



MARIANO MARCOS STATE UNIVERSITY

UNIVERSITY RESEARCH & DEVELOPMENT AGENDA 2019-2023



UNIVERSITY RESEARCH AND DEVELOPMENT AGENDA (2019 – 2023)

The Mariano Marcos State University (MMSU) has been pursuing various research activities since it was established as a University 41 years ago. The research outputs are utilized by target clienteles to improve their quality of life. However, the dynamism of the social, economic, socio-cultural, and political environment requires continuous updating and redirecting research efforts to align with the Harmonized National Research and Development Agenda (HNRDA) geared toward the attainment of the Sustainable Development Goals (SDGs).

To address this concern, the annual MMSU In-House Review and Planning Workshop is being conducted to: i) review research programs/projects/studies undertaken by full-time and faculty researchers of the university; and ii) to identify gaps and researchable areas in the context of changing development thrusts and priorities. The outputs serve as bases in updating the University R&D Agenda (URDA) for the next five years (2019-2023).

Under the new administration of the University, the 7-point agenda dubbed as ACHIEVE embraces the four-fold functions: instruction, research, extension, and production. The C stands for Creative, Relevant, and Innovative Research Programs. This component is envisioned to implement more responsive and relevant research and development projects and programs. To facilitate its realization, six (6) research centers were established through BOR resolutions. These are: 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); TuklasLunas Development Center (TLDC); and the Regional Research and Training Center for Climate Change Studies (RRTCCS). On the pipeline for BOR approval is the center that cuts across various disciplines- Humanities, Social Science, Communication and Education Research Center (HuSoComERC).

The URDA shall provide the overall direction in the pursuit of research activities in aid of planning and policy and decision making particularly in crafting the University Strategic Plan and in support to the achievement of local, regional and national goals.

For the next five years, the URDA shall continue to compose the various discipline clusters as follows:

- Education, Social Sciences, Humanities, Culture & Arts
- Agriculture, Fisheries, Forestry and Natural Resources and Environment (AFFNRE)
- Business, Management, Engineering & Industry
- Natural Sciences
- Health and Wellness
- Law & Governance
- Interdisciplinary Sciences

Each discipline contributes to the attainment of the following R&D Objectives:

1. Increase production through sustainable development;
2. Produce and develop food products that are competitive and have export potentials through clean production;
3. Develop low cost technologies to generate energy and biofuel from available renewable resources and promote the development and commercialization of appropriate machineries in support to micro, small and medium enterprise;
4. Promote sustainable development in the region amidst climate change;
5. Develop an integrated computer-based research management information systems of the university;
6. Improve the quality of education through science and information technology innovations;
7. Provide a market incubation center for technical breakthroughs that have excellent commercial potentials thereby providing an avenue for technology commercialization;
8. Promote healthy living, improve health delivery services and develop alternative source of cheaper medicines; and
9. Strengthen the R&D capacities in terms of both manpower and research facilities.

EDUCATION, SOCIAL SCIENCES, HUMANITIES, CULTURE & ARTS

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Education Program/Curricular Studies On Higher Education	
<i>Content Knowledge Pedagogy and Innovations</i>	<ul style="list-style-type: none"> ▪ Curriculum and policies that promote 21st century competencies and fluencies • 21st Century competencies, skills and fluencies in teaching and learning • New directions and priorities for teacher training ▪ Readiness of the 21st century learner to the 4.0 Industrial Revolution • Utilization of Information Technology in teacher education • Emerging images of 21st century teachers as perceived by different stakeholders
	<ul style="list-style-type: none"> ▪ Developing in - service teachers' Technological, Pedagogy Content Knowledge (TPCR) ▪ Teaching practices, students learning outcomes and education (in)equities and (in)equalities ▪ Use of Technology and Data for Effective Teaching Learning and Research ▪ Mathematics, language, music in indigenous Filipino expressive culture ▪ Production of instructional materials ▪ Leadership and instruction ▪ Innovations in delivering Graduate Education • Problems encountered by pupils/students in mastery of learning competencies • Stakeholders perceived effects of the K to 12 curriculum on student learning • Assessment/evaluation of teaching practices in different subject areas • Comparative study of different curriculum
<i>Curriculum and Planning</i>	<ul style="list-style-type: none"> ▪ Reform towards outcomes-based education. ▪ Curriculum Innovations in pursuant of globalization. ▪ Viability of new graduate course offerings ▪ Implementation of Philippine qualifications framework and alignment to ASEAN integration
<i>Input to teacher education</i>	<ul style="list-style-type: none"> • Profile of faculty and students in teacher education institutions • Student and faculty preferences in instruction and evaluation • Quality of teacher education programs and in-service programs for teachers • Existing knowledge and beliefs of pre-service education teachers • Intervention program for students with absentee parent • Self-efficacy and level of concerns of Grade 7 science teachers

