"Research: Quality Engine of Excellence"

(63)(077) 677-2994
Quiling Sur, City of Batac, Ilocos Norte
Mariano Marcos State University
rddirectorate@mmsu.edu.ph

UNIVERSITY RESEARCH AND DEVELOPMENT AGENDA

(2024–2028)

Creative, Relevant and Innovative Research Programs

Quiling Sur, City of Batac, Ilocos Norte (63)(077) 677 - 2994 rddirectorate@mmsu.edu.ph

Vision

A premier Philippine university by 2028

Mission

To develop virtuous human capital and sustainable innovations in a knowledge-driven global economy

Research Centers

- **Garlic Research Center (GRC)**
- **Tuklas Lunas Development Center (TLDC)**
- **Natural Resources Conservation and Management Centers (NRCMC)**
- **National Bioenergy Research and Innovation Center (NBERIC)**
- **Regional Research and Training Center for Climate Change Studies (RRTCCS)**
- **Center for Innovative Materials in Emerging Applications (CIMEA)**
- **Coastal Engineering Research Center (COASTER)**
- **Social Development Research Center (SDRC)**

Priority Projects

- ***Technology development for resilient and adaptive communities and ecosystems***
- ***Enhancement of adaptation and mitigation capacity of vulnerable communities***
- ***Knowledge management portal for information and resources on climate change adaptation***
- ***S&T Action Frontline for Emergencies and Hazards (SAFE)***
- ***Online EWS (Early Warning Systems) for key agricultural commodities***
- ***Rehabilitation and climate change proofing of vulnerable agri-aqua and natural resource areas***

Priority Projects

- ***Identification/Mapping/Biophysical Profiling of vulnerable ecosystems***
- ***Inclusive Science for Livelihood in the Agri-aqua Sector (ISLAs)***
- ***Quick response S&T- based assistance to AANR communities affected by hazards***
- ***Carbon neutral technologies***
- ***Role of forestry in disaster risk reduction***

UNIVERSITY RESEARCH AND DEVELOPMENT AGENDA
(2024 – 2028)

The Mariano Marcos State University (MMSU) has long been committed to advancing research and development (R&D) as a key pillar of its mandate. Over the past 46 years, the university's research initiatives have significantly contributed to the well-being of its stakeholders. As the social, economic, and environmental landscape evolves, the university recognizes the need to continuously refine its research direction to remain relevant and impactful.

Anchored by the Harmonized National Research and Development Agenda (HNRDA), the National Higher Education Research Agenda (NHERA), National Unified Health Research Agenda (NUHRA), and the United Nation's Sustainable Development Goals (SDGs), the University Research and Development Agenda (URDA) for 2024–2028 serves as a strategic roadmap for advancing research excellence, fostering innovation, and addressing critical societal challenges. The agenda is also firmly anchored on the university's 7-point strategic agenda, ACHIEVE, which underscores MMSU's commitment to creative, relevant, and innovative research programs. In pursuit of this goal, MMSU has institutionalized eight specialized research centers that serve as hubs for interdisciplinary collaboration, generating knowledge and technologies that support sustainable growth and development. These include the Center for Innovative Materials in Emerging Application (CIMEA); Garlic Research Center (GRC); Natural Resources Conservation and Management Center (NRCMC); National Bioenergy Research and Innovation Center (NBERIC); Tuklas Lunas Development Center (TLDC) Regional Research and Training Center for Climate Change Studies (RRTCCS), Social Development Research Center (SDRC), and Coastal Engineering Research Center (COASTER).

The URDA 2024–2028 encapsulates the university's research priorities across six thematic areas: (1) Agriculture, Aquatic, and Natural

Resources (AANR); (2) Socioeconomics, Policy Research, and Governance; (3) Information and Communication Technology (ICT), Energy, Engineering, and Emerging Applications; (4) Education and Culture; (5) Health, Wellness, and Bioprospecting; and (6) Climate Change Adaptation, Mitigation, and Disaster Risk Reduction. Each research priority aligns with national and regional development goals, ensuring that MMSU's R&D efforts contribute meaningfully to economic growth, environmental sustainability, and societal progress.

