclusion of emerging contaminants to GES and PNS.				45				45
Centralized Center for Wastewater Management and Treatment -MBR/MBBR treatment facilities with affordable membranes Technology Database and Technology Transfer of microplastic capturing technology/facility in strategic area. Application of technologies for treatment of Diffuse Pollution (Characterization, Evaluation, Monitoring, Loading analysis) Policy recommendation for centralized treatment of wastewater					90	30		120

Program Total	**118**	**136**	**220**	**119**	**242**	**182**	**152**	**1169**
V. PROCESS	**216**	**594**	**922**	**598**	**542**	**426**	**325**	**3,623**
W. MINING AND MINERALS								
Program for Metallic Minerals								
Value-adding of Nickel Laterite Ores								
Extraction of Critical Elements from Nickel ores (Laterite)	15	15						30
Refining of Nickel Pig Iron to Engineering Materials		15						15
Sc recovery from pig iron slag		15						15
Value-adding of Copper Copper Production from Oxides/Sulfide Ores Copper Production from Oxides/Sulfide Ores (Bench Scale)			50		40			90
Value-adding of Nickel Ores Extraction of Ni for battery application			50					50
Value-adding of Iron Pellets for Ironmaking				25				25
Value-adding of Nickel (Saprolite Ores)						40		40
Extraction of critical elements from other metallic minerals for emerging technology application							50	50
Nickel Program (Laterite Ores)							10	10
Chromite Program			8	7	10	10		35
Copper Program			5	5	6	6	10	32
Iron Program			14	14	21	21	21	91
Gold Program Laboratory Scale Process development for refractory gold ores							8	8
Advance Technical Training of Researchers			5.882	5.882	5.882	5.882	5.882	29.41
Program for Non-Metallic Minerals								
Value-adding technology for perlite	10							10
Value-adding technology for bauxite	10							10
Value-adding technology for CFA	3	5						8
Value-adding technology for clay	4	5						9
Value adding technology for clay/ceramics			30					30
Value-adding technology for marble				30				30
Value-adding technology for silica, lahar and blacksand					10			10
Value-adding technology for limestone						30		30
Development of value- adding technology for basalt							10	10
Program for extraction of Critical Minerals								
Nickel Ore Program for Critical Minerals Processing								

Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application	20	20						40
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application			12.5	12.5	12.5	12.5		50
Copper Ore Program for Critical Minerals Processing								
Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application		5	6					11
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application				15	15	20		50
Digitalization of Critical Minerals Exploration, Processing and Monitoring								
Use of ICT technology for exploration, and monitoring of mining operations (robotics, remote sensing, IA, AR/VR, etc)					14	14	14	42
Nonmetallic Ore for for Critical Minerals Processing								
Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application					18.18	18.18	18.18	54.54
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application						13.636	13.636	27.272

Other Metallic Ore for Critical Minerals Processing								
Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application					4.545	4.545	4.545	13.635
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application						13.636	13.636	27.272
Iron Ore Program for Critical Minerals Processing								
Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application			10	10				20
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application					20	15	15	50
Mine Tailings for Critical Minerals Processing								
Phase 1:Laboratory Scale Test Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/Ex-situ processing technology for critical minerals Refining of critical minerals and metals for specific emerging technology application			4.545	4.545	4.545	4.545	4.545	22.725
Phase 2: Pilot Scale Test (Partial integration with partner companies) Advance mineral exploration, mapping and emerging spectroscopic ore characterization Advance/innovative/Novel/In- situ processing technology for critical minerals Refining of critical minerals and metals specific for emerging technology application						13.636	13.636	27.27