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
<i>Process of teacher education</i>	<ul style="list-style-type: none"> • Use and effects of ICT and multimedia on instruction • Distance learning mode for teacher education students • Instructional materials development and validation in classrooms • Invention programs for effective teaching and learning • Analysis of current practices of traditional and non-traditional assessment tools and rating systems • Peace and human rights, values education studies • Development and assessment of HOTS among pre-service teachers • Introduction practices for beginning teachers • Multilingual education (MLE) and mother-tongues-based as a subject and language of instruction • Development of modularized instruction in physics and chemistry • Analysis and evaluation of the teaching-learning process, teaching methods and classroom management practices • Information and education campaigns
<i>Teacher preparation/ pre-service and in-service training</i>	<ul style="list-style-type: none"> • Program assessment of the field study courses offered • Improving the verbal and written communication skills of pre-service teachers • Approaches of learning and conceptions of learning • Learning styles of learners and its effect on their performance • Science process skills of BSE Science Concentrators: Its implications to science laboratory classes • Determining the readiness of TLE students of SUCs in Region 1 in the Licensure Examinations • Development of a reading program model for teacher education institutions in Ilocos Norte • Development a LET Review of Excellence • Outcomes-based assessment of practice teachers: developing global competitiveness
<i>Teaching methodologies</i>	<ul style="list-style-type: none"> • Effect of small groups/cooperative learning on the physical, social, moral and intellectual development of children • An analysis of teacher classroom management • An evaluation of instructional practices of teachers • Effects of the use of informal communication technology in the delivery of basic education to large number of learners • Effects of innovative teaching strategies on performance of students • Effectiveness of teaching-learning strategies/competencies
<i>Impact of teacher education</i>	<ul style="list-style-type: none"> • Congruence between teachers preparation and field requirement/s • Impact of the extension services of teacher education institutions • Impact of teacher education institutions in community development

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
	<ul style="list-style-type: none"> • An integrated school: A case study on adaptation in a rural community
<i>Effects of teacher education</i>	<ul style="list-style-type: none"> • Tracer study on the graduates of teacher education institutions • Licensure examination performance and classroom competencies • Case studies of successful graduates of teacher education institutions • Impact of LET Review Class • Impact assessment of the short-term programs
<i>Testing, grading and assessment tools</i>	<ul style="list-style-type: none"> ▪ Program and Curriculum Development and Evaluation • Validity and reliability of teacher-made tests • Use of authentic/non-traditional assessment tools • Practices in assessing for/of learning, and assessing as learning • Outcomes-based assessment of practice teachers: developing global competitiveness • Education and improvement of innovative educational assessment strategies and practices • Cultivating effective alternative assessment techniques for diverse learners ▪ Evidence-based assessment in Graduate Studies and TESDA. ▪ Practices on feedbacks and communication strategies that inform key stakeholders. • Graduate Tracer Studies • Accreditation of HEIs/TEIs, technical and skills development programs
<i>Learning Environments and Diversity of Learners</i>	<ul style="list-style-type: none"> ▪ Policies, guidelines and procedures that make environment for conducive for diverse learning. ▪ Effective practices in structuring learning environment to promote learner well-being, active engagement, self-regulated learning and academic achievement. ▪ Characteristics of safe learning space for diverse learners. ▪ Gender- fair concepts and ideas in instructional materials. ▪ Culturally responsive education and indigenous learners' participation in school ▪ Interdisciplinary approaches in responding to the psychological academic and social needs of learners. ▪ Inclusive education and its application. • Existing laws, policies and standards on support for diverse learners