Through collaboration with academic, industry, and government partners, the university remains steadfast in its mission to deliver cutting-edge research solutions that empower communities and enhance the nation's competitiveness in an increasingly knowledge-driven world.

Priority Projects

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)

6. Climate Change Adaptation and Mitigation, and Disaster Risk Reduction

6.1. Mitigation and adaptation studies of vulnerable communities and ecosystems

6. 2. Smart farming approaches and other climate-resilient agricultural production technologies

6.3. Strategies/decision management tools for climate change- and disaster-resilient environment

6.4. Sustainable development through lifescape – landscape/ seascape approach

c. In vitro and/or in vivo assays

d. Product development

e. Efficacy studies on rice based developed products

Priority Projects

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

TABLE OF CONTENTS

1. Agriculture, Aquatic and Natural Resources (AANR)

1.1. Crops

1.2. Livestock

1.3. Forestry

1.4. Aquatic

1.5. Natural Resources and Environment

1.1. Crops

- *Germplasm evaluation, conservation, utilization and management*
- *Varietal improvement and selection*
- *Production of certified good quality seeds and planting materials*
  - *Development/optimization of seed production protocols*
  - *Innovations in seed systems*
- *Cultural management practices (pest, water, soil and nutrient management)*
  - *Optimization of nutrient and water management*
  - *Optimization of integrated pest and disease management*
  - *Organic Agriculture*
- *Crop production systems*
  - *Smart farming approaches*
  - *Off-season production and cultivation*
  - *Development of climate-resilient technologies*
  - *Decision support systems*
- *Postharvest, primary processing and product development*

5. Health, Wellness and Related Bioprospecting Applications

5.1. Tuklas Lunas (Drug Discovery and Development)

5.2. Functional Foods

5.3. Nutrition and Food Safety

5.4. Re-Emerging and Emerging Diseases

5.5. Diagnostics

5.6. Omic Technologies for Health

5.7. Biomedical Devices Engineering for Health

5.8. Digital and Frontier Technologies for Health

5.9. Disaster Risk Reduction/Climate Change Adaptation in Health, and

5.10. Mental Health

Priority Projects

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*

4. Education and Culture

- *Improvement of teaching-learning competencies*
- *Improvement of teaching-learning competencies*
- *Digital transformation and academic performance of students*
- *Innovative teaching and strategies suitable for local challenges*
- *Culturally relevant assessment methods on holistic student development*
- *Employability and performance of graduates*
- *Industry competency requirements identification*
- *Innovative teacher training methods to improve the quality of education*
- *Cultural competence among educators in local indigenous communities*
- *Education policies*

Priority Projects

- *Documentation of Philippine indigenous knowledge, culture, and Heritage*
- *Extant arts, music, and language*
- *Indigenous technology in Filipino expressive culture*
- *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*

Priority Projects

- *Crop improvement through conventional and new breeding techniques (NBT)*
- *Field verification and adaptability trials of improved crop varieties and/or technologies*
- *Surveillance and management of pests and diseases of selected crops*
- *Postharvest innovations to extend the shelf life of priority crops*
- *Product development and value addition*
- *Roll out of matured technologies*

Priority Commodities

1. *Rice*
2. *Corn and Other Grains*
3. *Fruit Crops*
    a. *Mango*
    b. *Banana*
    c. *Other tropical fruits*
4. *Legumes (e.g. mungbean and peanut)*
5. *Medicinal Plants*
6. *Plantation Crops*
    a. *Coffee*
7. *Root crops (e.g. sweet potato, cassava)*
8. *Vegetables (e.g. tomato, white potato, mushroom)*

1.2. Livestock

- *Breed development and genetic improvement*
- *Reproductive bio techniques for priority livestock species*
- *Nutrition, feeds and feeding system*
- *Conservation and improvement of native animals*
- *Food quality and safety assurance*
- *Disease control and anti-microbial resistance management*
- *Production and management decision support systems*
- *Product development and processing*
- *Emerging technologies on breeding techniques*