Advance Technical Training of Researches								
Attend short courses on advance/ innovative critical minerals processing abroad Benchmarking/visit of laboratories/ facilities/processing plant on critical minerals processing in other countries abroad Invitation of experts (e.g. Balik Scientists) on critical minerals processing ICT technology for mining operations		2.777	2.777	2.777	2.777	2.777	2.777	16.662
Technologies in Support of Rehabilitation of Abandoned and Mined-out Area								
ACID MINE DRAINAGE								
Mine tailings/waste treatment and utilization to valuable products	30							30
Mine tailings/waste treatment and utilization to valuable products		30						30
Rehabilitation technique of legacy mines			20					20
DIGITALIZATION IN MINING	30	30	20	0	0	0	0	80
Application of digital systems in monitoring mine rehabilitation				20				20
Prediction modeling of Hg in SSGM					20			20
Innovative rehabilitation technologies for mined-out area						20		20
Innovative technology for the recovery of value from mine wastes/tailings							20	20
COAL FLY ASH								
Extraction of REE from CFA			5					5
OFFSHORE MINING								
Assessment of the Impact of Magnetite Sand mining in the ecosystem and the community					5	5	5	15
PHOSPHOGYPSUM TAILINGS								
Innovative/novel technique in the recovery of metals (precious, heavy, radiactive)							5	5
Utilization of treated tailings to valuable products							5	5
CAPACITY BUILDING OF RESEARCHERS			5		5		5	15
Program Total	**122**	**143**	**249**	**152**	**214**	**270**	**255**	**1,405**

X. TECHNOLOGY TRANSFER **Y. STARTUP DEVELOPMENT PROGRAM** **Z. TECHNOLOGY BUSINESS INCUBATION PROGRAM**								
(HEIRIT) Higher Education Institution Readiness for Innovation and Technopreneurship	62	85	12	85	85	12	85	329
HEIRIT Regional Startup Enablers for Ecosystem Development (ReSEED) Program	6	6	6	6	6	6	6	42
SPARK UP (S&T Parks for Accelerating Research and Knowledge for Universities Program)	5	24	5	24	5	24	5	92

FASTRAC (Funding Assistance for Spin-Off and Translation of Research in Advancing Commercialization)	23	81	81	81	81	81	81	509
IMPACT (IP Management Program for Academic Institutions Commercializing Technologies) Program	12	12	30	40	35	30	30	189
SciTech Super Highway Program	12	12	15	15	30	40	40	164
PCIEERD LINC (Leveraging Innovation Partners to Nurture Collaboration) and Capability Building Program for Startups, TBI Teams and Researchers (FEC, PREP, Licensing Clinics)	7	14	14	14	14	19	19	101
Startup Grant Fund: Jumpstarting the Economy in the New Normal (Support Program for RA 11337)	33	67	67	70	75	75	75	462
WHWise (Women-Helping-Women: Innovating Social Enteprises) Program	66	40	40	40	45	50	55	336
SCI4GOV (Startups Creating Innovations for Government) Program	4.5	17	20	23	25	30	35	154.5
i-NEST (Innovation-to-Incubation for New & Emerging Space Technologies	4	47	30	30	30	30	35	206
Program Total	**234.5**	**320**	**320**	**428**	**431**	**385**	**466**	**2584.5**

Institution Development Program	40	20	20	50	55	55	44	284
Human Resources Development Program	15	18	20	25	25	25	25	153
Regional Consortia	30	40	40	50	50	50	50	310
Young Innovators Program	5	7	9	11	13	15	17	77
Balik Scientist Program	62	65	65	65	65	65	70	457
Good Governance through Data Science and Decision Support System (GODDESS)	25	25	25	25	25.5	25.5	30	181
Program Total	**177**	**175**	**179**	**226**	**233.5**	**235.5**	**236**	**1462**