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
<i>Personal Growth and Professional Development</i>	<ul style="list-style-type: none"> ▪ Educators' professionalism and accountability in the context of a changing educational landscape ▪ Innovative Personal and continuing professional development models, strategies resource materials ▪ Planning system and procedures for professional development of teachers and support personnel ▪ Implications of the Philippine Professional Standards for Teachers for the Graduate Teacher Education Program ▪ Professional development through Massive Open Online course (MOOC)/ Learning Management System (LMS) ▪ School-based program and activities for the enhancement of in service teachers' values and attitudes toward effective teaching ▪ Teachers' values and positive attitude towards the profession through various socializing processes
<i>Languages/ Literature</i>	<ul style="list-style-type: none"> • Enhancement of literacy and educational processes • Improvement of English/Filipino proficiency for development • Research-/need-based training programs • Language and/in society • Media, communication and society • Ilokano-based translanguaging approach (IBTA) to mother tongue-based multilingual education (MTBMLE)
<i>Education/Culture and Arts</i>	<ul style="list-style-type: none"> • Local history, cultural beliefs, rituals and values and teacher education programs • Effects of music and movement on teacher stress response • Awareness on and promotion of Ilocano culture and indigenous knowledge • Nutritional status of MMSU athletes and students • Adopting, designing, developing, and monitoring possible nutritional programs for MMSU students, faculty and staff • Documentation of indigenous/Ilocano dances, games and local festivals • Socio-economic impacts of festivals • Socio-cultural research to promote understanding and preservation of culture • Perfect colorings of the Abel Iluko • Database of Ilocano dances; games and local festivals
<i>Cultural Identity and Global Relevance</i>	<ul style="list-style-type: none"> ▪ Policy studies on how heritage and culture can be integrated in urban planning and economic policies ▪ Assessing the economic contribution of culture in the province of Ilocos Norte ▪ Development of indicators, measurements to evaluate contribution of culture in economic development • Documentation of policies in the promotion of culture for regional development

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
<i>Cultural Promotion, Education and Assimilation</i>	<ul style="list-style-type: none"> ▪ Assessment of tangible and intangible cultural and historical resources ▪ Effectiveness of cultural activities in the promotion of culture ▪ Impact of quad media in the promotion of culture ▪ Impact of MTB – MLE in the promotion of cultural education
<i>Arts, history and culture</i>	<ul style="list-style-type: none"> ▪ Extant cultural heritage of ethnolinguistic groups ▪ Filipino innovation in music, theater, dance, literature, performing arts ▪ Codification of endangered Philippine languages ▪ Development and production of arts and handicrafts using indigenous materials
<i>Utilization of IT in the teaching and learning process</i>	<ul style="list-style-type: none"> • Development and deployment of information systems <ul style="list-style-type: none"> ▪ instructional materials ▪ content management systems for e-learning ▪ on-line learning systems, intelligent tutors, educational software applications and collaborative learning tools
<i>Human computer interaction and web environments</i>	<ul style="list-style-type: none"> • e-Learning and Instructional Systems • Design and development of expert systems, web-page information systems and instructional tools <ul style="list-style-type: none"> ▪ systems for human interactions (one-stop-information-shop) ▪ internet-based applications ▪ web portals for different communities <ul style="list-style-type: none"> ➢ SSD/CSC website, ➢ web-based system for the Alumni Relations Office; ➢ LGU/Institutional websites ➢ iNAP-Agricultural Portal of Ilocos Norte ➢ Web-based Research Management Information System for HEIs
<i>Computer networks security and management</i>	<ul style="list-style-type: none"> • Network and communications • Service science and enterprise system • Design, analysis and performance measurements of network systems ✓ WiFi Hotspot and Billing System • Enterprise security management access control, and web application security ✓ The Diffie-Hellman Key Agreement Protocol with Authentication Application to the Blue tooth Technology
<i>IT policy and performance management</i>	<ul style="list-style-type: none"> • Benchmarking for Green Computing Project • ICT Maturity of R1 and CAR • e-Graduate Tracer Survey System

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Software engineering and systems development	<ul style="list-style-type: none"> • Design and development of computer-based solutions <ul style="list-style-type: none"> ▪ University Integrated Library System ▪ Computerized enrolment system ▪ Customization of biometric system ▪ computerized election software ▪ Personnel Information system
Artificial intelligence and algorithm development	<ul style="list-style-type: none"> • Design and implementation of algorithm in the different fields of computer science
Knowledge management, data mining/ warehousing techniques	<ul style="list-style-type: none"> • Development of WebGIS-based Integrated Climate Change Information Infrastructure for improved environmental governance • Applying systems analysis in evaluating decision-making among farm households
Popularization of mathematics/ physical education	<ul style="list-style-type: none"> • Status of mathematics and mathematics education in the Philippines • Difficulties and mechanisms • DOTA Game strategies • Mathematics in music, arts and architecture • Algebraic interpretations in Ilocano families • Algebraic structures in the Ilocano kinship system • K-12 assessment of math curriculum
	<ul style="list-style-type: none"> • Graphing the social network • Mathematics of some indigenous games • Assessment of PE programs • Physical education interventions • Evaluation of LGU sports programs • Profiling of university athletes • Gender and PE activities • Organic food product and physical health