Priority Projects

- *Native Animal R&D Program (Pig, Poultry, Chicken, Cattle)*
- *Innovative food/feed product development*
- *Forage and pasture development (varietal improvement of forage species)*

Priority Commodities

1. Livestock
- *a. Swine*
- *b. Goat*
- *c. Sheep*
- *d. Cattle (dairy and meat)*
- *e. Carabao (dairy and meat)*

2. Poultry
- *Chicken (meat and egg)*

3. Native animals
- *a. Chicken*
- *b. Duck*
- *c. Swine*
- *d. Goat*

4. Feed Resources

h. Water auditing technologies (2023 - 2024)

- *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*
- *Water supply and demand management and monitoring technologies/S&T intervention*
- *Water desalination system (non-membrane, non-solar powered)*
- *Hydrological groundwater site investigation w/emerging contaminants*
- *Modelling and monitoring tools for extraction of safe quality of water*

Priority Projects
(DRC-CCA)

- *Multi-Hazard Assessment Tools and System*
- *Vulnerability Assessment, Risk and Warning Communication Systems*
- *Localization of Observation and Forecasting Tools and Monitoring Networks*
- *Modelling and monitoring tools for extraction of safe quality of water*

- *Next generation Energy efficient tech*
- *Lead Acid Battery life span improvement*
- *Assessment of indigenous materials for energy storage*
- *Offshore platform development for Solar and Wind applications*
- *Hybrid RE system for off/on grid application*
- *Ocean Thermal energy assessment and development*
- *Development of efficient catalyst and conversion system for biofuel*
- *Intelligent/Smart Energy Monitoring, Management and Control*
- *Development/Improvement of technologies for hemicellulosic materials for biofuels*
- *Biogas Storage and transport*
- *Design and development of local MHP system for irrigation channel application*
- *Development of efficient catalyst and conversion system for biofuel*
- *Indigenous materials for energy storage*
- *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

f. Green infrastructure for water management (2023 - 2024)

g. Sedimentation monitoring and mitigation system and technologies (2023 - 2024)

1.3. Forestry

- *Physiological and ecological studies*
- *Varietal improvement of priority agroforestry/non-timber*
- *and forestry species*
- *Sustainable production, management and processing of priority agro-forestry/non-timber and forestry species*
- *Innovative product development*
- *Decision support systems*

Priority Projects

- *Selection and production of superior genetic materials of selected agroforestry and forestry species*
- *Livelihood opportunities for upland communities*
- *Upland farming in urban setting*
- *Sustainable agroforestry models including, but not limited, to silvopasture models*
- *Sustainable agroforestry models*
- *Innovative techniques for processing of timber and non-timber species*
- *Industrial uses of bamboo and ITPs*
- *Decision tools for forest tree plantation management and marketing*

1.4. Aquatic

- *Application of genomics in the study of diseases of aquatic species and fish resistance to climate change; molecular phylogenetics; population genetics*
- *Physiological and ecological studies of aquatic species*
- *New species for culture*
- *Culture systems (broodstock management, hatchery, nursery, grow-out)*
- *Fish health, disease diagnostics and disease management*
- *Nutrition, feeds and feeding system*
- *Postharvest handling, processing and new product development*
- *Mechanization and automated systems for feeding, water and culture management, and post production*
- *Fish kill warning and mitigation systems*
- *Production and management decision support systems*
- *Conservation of endemic and threatened fishes*

Priority Projects

- *Aquatic Genomics R&D*
- *Pilot testing of technologies, systems and other products of aquatic re-search*
- *Fish disease diagnostic tools*
- *Alternative feeds and feed additives for improved nutrition of aquatic species*