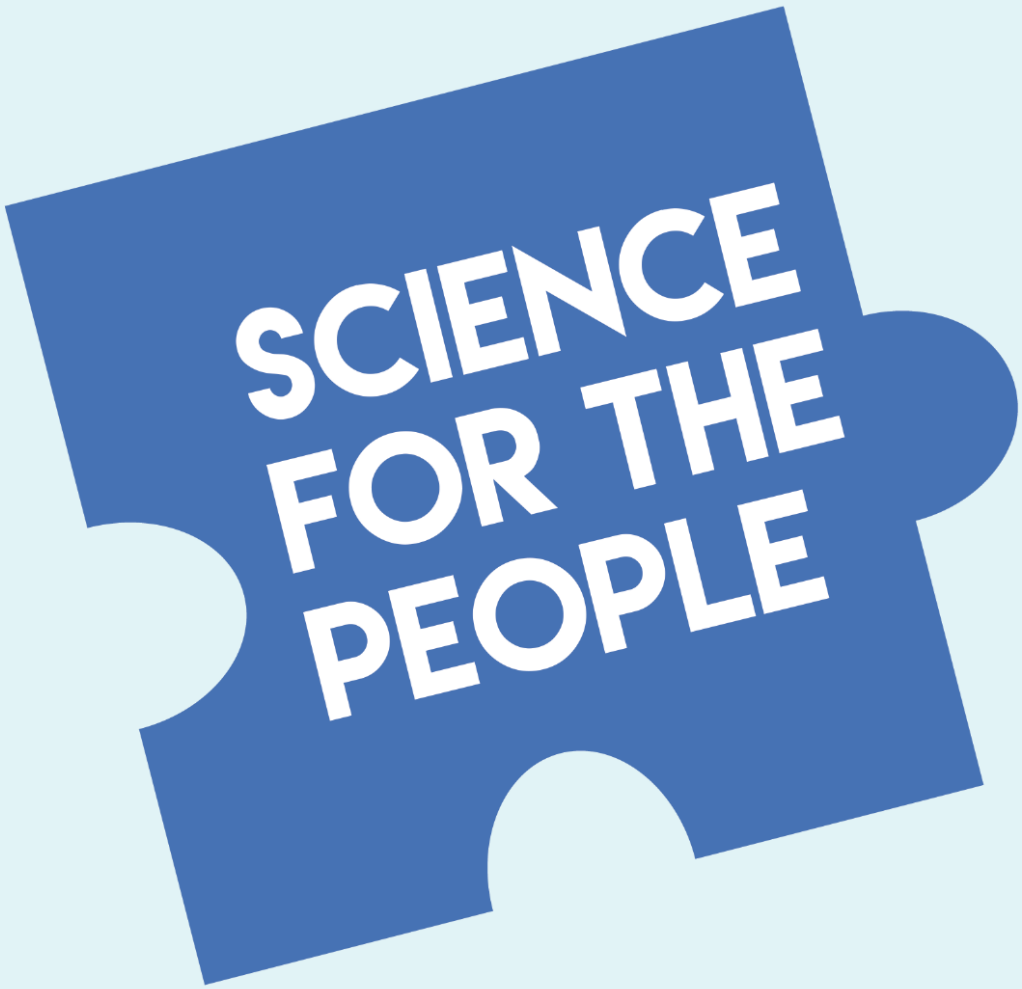
Science Communication for Innovation	15	20	25	20	20	20	20	**140**

SECTION 5 - DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION (DRR & CCA) Research and Development Agenda

FOREWARN								
Weather and Climate Data Science for Service Partnership for SEA (WCSSP)								
Wave modeling (DOST-PCIEERD MECO-TECO)	1.27							1.27
Socio-economic benefit of meteorological products and services (Cost benefit Analysis)			3	3	3			9
Multi-Hazard Impact-Based Forecasting and Early Warning System for the Philippines (MH-IBF-EWS Project)	674.445	200.12	54.226	67.430	60.562			1,056.78
Modernizing Weather Analysis and Forecast Operations		75	75	50				200
Enhancement of Space Technology Applications for TC monitoring		100	100	100				300
Improvement of Data Assimilation and Numerical Prediction System (DOST-PCIEERD) (MECO-TECO)								
Radar Quantitative Precipitation Estimate (QPE) (DOST-PCIEERD) (MECO-TECO)								
Operationalization of MCS Tracking Algorithm using HIMAWARI Satellite Data	1	2	1					4