BIOLOGICAL & PHYSICAL SCIENCES

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Physical Sciences	<ul style="list-style-type: none"> • Improve apparatus in mechanics used in teaching physics • Teaching/laboratory performance of chemistry and physics teachers in the secondary level • Development of modularized instruction in physics and chemistry <ul style="list-style-type: none"> ▪ Information and education campaign ▪ water analysis for drinking water ▪ ethanol production using underutilized over-ripe mangoes ▪ phytochemical screening and bioassay ▪ heavy metal analysis on irrigation water ▪ survey on laboratory apparatus acquired by secondary teachers

Biological Sciences	<ul style="list-style-type: none"> • Development models/systems/mathematical characterization based on structural and physiological changes • Identification of bioactive compound • Microbial load assessment of natural resources • Microbial assay, bio-assay studies • Genomics of biofuel plants • Biotechnology of crops and livestock commodities • Evaluation of biofertilizers • Coral assessment/transplantation • Genomics of microorganisms associated with sweet sorghum • Extraction of essential oils from indigenous plants • Insecticidal/pesticidal potential mangroves • Mapping and utilization Biological Resources • Project-based teaching in genetics • Fish inventory
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HEALTH AND WELLNESS

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
<i>Health Technology Development</i>	
<i>Drug discovery and development /Herbal products</i>	<ul style="list-style-type: none"> • Pre-clinical drug development from natural substances: <ul style="list-style-type: none"> • Indigenous Food Plants (IFPs) • Herbal plants • Dragon fruit • Seaweeds • Bugnay • Modulatory role of indigenous medicinal plants for acute and inflammatory diseases • Documentation and identification of potential anti-dengue herbal plants • Ethno-medicinal documentation and biophysical characterization of herbal plant used by traditional medical practitioners in the rural areas • Screening and evaluation of indigenous plants for health and other applications • Immuno modulatory role of terrestrial plants endemic to Ilocos Norte • Cancer chemotherapeutic potential of terrestrial plants endemic to Ilocos Norte

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
	<ul style="list-style-type: none"> • Cyclo oxygenase (Cox) and lipoxygenase (Lox) inhibition and safety assessment of unexplored plant species • Botanical identification and documentation of medicinal use of plants in Adams, Ilocos Norte • Physico-chemical evaluation and phytochemical screening of the medicinal plants used in Adams, Ilocos Norte • Anti-inflammatory activity of the ethanolic extracts of the medicinal plants • Toxicological profiling of the ethanolic extracts of the medicinal plants
<i>Hospital equipment and biomedical devices</i>	<ul style="list-style-type: none"> • Development of affordable, safe and reliable hospital equipment and biomedical services <ul style="list-style-type: none"> ▪ Assistive devices out of bamboo i.e. parallel bars, cones, crutches, and walkers ▪ Hospital treatment tables made of bamboo
<i>Occupational safety and health</i>	<ul style="list-style-type: none"> • Level and predictors of work-related stress among employees • Mental Health Status of Employees and Students
<i>Health ICT</i>	<ul style="list-style-type: none"> • Utilization of user-friendly ICT solutions to accelerate the gathering and processing of health and health-related information for policymaking and to deliver quality health services <ol style="list-style-type: none"> a. Telehealth Services and Systems <ul style="list-style-type: none"> ▪ Telepharmacy ▪ Telerehabilitation b. Public Health Surveillance <ul style="list-style-type: none"> ▪ Disease mapping in Ilocos Norte • Health and bioinformatics
<i>Health needs and services of special groups</i> <ul style="list-style-type: none"> ▪ Maternal & Child ▪ Geriatrics ▪ Persons with disabilities ▪ Indigenous peoples 	<ul style="list-style-type: none"> • Determination of the impact of health promotion activities for high risk individuals • Determination of models that will increase and sustain access to health services by indigenous peoples, persons with disabilities, etc. • Enhancement of service delivery and referral
<i>Morbidity and Mortality</i>	<ul style="list-style-type: none"> • Comparison of the incidence of morbidity and mortality in Ilocos Norte and in Region 1 • Determination of the factors associated with the incidence of morbidity and mortality in Ilocos Norte and in Region 1
<i>Gender and Development</i>	<ul style="list-style-type: none"> • Gender-Sensitive and Value-Enhanced IEC Materials on Disaster Risk Management • Persons deprived of liberty (PDL's) in city jails of Ilocos Norte