- *Graphene-enabled consumer products (solar panels, flexible displays, sensors, imaging devices)*
- *Convergence of Nanotechnology and Big Data analysis*
- *Graphene-enabled consumer products (solar panels, flexible displays, sensors, imaging devices)*
- *Prototyping of robots (micro, swarm, exo-suits, general)*
- *Prototyping of electronic components for autonomous vehicles*
- *Development of advanced sensors (event-based, nano, lenseless)*
- *Service delivery optimization*
- *Public sensor networks for situation monitoring*
- *Improvement of Local RE facility*
- *Localization of equipment including balance of systems (BOS)*
- *Improvement of energy generation for microgrid applications*
- *Micrositing tools and small wind applications*
- *Design and development of Ocean RE mechanical harvesting devices*
- *Energy profiling of Philippine MSMEs*
- *Development and demonstration of low carbon technology applications for Philippine MSMEs*
- *Energy storage R&D Facility*
- *Energy Storage Testing Facility*
- *Novel and innovative RE technologies (hydrokinetic turbine, low head low flow application, wind harvesting)*
- *Solar PV facility for certification*
- *Wave energy harvesting system*
- *Development of next generation biofuels*

- *Development of nanostructured materials for efficient energy conversion and storage devices*
- *Development of smart energy systems (nano engineering of highly efficient conductors and superconductors)*
- *Development of nanostructured aerogels (applications in insulation, energy and environment)*
- *Development of nanogenerators*
- *Development of blue nanotech (development of blue nanomaterials, applications in consumer electronics, Carbon dioxide (CO2) to Carbon nanotubes conversion)*
- *Nano Biomimicry (applications on wave and tidal energy, sensing, bioluminescent household and street lighting)*
- *Nanomaterials for efficient energy conversion and storage devices (hydrogen energy storage, solar energy conversion)*
- *Deployment of smart energy systems (nano engineering of highly efficient conductors and superconductors)*
- *Development of nanostructured aerogels (applications in insulation, energy and environment)*
- *Graphene R&D (applications in flexible electronics, solar energy, sensors, bioimaging)*
- *Assembly and deployment of Nanogenerators*
- *Blue nanotech systems (development of blue nanomaterials, applications in consumer electronics, CO2 to carbon nanotubes conversion)*
- *Nano Biomimicry (applications on wave and tidal energy, sensing, bioluminescent household and street lighting)*

- *Product development from various aquatic species (including marine toxins)*
- *Rollout/commercialization of aquatic technologies*
- *Conservation and production of endemic and threatened species*

Priority Commodities

1. *Finfishes*
   a. *Tilapia*
   b. *Endemic and threatened species (Mudfish, Gourami, ar-aro, bukto, birut, pallileng, bagsang, etc.)*
2. *Seaweeds*
3. *Sea cucumber*
4. *Cephalopods*
5. *Aquafeeds*

1.5. Natural Resources and Environment

- *Conservation, sustainable utilization, and management of biodiversity in terrestrial, freshwater and marine ecosystems*
- *Sustainable inland and coastal watershed management and utilization*
- *Management and rehabilitation of degraded and polluted agricultural soils*
- *High-value product development from agricultural and forests wastes*
- *Strategies/decision management tools for climate change resilient environment*
- *Resource and ecosystems assessment and monitoring*
- *Habitat management for fishery and ecosystem sustainability*
- *Marine environmental management (Harmful Algal Blooms, coastal integrity/erosion and eutrophication)*
- *Fishkill warning and mitigation systems*
- *Innovative management systems for unique landscapes and ecosystems*
- *Ecotourism management*

Priority Projects

- *Biodiversity R&D Program*

  i. Conservation, sustainable utilization and management of endangered, threatened and endemic terrestrial and aquatic species

  ii. Biodiversity assessment of terrestrial and aquatic ecosystems

  iii. Genetic diversity conservation and dynamics in various ecosystems

3. Information and Communications Technology (ICT), Energy, Engineering and Emerging

- *Smart packaging*
- *Nanodelivery – Applications*
- *Nanosensors – Applications*
- *Nanodiagnostic devices*
- *Nanotech-enabled solutions addressing climate change (e.g. more efficient materials—light harvesting coatings, green technology, etc.)*
- *Nanodevice fabrication for drug delivery and diagnostics (nanobots)*
- *Agricultural detection of pathogens, pesticide residues and determination of crop quality*
- *Nano-photonic materials*
- *Renewable Energy (RE)*
- *Energy Efficiency and Conservation*
- *Energy Storage*
- *Disaster Risk Reduction-Climate Change Adaptation (DRR-CCA)*
- *Nanofabrication techniques for electronics and materials manufacturing (NEMS, memory tech, blow spinning)*
- *Adoption of advanced materials such as intermetallics, nanoclays and smart fibers*