Philippines Storm Surge Atlas for Coastal Flood Early Warning		2	2	2				6
Risk Communication (GCF-Counterpart)		2	2	2				6
Observation and Modeling Studies of Typhoon Formation and Structure		3	3	2				8
LIGTAS BAHA								
Flood Modeling for Major River Basins	5							5
IFAS Model Application to Large Major River Basins	1.5							1.5
Application of RRI to Model Inundations Due to Dam Releases	2							2
Verification & Operationalization of SAOFFGS for the Philippines	2							2
Hydrologic Data Management System	59.047							59.047
Community-level Flood Monitoring and Forecasting		7.45	7.032	6.825				21.307
Radar and Satellite-Based Flashfloods and Landslides Forecasting			180	179				359
Land Subsidence-flooding Relationship in Critical Areas		7.95	7.39	7.391				22.732
Basin-wide Water Resources Assessment with Climate Predictions					5	4	3	12
High-Resolution Flood Modeling of Major Urban Areas with Advanced Hydrological Models (SHIELD Project) UNDP-AusAID								
Advanced Space Technology for Real-Time Flood Monitoring					25	15	10	50
Internet of Things (IoT) Approach and Cloud Computing in Flood Forecasting					20	15	10	45
CLIM' UP								
High-resolution observation-based gridded data for the Philippines (DOST-PCIEERD)								
Warning System of Extreme Events Associated with Monsoon (DOST-PCIEERD)								
Sectoral Climate Impact Assessment and Modeling		1.2	1.2	1.2	1.2	1.2	1.2	7.2
Dynamically Downscaled Seasonal Forecast System		7.2	3.8					11
Impact-based forecasting of El Nino-induced Drought		1.2	3.5	2.2	1			7.9
Enhancement of PUMIS Integrating High-resolution Data divide		5		5		5		15
Climatological Data Management System Life Cycle Sustainability								
Sectoral Climate Impact Assessment and Modeling (Nationwide)								
Impact-based forecasting of El Nino-induced Drought (6 provinces impacted, 2006)								
Improved Program seasonal to Seasonal (S2S) Forecasting of Extreme Climate Event					3.2			3.2
Development of Fire Weather-based Index for Monitoring and Predicting Forest and Bush Fire due to Drought					2.2	2		4.2
Development of Next Generation Technologies for Drought Monitoring					1.5	3	1.5	6
DRR/CCA								
Cloud Seeding Experiments and Application		3	3	3				9
Atmospheric Aerosols Dispersion Modeling (DOST-PCIEERD)								
Strengthening Institutions and Empowering LOcalities Against Disasters and Climate Change in the Philippines (SHIELD Program) Component 3: Science to Action (Severe Wind and Storm Surge Hazard Mapping and Risk Assessment - SHIELD Project) PAGASA UNDP/AusAid								

Green Climate Fund (GCF) Coastal Resilience Project Output 1: Enhanced Knowledge Management Systems for Reducing Vulnerability of Coastal Communities to Climate-Induced Coastal Hazards								
Program Total	746.26	417.12	446.15	431.05	122.662	45.2	25.7	2,234.13
Volcano, Earthquake and Tsunami Monitoring and Warning Program								
Seismic and Tsunami Network Development		22.5	18.5	18.5	18.5	18.5	18.5	115
Volcano Network Development		3	6.5	3	3	3	3	21.5
Volcano, Earthquake and Tsunami Hazards Mapping and Research and Development Program								
Earthquake Hazards Assessment and R&D		3	3	3	3	3	3	18
Volcano Hazards Assessment and R&D		1	1	1	1	1	1	6
Volcano Eruption Potential R&D		1.5	1.5	1.5	1.5	1.5	1.5	9
Innovations Laboratory for Geospatial, Remote Sensing, Product Development and other R&D for DRR-CC (Innovations Lab)		0.15	0.15	0.15	0.15	0.15	0.15	0.9
GeoRisk Philippines		0.7	0.7	0.7	0.7	0.7	0.7	4.2
National Exposure Database (NED)		0.15	0.15	0.15	0.15	0.15	0.15	0.9
Measurement of Velocities of Earthquake Faults (MOVE Faults)		20	20	20	20	20	20	120
Landslide Monitoring, Early Warning, and Risk Assessment (Dynaslope Project)		45	45	45	45	45	45	270
3D Philippines (DOST-PCIEERD)								
Volcano, Earthquake and Tsunami Disaster Preparedness and Risk Reduction Program								
Stakeholders' Engagement and Analysis (SEA)		0.4	0.4	0.4	0.4	0.4	0.4	2.4
Impact Assessment of DOST-PHIVOLCS Selected Projects and Activities		0.15	0.15	0.15	0.15	0.15	0.15	0.9
Analysis of DOST-PHIVOLCS Social Media data and Science Communication		0.05	0.05	0.05	0.05	0.05	0.05	0.3
Narrative Accounts Analysis of Significant Earthquake, Tsunami and Volcanic Eruption events		0.1	0.1	0.1	0.1	0.1	0.1	0.6
DANAS: Earthquake, Tsunami and Volcano Disaster Narratives for an Experiential Knowledge-based Science Communication								
Program Total		**97.7**	**97.2**	**93.7**	**93.7**	**93.7**	**93.7**	**569.7**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