<p><i>Increasing farm labor and efficiency</i></p>	<ul style="list-style-type: none"> • Development/improvement, testing and evaluation of gender-sensitive and age-appropriate farm tools, equipment and machineries (activities) for selected cereals, vegetables and bulb crop production in rice-based lowland conditions in the Ilocos • Case studies of working women in agriculture • Correlation analysis of gender-age to farm tools/equipment/machineries with reference to productivity and income • Intra and inter-household dynamics and gender analysis of work roles and decision making processes
<p><i>Ensuring effectiveness and efficiency of S&T interventions</i></p>	<ul style="list-style-type: none"> • Assessment of gender- and age-appropriate farming activities • Gender-role analysis on ST agenda-based enterprises • Gender-role analysis on improved crop production • Gender studies in seaweed fishery • Ex-ante evaluation and impact assessment of S&T programs • Documentation on the utilization of biomass cook stove in food production
<p><i>Documentation and local knowledge</i></p>	<ul style="list-style-type: none"> • Documentation, evaluation of the social relevance of renewable energy and bio-energy technologies • Ethno-botanical and socio-cultural studies of ecologically important and endemic flora and fauna
<p><i>Impact Evaluation/ Assessment Studies</i></p>	<ul style="list-style-type: none"> • Documentation and evaluation of human capital formation Database of socially-relevant and acceptable organic production • Documentation, evaluation, and blending traditional and indigenous/ local knowledge systems on crop production with improved farming technologies: the case of rice-based lowlands in the Ilocos
<p><i>Impact Evaluation/ Assessment Studies</i></p>	<ul style="list-style-type: none"> • Ex-ante and impact assessment of participatory on-farm Evaluation of improved crop varieties and farming techniques under varying soil and climate conditions in rice-based lowlands in the Ilocos Region • Assessment of levels of use and social sustainability and impact on social well-being and social structure of adopted or implemented innovations/technologies
<p><i>Impact Evaluation/ Assessment Studies</i></p>	<ul style="list-style-type: none"> • Analysis of the social relevance/dimensions of regulatory policies
<p><i>Impact Evaluation/ Assessment Studies</i></p>	<ul style="list-style-type: none"> • Assessment of levels of acceptability and impact on social well-being and social structure of adopted or implemented innovations/technologies
<p><i>Impact Evaluation/ Assessment Studies</i></p>	<ul style="list-style-type: none"> • Assessment of the applicability of soil and water conservation farming technologies/modalities with reference to farmer's resource capability for sustainable livelihood in the lowland rice farm communities

**AGRICULTURE, FORESTRY, FISHERIES, NATURAL RESOURCES & ENVIRONMENT
(AFFNRE)**

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
CROPS	
<i>Germplasm evaluation, conservation, utilization and management</i>	<ul style="list-style-type: none"> • Germplasm conservation and characterization of Traditional Upland Rice (TUR) <ul style="list-style-type: none"> ▪ Indigenous food plants (IFP), root crops (cassava), legumes, garlic, sweet sorghum, plantation crops • Fruit crops germplasm collection and commercialization for climate change adaptation, biodiversity conservation, health promotion, agri-ecotourism and income generation • Conservation and improvement of vegetable landraces in Ilocos Norte
<i>Varietal improvement and selection</i>	<ul style="list-style-type: none"> • Breeding high yielding rice varieties for the rainfed lowland • Varietal development and conservation of vegetables and root crops <ul style="list-style-type: none"> ▪ Pureline selection of various vegetable crops for wet season (WS) planting (Eggplant, ampalaya, tomato) ▪ Varietal selection, maintenance and seed production (Cereals, plantation crops) • Varietal improvement of glutinous corn, seed production and maintenance of MMSU Glut I • Varietal development, evaluation and maintenance of legumes • Evaluation of promising varieties of vegetables in support to NCT program • R&D on the indigenous vegetable • Development of a technology to increase the productivity of the less-known yam species • Controlled indoor propagation nursery for clean garlic planting material
<i>Production of good quality seeds and planting materials</i>	<ul style="list-style-type: none"> • Development/optimization of seed production protocols • Sustainable seed production of tomato hybrids for off-season planting • Establishment of sustainable seed system
<i>Cultural management practices</i>	<ul style="list-style-type: none"> • Improvement of cultural management practices and conservation and sustainable utilization of traditional varieties • Cultural management strategies <ul style="list-style-type: none"> ▪ Irrigation management ▪ Fertilizer management ▪ Cropping pattern ▪ Crop establishment (tillage, spacing) ▪ Pest management system • Enhancing productivity and quality of aromatic rice cultivars through improved cultural and postharvest management practices and product development • Investigation on the properties of <i>bokashi</i> and development of its application technology • Propagation techniques <ul style="list-style-type: none"> ▪ In vitro-propagation techniques (Jackfruit, breadfruit,