- **The impact of specific environmental factors on health (water quality, solid waste management) and developing strategies to mitigate these impacts**
- **Evaluating the effectiveness of current sanitation practices in preventing diseases and developing new practices based on identified gaps.**
- **Knowledge, attitude, and practices on solid waste management**
- **Assessment of health literacy**
- **The effectiveness of health governance structures and processes**
- **Studies on health expenditures**
- **Development of integrated HMIS**
- **Development of mental health programs in the workplace**
- **Implementation and effectiveness of school-based mental health programs and interventions**
- **Development, implementation and evaluation of adolescent friendly and culturally appropriate sexual and reproductive health programs and interventions**
- **Enhancement of sexual health education**
- **Understanding and addressing gender-based violence**

- ***Ocean studies (ocean currents, waves, dynamics, plate tectonics, hydrology)***
- ***Valuation and payment for ecosystem services of watersheds***
- ***Knowledge management for enhancing science, policy and practice of water-sheds***
- ***Reef assessment, monitoring and conservation***
- ***Control and management of risks and hazards in water ecosystems***

Priority Commodities

Timber

1. ***Tree plantations (e.g. yemane, falcata)***

Non-Timber

1. ***Bamboo***
2. ***Vines and other non-timber***
3. ***Biodiversity***
   - ***a. Ecosystem (e.g. mangrove, marine, freshwater)***
   - ***b. Microbial***
   - ***c. Flora and Fauna***
   - ***d. Ecotourism***
4. ***Climate change adaptation and disaster risk reduction***

2. Socioeconomics, Policy Research and Governance

- *Business and Food Innovations*
- *Tourism Improvement*
- *Community Development*
- *GAD Mainstreaming*
- *Capability enhancement trainings/*
- *Human resource development*

Priority Projects

- *Business performance of MSMEs and local industries*
- *Investment climate and economic opportunities*
- *Programs and services of government agencies to micro enterprises for entrepreneurship development*
- *Human capital development for organizational (institutional and local industry) effectiveness*
- *Policy problem assessment and Policy Analysis*
- *Regulatory and market-based approaches to environmental policy*
- *Policy for science*
- *Technology foresight*
- *Institutional innovations on building capacity*
- *Efficient and Effective Government Structure, Systems and Program*
- *Leadership Development*
- *Stakeholders Engagement for Sustainable Development*
- *Social policy analysis on food security programs and projects*
- *Community capacity assessment on local climate change adaptation and governance*
- *Alumni impact on local and global social change and development*
- *Narrative Inquiry of Ilokano Broadcasters' Principles and Practices*
- *Assessment studies on the welfare of the diverse populations*
- *Enhancing public health through integrated approaches*
- **Development of health technology, telehealth, and diagnostics**
- **Assessment of health human resources needs**
- **Development of innovative approaches on health promotion and education**
- **Capacity assessment to deliver health services during and after disasters or climate-change related events**
- **The impact of specific environmental factors on health (water quality, solid waste management) and developing strategies to mitigate these impacts**
- **Evaluating the effectiveness of current sanitation practices in preventing diseases and developing new practices based on identified gaps.**
- **Knowledge, attitude, and practices on solid waste management**
- **Assessment studies on the welfare of the diverse populations**
- **Enhancing public health through integrated approaches**
- **Development of health technology, telehealth, and diagnostics**
- **Assessment of health human resources needs**
- **Development of innovative approaches on health promotion and education**
- **Capacity assessment to deliver health services during and after disasters or climate-change related events**