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
<p>kits/techniques and disease management protocols</p> <ul style="list-style-type: none"> • Organic agriculture <p>Organic agriculture</p>	<ul style="list-style-type: none"> • dipterocarps) <ul style="list-style-type: none"> ▪ Asexual/sexual propagation (IFPs, fruit trees, dipterocarps) • Effect of Potassium and Phosphorus Fertilization on the Growth, Yield and Storability of Ilocos White Garlic Cultivar • Rejuvenation studies (pruning, ratooning) • Enhancing the adoptability of organic-based technologies through the establishment of a techno demo farm • Sustainable organic management system • Development and assessment of organic production management technologies for rice-based agro-ecosystem • Development of pest management products and systems for organic vegetable production • Promotion and commercialization of developed biopesticides (biofungicides and bio insecticides) for selected vegetables in Ilocos • Organic fertilizers and microbials for improved soil fertility in organic vegetable production enterprise • Molecular virus indexing through tissue culture
<p><i>Crop production systems research</i></p> <ul style="list-style-type: none"> • Smart farming approaches • Development of climate-resilient technologies • Decision support system 	<ul style="list-style-type: none"> • Development of a soilless method for agri-fishery resilient-production technology (SMART) • Development of Weather information system and tools (WISAT) for sustainable development and agricultural productivity • Crop modelling • Off-season production management system <ul style="list-style-type: none"> ▪ crop productivity and profitability through off-season vegetable production
<p><i>Postharvest, processing and product development</i></p>	<ul style="list-style-type: none"> • Post-harvest management strategies <ul style="list-style-type: none"> ▪ Maturity indices ▪ Development of storage techniques • Verification, promotion and impact assessment on the use of the tomato storage technology • Establishment of seed production and storage system for sustainable organic crop production • Development of postharvest strategies to prolong the shelf life of bulb crops and vegetables • Shelf life studies, storability and viability of vegetables
<p><i>Fruits/Fruit Trees</i></p>	<ul style="list-style-type: none"> • Varietal improvement, conservation and mass propagation of fruits <ul style="list-style-type: none"> ▪ Collection, identification and characterization of promising fruit cultivars adaptable in the region ▪ Production of disease-free planting materials through tissue culture ▪ Development and field evaluation of eco-friendly field technology packages for carabao mango for Ilocos Norte
<p><i>Post-production machinery and systems</i></p>	<ul style="list-style-type: none"> • Engineering support for mango processing and product development • Design and development of automated hot water treatment for mango

R&D Agenda	Priority R&D Areas
Support System	<ul style="list-style-type: none"> • Crop modeling • Phenology studies • Market system • Technology promotion • Establishment of market support system for organically-grown products • Optimization and utilization of developed food products for agripreneurship
Forest Trees/Bamboo Sustainable urban forest management in Region 1	<ul style="list-style-type: none"> • Biodiversity assessment in the urban forests and green spaces • Carbon stock assessment of urban forests and green spaces • Stakeholder's perception on the management of urban forests and green spaces • Tree health assessment in the urban forests and green spaces
Timber/Bamboo production	<ul style="list-style-type: none"> • Resource assessment and evaluation of dipterocarps and premium indigenous timber species • Community-based S&T farm on improving production of quality bamboo poles
INDIGENOUS PLANTS/ TREE SPECIES	
New or indigenous food crops/plants for medicinal uses	<ul style="list-style-type: none"> • Development of management technologies of indigenous food plants towards their genetic conservation and improved productivity
Indigenous forest tree species	<ul style="list-style-type: none"> • Species-site suitability assessment of some indigenous timber species in denuded areas/ • Establishment of clonal nursery and production of quality planting materials for indigenous forest tree species • Resource assessment and evaluation of dipterocarps, bio-fuel and other premium tree species • Development or propagation techniques of dipterocarps, premium indigenous tree species, and bamboo in Ilocos Norte • Valuation of ecosystems' services for sustainable utilization and management of resources
Conserving, improving, valuing and maximizing benefits of local genetic resources	<ul style="list-style-type: none"> • Ethno-botanical and socio-cultural studies of ecologically important and endemic flora and fauna
LIVESTOCK AND POULTRY	
Breed development and genetic improvement	<ul style="list-style-type: none"> • Genetic improvement, conservation, production management, and commercialization of indigenous livestock and poultry • Documentation and characterization of native breeds <ul style="list-style-type: none"> ▪ Locally-raised sheep, pig, chicken
Nutrition, feeds and feeding system and disease management	<ul style="list-style-type: none"> • Feeding management • Development of feeds for monogastric animals from underutilized indigenous rootcrops • Development of improved rearing practices • Disease management

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Fisheries	
Enhancing productivity for food security	<ul style="list-style-type: none"> • Species inventory and assessment of sea cucumber fisheries in key marine geographic regions in the Philippines • Hatchery and grow-out studies • Feed formulation studies using locally-available raw materials • Resource assessment/fisheries biology studies • National aqua-silviculture program of BFAR and CHED in Ilocos Norte • Integrated R&D on the production, management and utilization of commercially important fish, seaweeds, and protection of marine resources • Improvement of existing fishing methods and development of new fishing technologies in I.Norte <ul style="list-style-type: none"> ▪ Fishing gear improvement ▪ Exploratory fishing technologies e.g. remote sensing, GIS
Aquatic environmental protection and sustainability of aquatic resources in Ilocos Norte	<ul style="list-style-type: none"> • Resource and ecological assessment of aquatic ecosystems • Integrated coastal/marine resources management program • Post-harvest technologies and product development of fishery products
Engineering/ Bio-Fuels/Bio-Energy	<ul style="list-style-type: none"> • Development of low cost technologies to generate energy from available renewable resources • Design and production of new and low-cost technologies to improve productivity of farmers/fisherfolks
	<ul style="list-style-type: none"> • Development and sustainability of bio energy feedstock continuous production of hydrous ethanol • R&D on alternative bioethanol feedstock • Purification from hydrous to anhydrous bio-ethanol • Biofuel application to transportation, industrial & residential heating • Performance testing of biofuels
Energy (renewable, efficiency, conservation & management)	<ul style="list-style-type: none"> • Alternative sources of energy (solar, wind, wave, solar, hydrogen, CNG-compress natural gas, auto LPG) • Energy Sufficiency • Transportation • Solar energy assisted devices & machines • Fuel Cells • Waste to energy conversion process • Heat recovery system • Innovative energy-saving cooking furnace/ stove/ facility • Zero water waste distillation
Materials development, utilization testing (construction, nanotechnologies etc.)	<ul style="list-style-type: none"> • Nanomaterials and nanocomposites • Testing and calibration laboratories • Non-destructive testing technology • Greenhouse construction materials and design • Bambootization of assistive devices for person with disability (PWD) • Insulation materials for industry & building/residential construction

R&D Agenda	Priority R&D Areas
Machineries & process control	<ul style="list-style-type: none"> • Localization of farm machineries, implements, tools and devices • Production automation-robotic arm • Instrumentation and control systems • Development, deployment and monitoring of bioethanol distillers, and maintenance of deployed distillers in support to model nipa stand farm • Power generation for energy self-sufficient bioethanol distiller
Electronic and semi-conductor industries	<ul style="list-style-type: none"> • Agricultural application of electronics • Development of nano sensors & actuators for soil and water resource management of priority commodities
Metals and Engineering	<ul style="list-style-type: none"> • Casting, Forging, Recycling of materials
Environmental management	<ul style="list-style-type: none"> • 4R – reduce, refuse, recycle, reuse technologies • Enclosed space airborne pollutant absorbent materials using <i>kawayan</i>biochar
Food processing	<ul style="list-style-type: none"> • Food product formulation • Development of environment-friendly packaging materials • Accelerated shelf life testing • Development of quality packaging materials, nutritional info, branding, bar coding • Development, testing & evaluation of cost-effective and innovative instruments for quality measurement and control systems • Development/improvement of processing equipment/machineries/ extraction systems, handling and storage systems for quality products • Mechanization of automation of operation
Product Development Development of intermediate food products and ingredients form local raw materials Development of innovative food products	<ul style="list-style-type: none"> • Product development and processing of priority crops and its by-products • Enhancing the economic potentials of the low priority commodities through food product development • R&D on Black Garlic Production and Food Product Development • Less-known yam species • Formulation of sweet potato-based food products in the Ilocos • Evaluation of carcass quality • Mutton, native pig and native chicken
Functional Foods	<ul style="list-style-type: none"> • Development of functional foods • Formulation of new products and post-harvest techniques <ul style="list-style-type: none"> ▪ Seaweeds, invertebrates, finfishes
Standardization system	<ul style="list-style-type: none"> • Creation of university/enterprise-level standards and methods for testing and production based on the consolidated results of science, technology and experience • Quality control standards

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Business – Tourism Industry	<ul style="list-style-type: none"> • Assessment of tourism industry in Ilocos Norte <ul style="list-style-type: none"> ▪ Profiling of tourist attractions and support services ▪ Tourist profile, motivation and expenditure patterns ▪ Analysis of standards of the tourist support services vis-à-vis DOT standards • Financial performance of tourism businesses in Ilocos Norte • Needs assessment for tourism investment potential and opportunities • Socio-economic profile of stakeholders in tourism industry in Ilocos Norte
Human capital development	<ul style="list-style-type: none"> • Profile and competencies and developmental needs of employees of accommodation facilities and food & beverage establishments in Ilocos Norte
Support to MSMEs	<ul style="list-style-type: none"> • Profile of MSMEs and their own proprietors • Problems of MSMEs in the manufacturing industry • Establishment of data processing system of MSMEs in the manufacturing industry
Supply Chain	<ul style="list-style-type: none"> • Supply chain analysis for priority crops
Impact of tourism industry	<ul style="list-style-type: none"> • Socio-economic impact of tourism • Technological/institutional/political impact of tourism industry
Licensing & commercialization	<ul style="list-style-type: none"> • Patent, utility model, and industrial design and application/registration • Copyrights and trademarks • Commercialization of matured technologies – Philippine Technology Transfer Act of 2009 (Republic Act No. 1005)

LAW& GOVERNANCE

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Local Governance & Health	<ul style="list-style-type: none"> • Review of health laws and policies applicable to the locality and its extent of implementation • Performance Evaluation • Local Health Policy Framework
Improving post-production and marketing efficiencies	<ul style="list-style-type: none"> • Research on new institutional economics and governance
GIS and remote sensing	<ul style="list-style-type: none"> • Harnessing GIS and remote sensing technology for improved governance and agricultural productivity
Local government support/programs for the Tourism industry	<ul style="list-style-type: none"> • Policies and programs for tourism development • Awareness and implementation of tourism policies and programs
Policy and institutions	<ul style="list-style-type: none"> • Integrating climate change concerns in national sustainable development policies • Mainstreaming climate change programs in local governance mechanisms • Policy and institutional landscaping for Philippine AFNR readiness to climate change

INTERDISCIPLINARY SCIENCES

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
INFORMATION COMMUNICATION TECHNOLOGY	
Knowledge and information management	<ul style="list-style-type: none"> • Managing R&D knowledge and information resources for effective utilization • Evaluation and enhancement of the research directorate management information system (RDMIS) application and its information
CLIMATE CHANGE/ PRECISION AGRICULTURE	
Climate resilient agriculture	<ul style="list-style-type: none"> • Integrated RDE program towards building a climate resilient agriculture in the Philippines • Enhancing resiliency of the agriculture sector to climatic variability and climate change through development of improved production and risk management • Documentation and assessment of the impacts of climate change and adaptation strategies • Social vulnerability and social impact assessment
	<ul style="list-style-type: none"> • Documentation, development and evaluation of rural support system (e.g. cultural and indigenous adaptation practices) • Documentation of the phenology and pest occurrence of major crops grow in Ilocos weather conditions • Evaluation/vulnerability assessment of the effects of climate change on aquatic ecosystems and their resources • Alternative livelihood for coastal dwellers as adaptation response to climate change
Response Mechanism- Adapting to climate change	<ul style="list-style-type: none"> • Indigenous genetic conservation, maintenance, improvement, and utilization • Innovative technology transfer modalities for climate change in AFNR • Ilocos region's mangrove ecosystem: Status, threats and conservation for adaptability in different climatic events • Adaptation technology to drought or climate change and controlling soil erosion
Health, Environment and Climate Change	<ul style="list-style-type: none"> • Determination of the climate change-related diseases • Determination of the health-related practices of the community in adapting to climate change
Environment & Natural Resources	
<p>Sustainable watershed management and utilization</p> <p>Management and rehabilitation of problem, degraded and polluted agricultural soils through remediation</p>	<ul style="list-style-type: none"> • Watershed rehabilitation • Resource assessment • Biophysical and biological assessment of Paoay Lake • Eco-tourism studies • Management of degraded areas • Bioremediation • Waste management • Development of cleaner and safer technologies for application to industrial wastewater, waste management, safe and

<i>R&D Agenda</i>	<i>Priority R&D Areas</i>
Development of high value products from agricultural and forest wastes	potable drinking water, and other pressing environmental problems